Deloitte Access Economics

2015-2025 Western Australian Resources Sector Outlook

Chamber of Minerals and Energy of Western Australia

November 2014

CME




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Contents

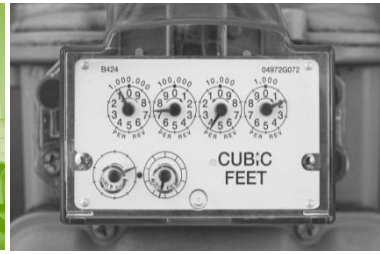
Glossary of terms

Acronym	Definition
ABS	Australian Bureau of Statistics
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BREE	Bureau of Resources and Energy Economics
CAGR	Compound annual growth rate
CME	The Chamber of Minerals and Energy of Western Australia
FIFO	Fly-in fly-out
GJ	Gigajoule
GL	Gigalitre
GWh	Gigawatt hours
IMO	Independent Market Operator
Mt	Mega (million) tonnes
Mtpa	Mega (million) tonnes per annum
MWh	Megawatt hours
PAX	Passenger headcount
PJ	Petajoule
SWIS	South West Interconnected System
tkm	Tonne kilometre

1 Executive summary

Chapter contents



1.1 Introduction

The Chamber of Minerals and Energy of Western Australia (CME) is the leading advocate for the Western Australian resources sector. CME exists to champion the Western Australian resources sector and assist it in achieving its vision to be innovative and competitive and deliver value to the community and investors while underpinning Australia's economy.

CME commissioned Deloitte Access Economics to prepare the 2015-2025 Western Australian Resources Sector Outlook. This study is a continuation of the CME's State Growth Outlook, which was first published in 2009. This Outlook seeks to forecast change in the sector in relation to the key growth enablers of people, energy, water and infrastructure.

This report is a key CME advocacy document in forecasting change within the resources sector, and is used to inform government policy settings and assist corporate planning and investment decisions.

This edition is particularly unique in terms of cataloguing the policy implications and opportunities arising from a market environment that has changed rapidly over the past two years. During this period the transition from construction to an operational phase in the sector has occurred against the backdrop of falling commodity prices, as foreshadowed in the 2013 State Growth Outlook.

A number of major project expansions in the State's resources sector coupled with then record high commodity prices led to a near quadrupling in the value of production from the sector in the last 10 years, to $120 billion in 2013-14[1].

The flow on effect that investment and activity in the resources sector has to other industry sectors, including to the State Government through taxation and royalties, means its importance to the economy is much larger.

Approximately $142 billion worth of investment projects were under construction in the September quarter 2014. However, only $6.6 billion worth of projects had been given the green light to commence construction but were yet to start development[2]. This indicates the sector is experiencing a collective shift. Major expansion projects are reaching completion and are transitioning to the operational phase, with few significant projects ready to commence construction.

A further $99 billion worth of projects remained in preliminary planning phases in the September quarter 2014. Reflecting the current environment of uncertainty however, the value of projects at these planning phases has declined from over $104 billion in the September quarter 2013[2].

Weaker commodity prices underpin this decline in the pipeline of mineral and energy investment projects in Western Australia. To September 2014, average non-rural commodity prices received by Australian mineral and energy producers had fallen by 44% from mid-2011[3], the time when most commodity prices peaked.

This flattening in construction activity and softening in investment confidence amid a weaker commodity price environment is a key consideration in the 2015-2025 Outlook.

[1] Department of Mines and Petroleum
[2] Deloitte Access Economics, Investment Monitor, September 2014
[3] Reserve Bank of Australia, index of commodity prices

1.2 People – key findings

The resources sector workforce is expected to decline through to 2025 as the sector transitions from a construction to operational phase.

Overview

- The resources sector workforce is expected to decline from 105,200[4] in 2014 to 87,000 by 2025.
- While lower than current numbers, the resources sector workforce will still be approximately double that of pre-expansion levels in 2004.
- Labour productivity in the production phase is expected to increase by 40% to 2017 and then plateau to 2025.
- The share of women in the resources sector workforce is forecast to increase by 1.5% by 2020.
- The share of Aboriginal people in the resources sector workforce is forecast to increase by 2.3% by 2020.
- The construction workforce is expected to decline by 17,300 below 2014 levels in 2020.
- The operational workforce is expected to peak at 4,300 above 2014 levels in 2019, before declining to 3,500 above 2014 levels in 2020.
- In 2014, the proportion of residential workers in the construction phase was 13% of the workforce. This is expected to increase to 25% of the overall workforce in 2020.
- The proportion of residential workers in the operational phase is expected to decrease to 37% in 2020, from 40% in 2014
- The proportion of FIFO workers in the operational phase is expected to increase to 63% in 2020, from 60% in 2014
- The Perth and Peel regions contributed 70% of the FIFO workforce in 2014. A further 3% of the FIFO workforce is expected to come from this region in 2020.

The regions

- The workforce in the Pilbara is expected to decrease by 14,300 workers by 2020, comprising a reduction of 17,900 construction workers and increase of 3,600 operational workers.
- The workforce in the Goldfields-Esperance region is expected to decrease by 900 workers by 2020, comprising a reduction of 700 construction workers and 200 operational workers.
- The workforce in the Kimberley is expected to increase by 2,900 to 2020.
- Workforces in the Mid West, Great Southern and South West are expected to remain relatively constant through to 2020.

[4] Average headcount of ABS quarterly labour force numbers in 2014

Summary of implications and opportunities

- The transition from the construction to the operational phase will decrease the construction based workforce.
- The significant growth in the workforce over the past decade will not be unravelled by the current shift from the construction to the operational phase. Rather, the workforce is forecast to remain more than double pre-expansion levels.
- Accommodating the future workforce will require both FIFO and local residential options.
- New strategies will be required in the future to continue the momentum created in recent years in increasing the representation of women in the resources sector.
- Operational labour productivity is projected to increase significantly over the short term. Over the medium term labour productivity will plateau and needs to improve if the sector is to continue to compete effectively on the world stage.

1.3 Energy – key findings

Energy consumption in the resources sector is forecast to continue to grow – incremental changes in demand will see natural gas replace diesel as the main energy source.

Overview - Energy

- Primary energy consumption in the resources sector is expected to grow from 223 PJ in 2013 to 267 PJ by 2025, representing an annualised rate of growth of 1.5%.
- Diesel consumption will increase by 20 PJ between 2013 and 2016 before declining to 14 PJ above 2013 levels in 2020.
- Natural gas consumption will increase by 41 PJ above 2013 levels in 2020.
- The forecast increase in gas consumption suggests tight market conditions could emerge in the medium term.
- Natural gas will increase to 52% of resources sector primary energy consumption by 2020, while diesel will decrease to 48% of resources sector primary energy consumption by 2020.

The regions - Energy

- An additional 61 PJ of energy is forecast to be consumed in the Pilbara by 2020.
- Energy consumption in the Goldfields-Esperance region is forecast to increase by over 2 PJ between 2013 and 2016 before declining to 7 PJ below 2013 levels in 2020.
- Energy consumption in the South West is expected to remain steady out to 2020.

Overview - Electricity

- Electricity consumption in the resources sector is forecast to grow from 11,712 GWh in 2013 to 17,340 GWh by 2020, representing an annualised rate of growth of 5.7%.
- Electricity consumption in the resources sector represents 73% of the state's forecast electricity growth by 2020.
- Self-generated electricity is forecast to rise by over 3,330 GWh by 2020, or around 60% of the state's forecast electricity growth.
- The use of diesel in self-generated electricity is forecast to decline from 16% of total generation in 2013 to 9% in 2020.
- The use of natural gas in self-generated electricity is forecast to increase from 82% of total generation in 2013 to 87% by 2020.
- Purchased electricity is forecast to grow by 2,300 GWh by 2020.

The regions - Electricity

- Electricity consumption in the Pilbara is forecast to increase by over 4,000 GWh by 2020 accounting for 72% of the projected incremental demand.
- Electricity consumption in the Kimberley (613 GWh), Mid West (521 GWh) and Goldfields-Esperance (441 GWh) regions is forecast to increase by 11%, 9% and 8%, respectively, of the projected incremental demand by 2020.
- Electricity consumption in the South West is forecast to remain constant, as a percentage, through to 2020.

Summary of implications and opportunities

- The energy mix in the resources sector over the medium term will change from diesel to natural gas.
- Significant forecast growth in natural gas consumption in Western Australia supports the development of onshore gas resources.
- Electricity consumption is forecast to increase in the Pilbara, with growth underpinned by self-generation and purchased sources.
- The Electricity Market Review may have important implications for industrial users in the South West Interconnected System.

1.4 Water – key findings

Water abstraction in the resources sector will continue to increase largely for mine operations and dewatering purposes.

Overview

- Water abstraction in the resources sector is forecast to increase from 530 GL in 2013 to 692 GL by 2020, an increase of 31%.
- Groundwater dewatering is forecast to be the largest source of water abstracted in 2020 and is forecast to be 115 GL higher than 2013 levels, a 35% increase.
- Groundwater reinjection is forecast to increase by 55 GL to 2020, a 50% increase.
- Water use for mine operations will increase by 60 GL to 2020, a 30% increase.
- Groundwater dewatering is forecast to increase 35% above 2013 levels to 2020.
- Water use for mine operations is forecast to increase 60 GL while groundwater reinjection is forecast to increase 55 GL to 2020.

The regions

- Resources sector water abstraction in the Pilbara is forecast to increase from 350 GL in 2013 to 491 GL in 2020, an increase of 141 GL or 40%.
- Groundwater dewatering in the Pilbara is expected to be 404 GL in 2020, an increase of 122 GL on 2013 levels, and will account for 82% of all water abstracted.
- Water abstracted by the resources sector in the Pilbara in 2020 will largely be either reinjected (207 GL) or used in mine operations (193 GL).
- Water abstraction in the Goldfields-Esperance region is expected to peak in 2015, from 100 GL in 2013 to 103 GL, and then decline to 102 GL in 2020.

Summary of implications and opportunities

- Water scarcity will require market mechanisms to efficiently allocate supply, where markets are possible.
- The volume of dewatering surplus to mine needs may provide a supply for beneficial purposes, but volatility of supply and water quality are key constraints which will impact the viability of options.
- Cumulative effects remain a priority issue, but further work is needed to ensure an appropriate management framework is developed.

1.5 Infrastructure – key findings

The State's infrastructure is forecast to continue to be under pressure as the resources sector transitions into the operational phase.

Overview

Aviation

- By 2020, resources sector passenger movements through Perth Airport are forecast to be 313,000 above 2014 levels.
- Despite a projected smaller resources sector workforce by 2020, resources sector passengers utilising Perth Airport are forecast to increase due to shorter shift patterns during the operational phase.
- Over the longer term, demand for departure times from Perth Airport is expected to remain between 6:00 am and 9:00 am from Monday to Thursday. Arrival times will similarly be maintained over the longer term, after 3:00 pm from Tuesday to Thursday.
- The number of resources sector related passengers travelling via regular passenger transport services to and from site is expected to grow by 172,000 between 2014 and 2020.
- The number of resources sector related passengers travelling via charter passenger transport is expected to grow by 141,000 between 2014 and 2020.

Ports

- Resources sector exports are forecast to increase by 534 Mtpa by 2020, representing an 80% increase on Western Australia's entire seaborne freight volume in 2012-13.

Rail

- The regional freight task of the Brookfield rail network is forecast to increase from 75 million net tonnes per annum in 2012 to more than 130 million net tonnes per annum by 2030[5].

Roads

- Freight moving into, within and out of the state's regions is forecast to increase from 24 billion tonnes per kilometre per annum in 2012 to 40 billion by 2030.[5]
- The expansion of mines and development of processing plants and industrial estates along the Pilbara coast will place pressure on the existing road network.
- The Great Northern Highway and North West Coastal Highway will continue to be integral parts of the road network.

[5] Western Australian Regional Freight Transport Network Plan

Social infrastructure[6]

- Provision of regional health services (including clinics, hospitals and pharmacies) and counselling services needs to continue to grow in the future in terms of service offering and quantity, particularly in the Pilbara and Kimberley.
- Provision of emergency services (including fire, police and ambulance services) was perceived to be adequate, with some regional outliers.

Summary of implications and opportunities

- A sound business case for determining investment at Perth Airport is required as resources sector passengers are forecast to increase over the medium term due to shorter operational rosters.
- Investment in regional airport infrastructure must keep pace with investment at Perth Airport to avoid transferring bottlenecks to the regions.
- Some regional airports in Western Australia hold national significance and would benefit from being operated by the private sector.
- Additional port capacity will be required in the Pilbara in the medium term.
- There is room for improvement in infrastructure planning in Western Australia, while fiscal constraints also require new ways of funding infrastructure.

[6] This Outlook sought views from the resources sector in terms of the provision of non-company social infrastructure in areas nearby to projects. The responses are a qualitative perception of the resources sector.

2 Study background

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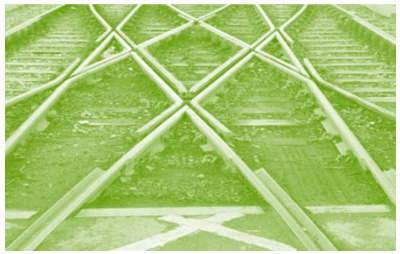


2.1 Study objectives and report structure

CME commissioned Deloitte Access Economics to prepare the 2015-2025 Western Australian Resources Sector Outlook. This study is a continuation of CME's State Growth Outlook, which was first published in 2009 and is a key CME advocacy document in forecasting change within the resources sector, and is used to inform government policy settings and assist corporate planning and investment decisions.

Like the previous editions of the State Growth Outlook, this study is also focussed on monitoring future trends relating to the key growth enablers of people, energy, water and infrastructure in order to guide policy development. A survey tool, capturing the sector's future expectations with regard to the enablers, is again used to develop this Outlook.

The objectives of this study are to:

- Provide an integrated supply and demand outlook across Western Australia and at the regional level on the key enablers.
- Examine changes to the structure and composition of the workforce and productivity.
- Examine energy requirements in relation to electricity and natural gas.
- Examine water abstraction and changes in sources and destination.
- Examine infrastructure requirements and bottlenecks.
- Analyse the policy implications with a particular emphasis on the opportunities and challenges.
- Provide input into government planning to improve regulatory and policy regimes.

The 2015-2025 Outlook seeks to update the forecast for the sector and catalogue the policy implications and opportunities arising from a market environment that has changed rapidly over the past two years. During this period, lower commodity prices have reduced investment in new projects, while many major projects developed in the last two years are also transitioning from a construction to operational phase, as was predicted in the 2013 State Growth Outlook.

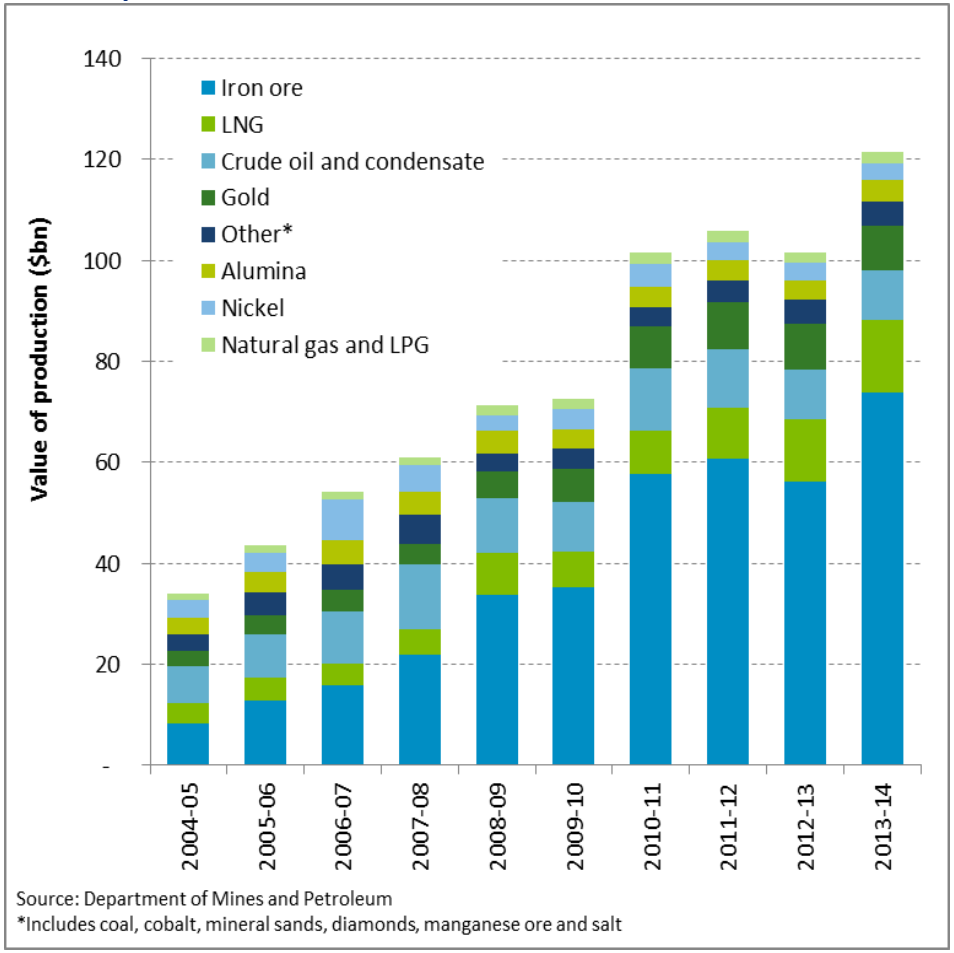
The report comprises six sections:

- **Section 1 – Executive summary** describes the key aspects of the outlook from the survey and the policy implications and opportunities identified.
- **Section 2 – Study background** provides context on the minerals and energy sector and insight into the study approach.
- **Section 3 to 6 – Growth enablers** contains the analysis of the growth enablers, commencing with a review of historical trends through to the projections and expected trends arising from the survey results. Each section concludes with a discussion of the relevant implications and opportunities.

2.2 The minerals and energy sector in Western Australia

2.2.1 The value of the sector to the State

Value of production from the Western Australian resources sector



Source: Department of Mines and Petroleum
*Includes coal, cobalt, mineral sands, diamonds, manganese ore and salt

The rise in global commodity prices over the past 10 years has driven significant growth in the value of the resources sector, increasing its significance to the State economy.

The value of production from the Western Australian resources sector has nearly quadrupled over 10 years, with production from the sector worth over $120 billion in 2013-14. Iron ore is the key contributor to production value, accounting for over 60% of total value in 2013-14[7].

Adjusting for price effects, the value of production from the sector has increased by almost 90% over the past decade, giving it a share of approximately 34% of total Western Australian domestic economic output[8].

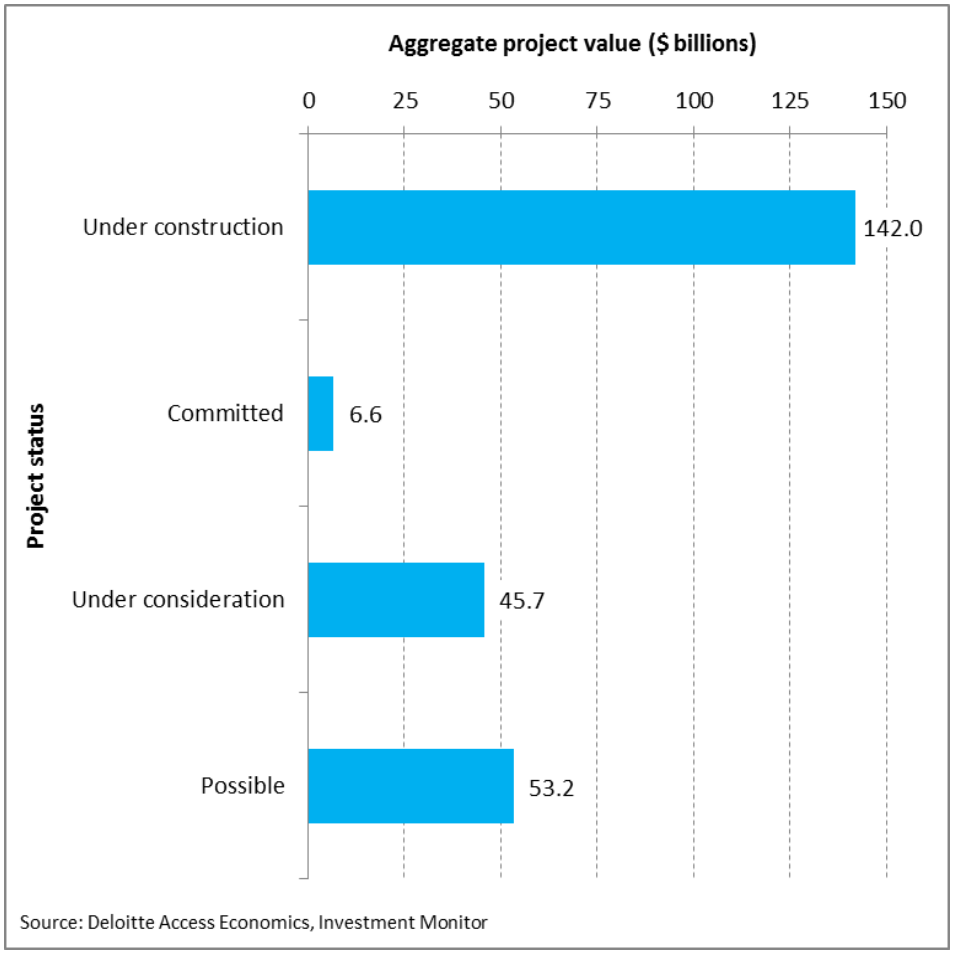
However, the flow on effect activity in the resources sector has to other industry sectors, including to construction and to the State Government through taxation and royalties, means its importance to the economy is larger.

This underscores the significance of this Outlook in providing insights into future trends in the sector. These trends will continue to influence the fortunes of the Western Australian economy over the next 10 years.

[7] Department of Mines and Petroleum
[8] ABS catalogue 5220.0, industry gross value added for the mining sector, constant price terms

2.2.2 Investment projects

Western Australian investment projects by status, September quarter 2014



Investment in new capacity in the resources sector and other parts of the economy has driven growth in Western Australia in recent years. However, this pipeline of investment is beginning to thin.

In the September quarter 2014, there were approximately $247 billion worth of investment projects at various stages of development and planning. Almost 60% of this pipeline of investment was accounted for by projects already under construction[9].

However, as construction of these projects progresses to completion, there are few other projects to follow. Only $6.6 billion worth of projects have been given the green light to commence construction but are yet to start development. As a result, the sector is experiencing a collective shift, as major expansion projects reach completion and transition to operational phase.

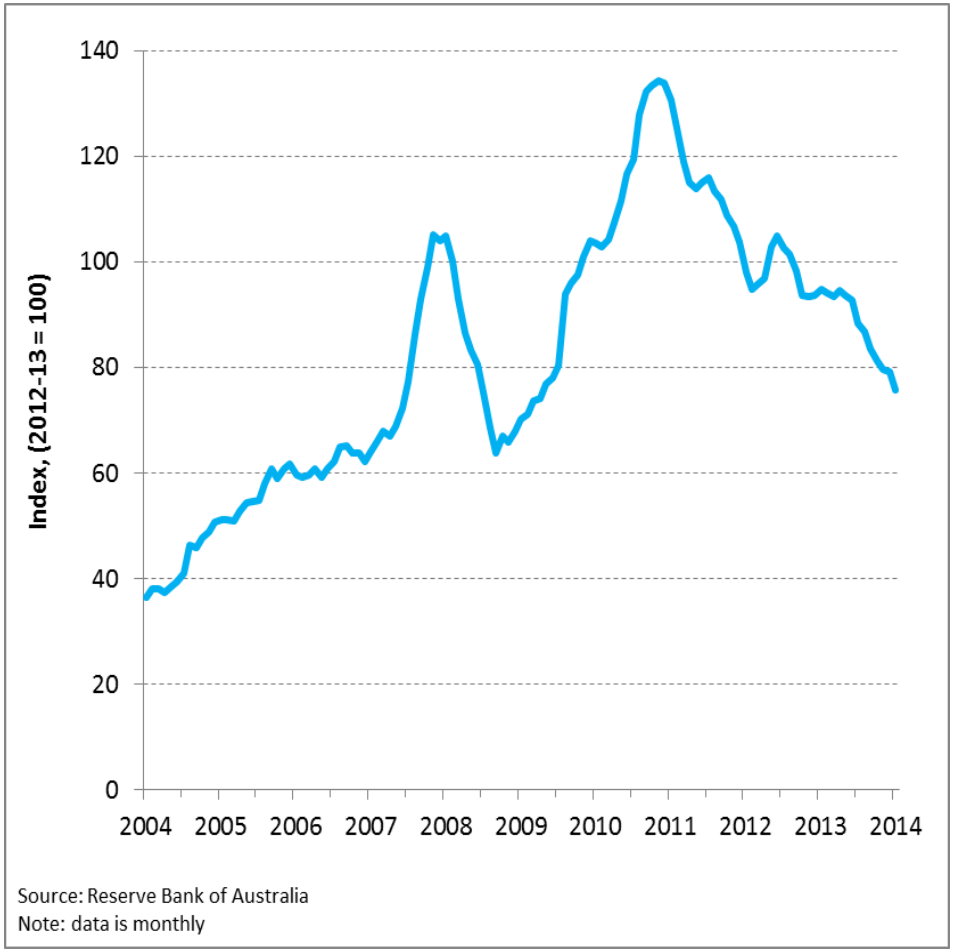
A further $99 billion worth of projects were at preliminary planning phases in the September quarter 2014. However, reflecting the current environment of uncertainty, the value of projects at these planning phases has declined from over $104 billion in the September quarter 2013.

This flattening in construction activity and softening in investment confidence is a key theme of this Outlook.

[9] Deloitte Access Economics Investment Monitor, September quarter 2014

2.2.3 Commodity price trends

Index of non-rural commodity prices, US dollar terms



Source: Reserve Bank of Australia
Note: data is monthly

Weaker commodity prices underpin the decline in the pipeline of mineral and energy investment projects in Western Australia.

The significant growth in non-rural commodity prices[9] experienced over the past 10 years was driven by growing demand for raw materials and energy from China, including iron ore and natural gas.

However, global producers of resources have responded to the stronger price signals and increased supply, while demand from China itself has steadied as policy makers seek to rebalance growth and reduce excess credit.

The resulting dynamic has seen a decline in the significant gap that previously existed between demand and supply in the market for many mineral and energy commodities. As a result, to September 2014, non-rural commodity prices received by Australian producers have decreased by 44% since prices peaked in mid-2011[10].

[10] The prices of non-rural commodities are measured by the Reserve Bank of Australia's index of commodity prices. The index is a weighted average of recent changes in commodity prices, where the weight given to each commodity reflects its importance in total Australian commodity export values in a base period. Non-rural commodities refer to base metals, bulk commodities, LNG, crude oil, alumina, gold and copper.

2.3 Study approach

The approach adopted for the 2015-2025 Western Australian Resources Sector Outlook incorporated a four stage process:

1. Designing a comprehensive demand survey and conducting a test process with selected mineral and energy companies to refine the survey approach;
2. Collecting direct survey data and publicly available information from minerals and energy companies on operating and development projects;
3. Consulting with key government and other agencies on the supply issues for each of the growth enablers; and
4. Validating survey results and identifying potential implications and opportunities with various reference groups.

The demand forecasts presented in this report were derived from the results of the demand surveys. The survey covered projected demand to 2025 for people, energy, water and infrastructure capacity, and accompanying project information such as annual production rates.

CME members and selected non-members contributed to the survey. In total, the projects included in the demand outlook represent approximately 82% of the total value of production in the resources sector in 2013, and over 75% of the value of upcoming capital spending in the industry[11].

To ensure completeness, the direct survey data was supplemented with benchmark data to estimate the aggregate contribution to the demand outlook from operating projects not covered by direct survey responses. Additionally, publicly available information and benchmark data on major upcoming projects not surveyed was also included in the demand forecast. However, there is potential for new projects which are not recognised in this study to enter construction by 2025.

A risk adjustment was applied against projects not in operation or under construction to account for the fact not all proposed projects eventuate. Probabilities were assigned to these projects based on historic project realisation rates[12].

The demand outlook was developed under an assumption of unconstrained supply of all resources. Additionally, macroeconomic and price assumptions were not provided to survey respondents. Rather, respondents were asked to reply according to their own internal base case assumptions of future economic conditions.

The supply outlook was developed in consultation with numerous government departments and companies, which provided data where available.

Four industry reference groups (people, energy, water and infrastructure) and a government reference group were consulted throughout the project to validate data quality, identify and advise on implications and opportunities, and ensure alignment with objectives.

[11] The value of the pipeline of upcoming capital spending in Western Australia is defined according to Deloitte Access Economics' *Investment Monitor* and includes projects under construction, committed or under consideration as at the June quarter 2014.

[12] Realisation rates were based on estimates outlined in the study, *The investment project pipeline: cost escalation, lead time, success, failure and speed*, Kenneth W Clements and Jiawei Si, Business School, The University of Western Australia, Crawley, Australia

3 People

Chapter contents




3.1 Chapter summary

Key trends

- The resources sector has created around 42,000 direct jobs in Western Australia over the past five years alone, accounting for 30% of total jobs growth in the State and representing the largest job creation of all sectors.
- In August 2012, when many expansion projects were under development, employment in the sector peaked at over 120,000 workers. By August 2014, the workforce had fallen by around 27,000 personnel. This substantial drop was the largest of all industries in Western Australia over this period.
- However, the workforce is not projected to decline significantly more with a workforce of 87,000 persons expected by 2025 – a loss of a further 18,200 positions over the next 10 years.
- This rate of attrition will take the sector's total employment headcount down to a level last seen in May 2010. This is still more than double 2004 levels suggesting the sector is not foreseeing a significant decline in employment to pre-expansion levels (41,000 in 2004).
- The decline in the resources sector workforce is underpinned by a contraction in the construction workforce. The construction workforce is forecast to decrease by 17,300 to 2020 compared with 2014 levels.
- As the total number of FIFO positions declines, so too does the proportion of the construction workforce on FIFO arrangements. Approximately 75% of the construction workforce is projected to be working on FIFO arrangements in 2020, down from 87% in 2014.
- Despite a short term fall to 2016, the operational workforce is projected to increase by 2020. As projects transition to production, approximately 3,500 operational roles are projected to be created between 2014 and 2020.
- The projected increase in the operational workforce will be driven by workers on FIFO arrangements. On aggregate it is anticipated 63% of the operational workforce will be on FIFO arrangements by 2020, up from 60% in 2014.
- The share of women in the resources sector workforce is projected to increase by 1.5% to 2020. Aboriginal employment in the sector is forecast to rise, from 5.8% in 2014 to 8.1% by 2020.
- As the construction workforce begins to decline from 2015, total labour productivity in the resources sector is expected to rise steadily to 2020. However, when examining the operational workforce alone, productivity is forecast to increase in the short term before plateauing to 2020.

Regional overview

- As major projects transition to operations, the Pilbara construction workforce is expected to be 17,900 lower than 2014 levels by 2020. In contrast, the operational workforce of the Pilbara is expected to increase by 3,600 workers over 2014 levels by 2020.
- Over the short term, both the FIFO and local resident workforces of the Pilbara are forecast to decrease. After 2017 the FIFO workforce of the region will continue to decrease and by 2020 is forecast to be 13,700 below current levels. The residential workforce is expected decline marginally between 2014 and 2020.
- Some of the residential Pilbara workforce may transition to intra-regional FIFO arrangements between 2014 and 2020, which may partially explain the marginal decline in the total residential workforce during this period.
- The workforce projections show a difference in the timing of the shift from the construction to the operational phase for projects in the Goldfields-Esperance region compared to the Pilbara. Construction activity appears to be stronger in this region until at least 2016. In total, the Goldfields-Esperance resources sector workforce is projected to decrease by 900 people by 2020 (or 4% of the 2014 total).
- The resources sector workforce of the Kimberley is projected to increase by over 2,900 between 2014 and 2020 (a 50% increase). This expansion will comprise 1,600 construction workers and 1,300 operational workers.

Summary of policy implications and opportunities

1. **The transition from the construction to the operational phase will decrease the construction based workforce.**

   There are opportunities to transition construction-based roles into operational roles in the resources sector however this only applies to some parts of the workforce. To support the transition phase by sustaining employment and economic activity, there will be growing potential for governments to capitalise on rising availability in this segment of the labour force through strategic countercyclical investment in new infrastructure.

2. **The significant growth in the workforce over the past decade will not be unravelled by the current shift from the construction to the operational phase. Rather, the workforce is forecast to remain more than double pre-expansion levels.**

   Preserving this momentum sets a sound platform to maintain a strong base of skills in minerals and oil and gas development in Western Australia. This could form the basis for a future growth industry focussed upon the export of skills. Industry, governments and education and training institutions should continue to work collaboratively to develop the State's skills and knowhow.

3. **Accommodating the future workforce will require both FIFO and residential options.**

   The transition from the construction phase to the operational phase is not expected to see a decline in the use of FIFO arrangements in the resources sector.

   Continued policy support for FIFO arrangements will be required, including approvals for existing and new transient worker accommodation and investment in local aviation infrastructure.

4. **New strategies will be required in the future to continue the momentum created in recent years in increasing the representation of women in the resources sector.**

   Gains have been made over time to increase the representation of women in the sector. To enable this momentum to continue it will be necessary for companies to re-examine existing strategies aimed at attracting and retaining women and give them renewed priority.

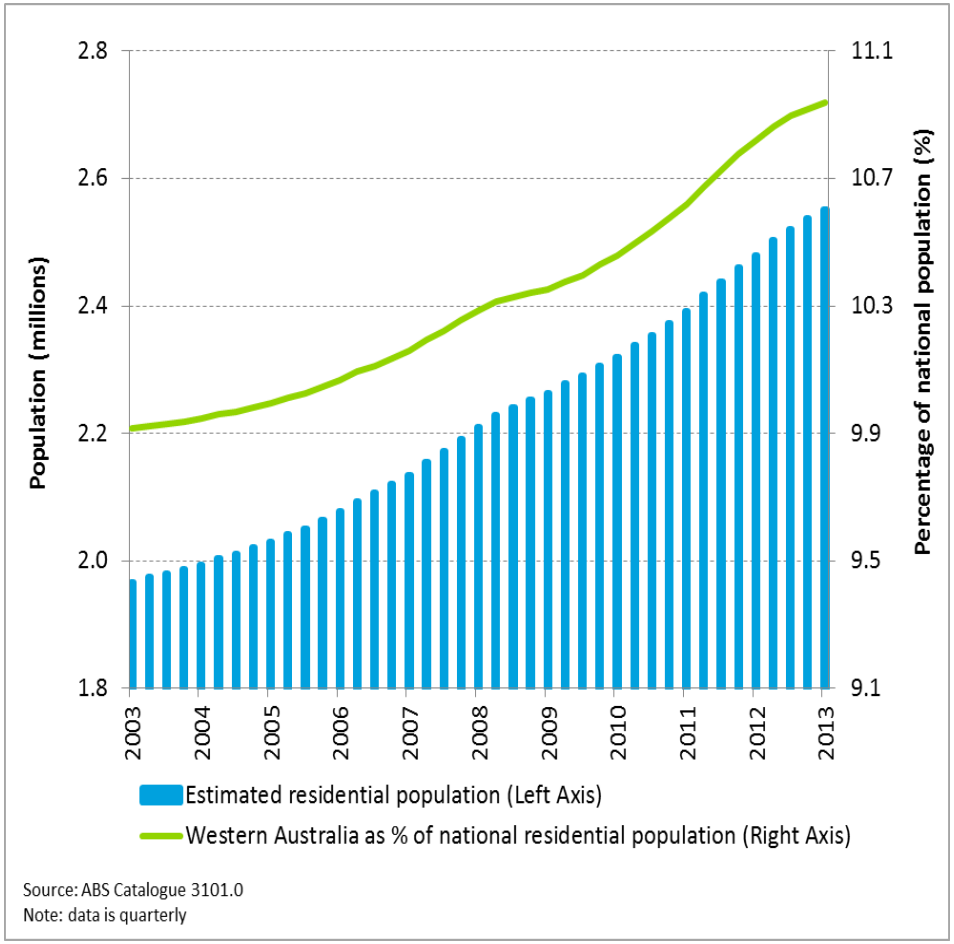
5. **Operational labour productivity is projected to increase significantly over the short term. Over the medium term labour productivity will plateau and needs to improve if the sector is to continue to compete effectively on the world stage.**

   Although the total productivity of the resources workforce is expected to rise over the shorter term, these gains are mostly underpinned by the falling number of construction workers and the significant rise in output. A projected levelling off in the productivity of the operational workforce in the medium term suggests more emphasis may be needed to sustain initial efficiency improvements captured through the implementation of productivity strategies currently underway across the sector.

3.2 Past trends

3.2.1 Population growth

Western Australian population



Source: ABS Catalogue 3101.0
Note: data is quarterly

Western Australia's population has increased sharply as a result of the employment opportunities created by the State's resources sector.

Population changes are a key driver of labour market outcomes. As at December 2013, Western Australia's population was estimated at 2,550,874, representing an increase of 30% over the past 10 years. This compares to a population increase of 18% across Australia as a whole over the same period[13].

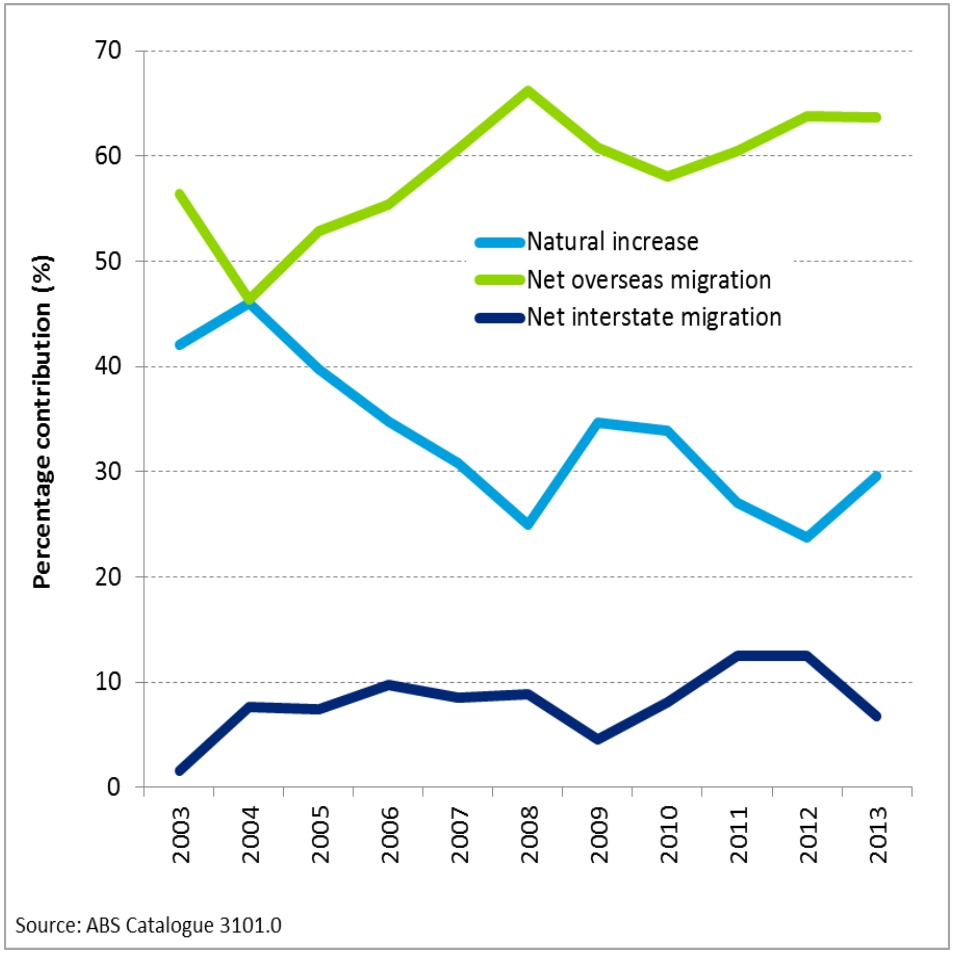
During this period, Western Australia has had the highest annual rate of population growth of all Australian states and territories. Western Australia's population increased at a compound annual growth rate (CAGR) of 2.6% over this time, while the national population increased at an annual rate of 1.6%[13].

As a result of this growth, Western Australia's share of the nation's population increased steadily from 9.9% in 2003 to 10.9% in 2013 – the highest share since records commenced.

[13] ABS catalogue 3101.0

3.2.2 Sources of population growth

Contribution of population sources to Western Australian population growth



Source: ABS Catalogue 3101.0

[14] Department of Immigration and Border Protection, Subclass 457 quarterly report, quarter ending 30 June 2014

Overseas migration has underpinned the State's population increase.

As result of strong economic growth, net overseas migration contributed almost 60% of Western Australia's population growth over the 10 years to 2013. In comparison to overseas migration, the natural increase in population has accounted for 33.4% of population growth over the 10 year period to 2013 and net interstate migration has accounted for just 8%.

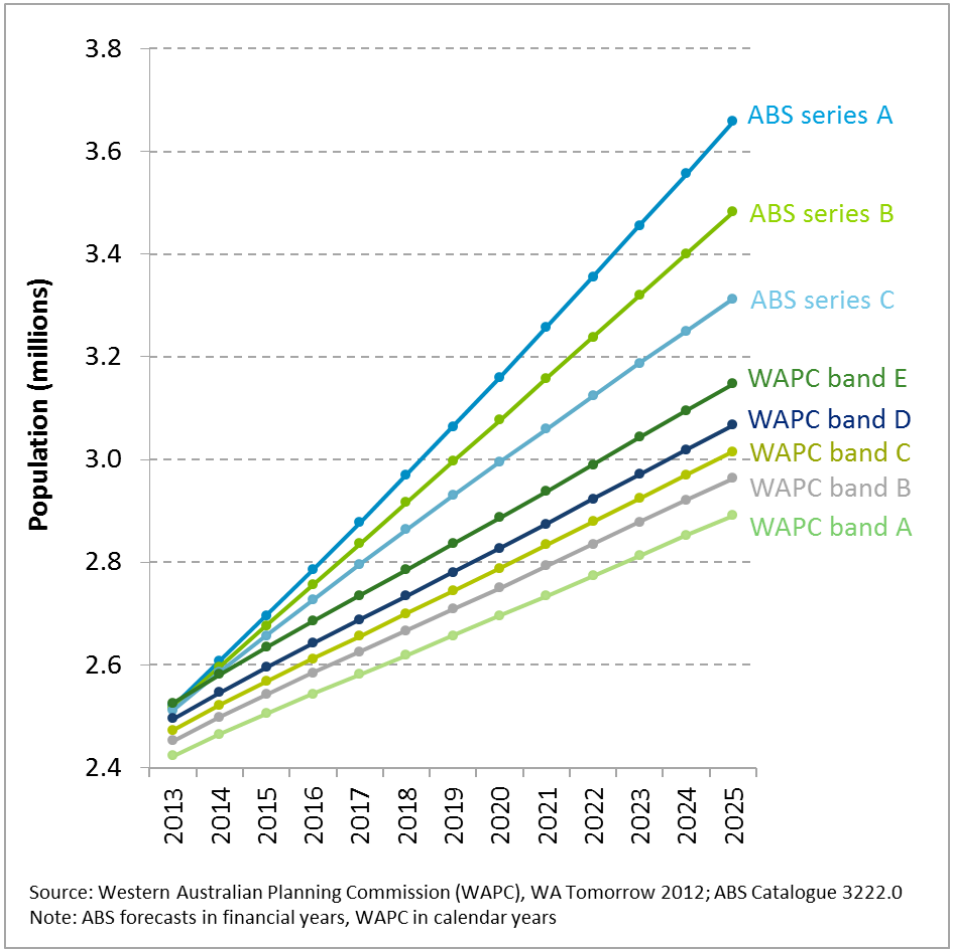
In 2013 alone, net overseas migration accounted for approximately 65% of population growth while the natural increase and interstate migration made up 30% and 8% of growth, respectively.

The Subclass 457, Temporary Skilled Work Visa, has been a significant contributor to the growth of Western Australian net overseas migration. Primary visas granted to the mining and construction sectors from 2008-09 to 2012-13 represented 40% to 50% of the increase in primary visas during this period in Western Australia[14].

However, the number of primary visas granted in 2013-14 for the construction and mining sectors decreased by almost half on the previous year's number, reflecting the softening in demand for labour. The number granted for the mining sector alone accounted for approximately 17% of all applications granted in Western Australia in 2013-14, and represented around 1.5% of the total workforce of the sector in 2013-14[14].

3.2.3 Projected population increase

Population projections for Western Australia, various growth scenarios



Source: Western Australian Planning Commission (WAPC), WA Tomorrow 2012; ABS Catalogue 3222.0
Note: ABS forecasts in financial years, WAPC in calendar years

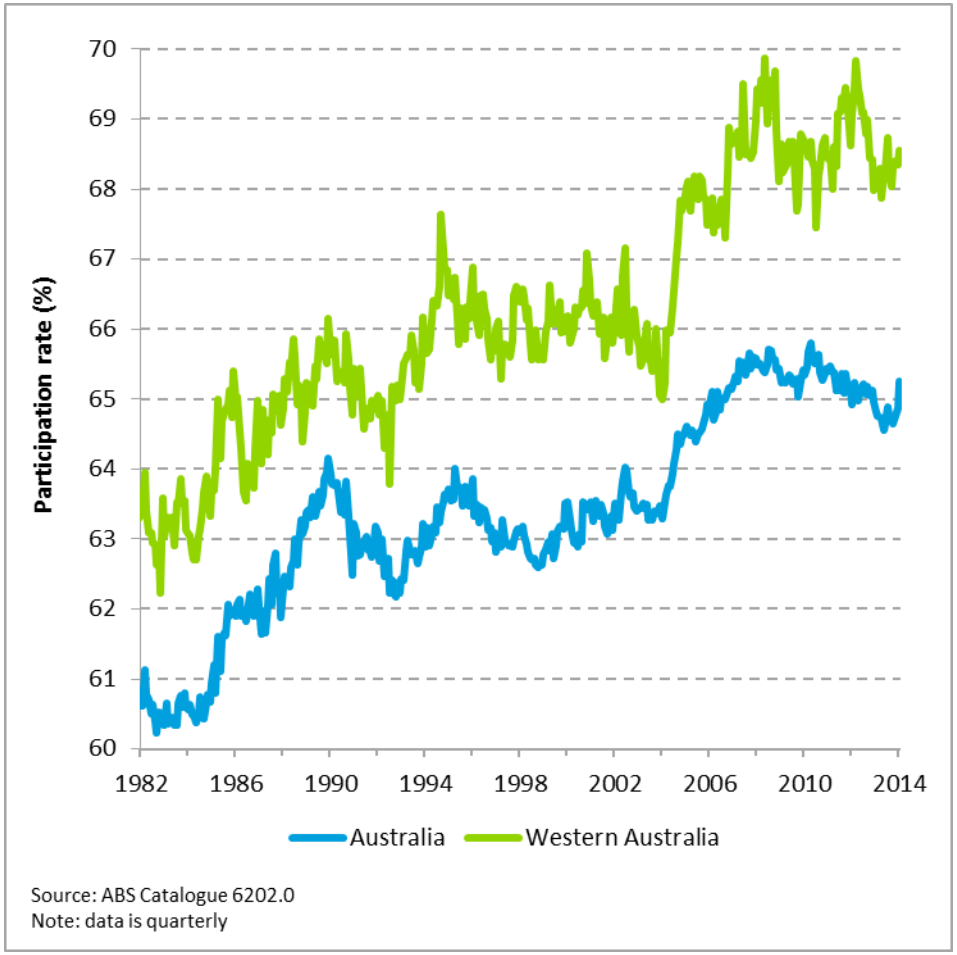
Western Australia's population is projected to exceed three million people in the next 10 years.

The latest population projections by the Australian Bureau of Statistics (ABS) suggest Western Australia could have a population of between 3.3 million and 3.6 million residents by 2025. The Western Australian Planning Commission (WAPC) has a more conservative forecast range of between 2.8 million to 3.1 million residents by 2025.

The ABS projection series also shows an ageing population profile. The most conservative forecast series (C) showing the proportion of the State population aged 60 years or more is expected to rise from approximately 17.5% in 2013 to above 20% by 2025. At the same time, the proportion of the population aged between 18 and 40 years is predicted to decline from 34.2% in 2013 to 33.2% by 2025.

3.2.4 Labour force participation

Western Australian and Australian labour force participation rates



Source: ABS Catalogue 6202.0
Note: data is quarterly

A positive economic environment has led to a high rate of labour force participation, although the labour market is beginning to soften.

In August 2014, the participation rate[15] in Western Australia was 68.2%, with a total labour force of 1.4 million people[16].

The participation rate can be interpreted as a barometer of confidence in the labour market, as a higher participation rate implies a higher percentage of the population is either working or seeking employment.

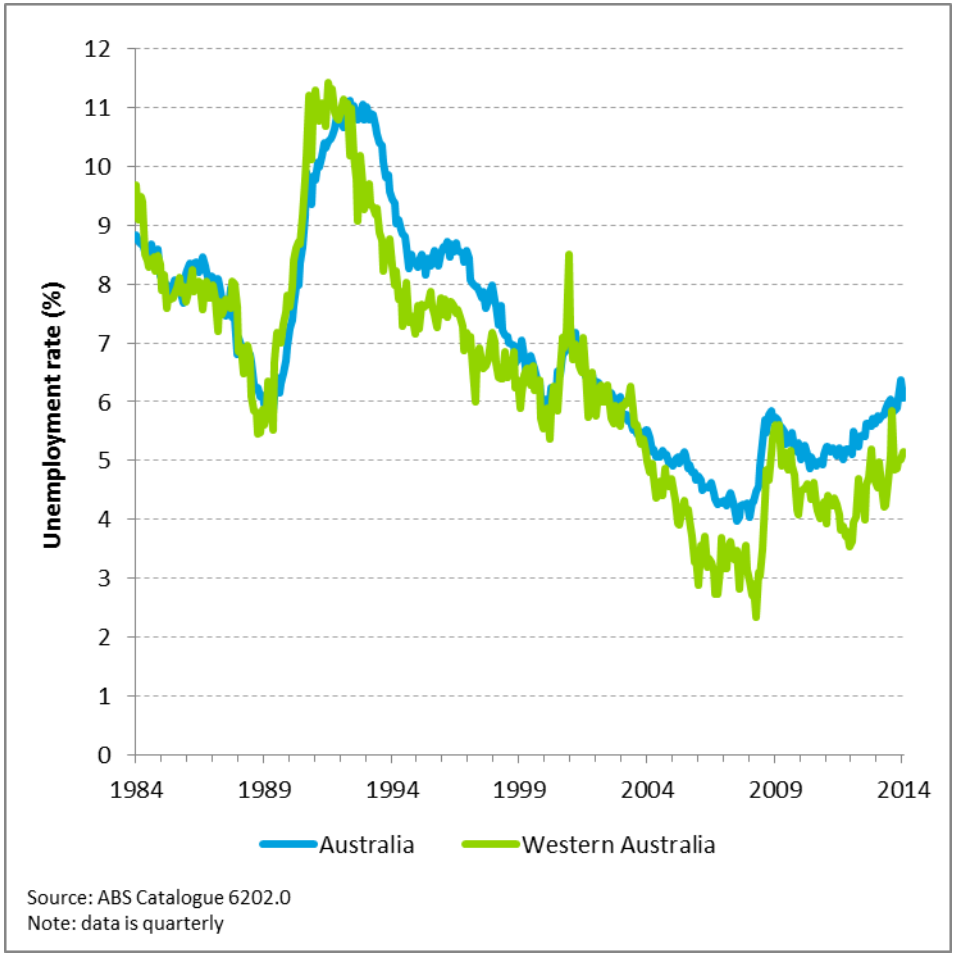
Between 2004 and 2005, Western Australia experienced a step-change in participation as the resources sector began to undertake significant capacity expansion. Since then, the State has maintained an average annual labour market participation rate of around 68%, well above the national average.

The high rate of participation in Western Australia has been underpinned by strong growth in the labour force (those in employment), which has stayed ahead of the population increase. However, commensurate with the weakening in economic activity – which has seen some workers exit the labour force in Western Australia – the State participation rate has followed a downward trend since 2012.

[15] The participation rate is the labour force (persons employed or unemployed and actively seeking work) expressed as a percentage of the working-age population.
[16] ABS catalogue 6202.0

3.2.5 Unemployment

Western Australian and Australian unemployment rates



Source: ABS Catalogue 6202.0
Note: data is quarterly

State unemployment is edging higher.

Western Australia has enjoyed a buoyant labour market over the last 10 years, maintaining an unemployment rate lower than the national average since April 2004.

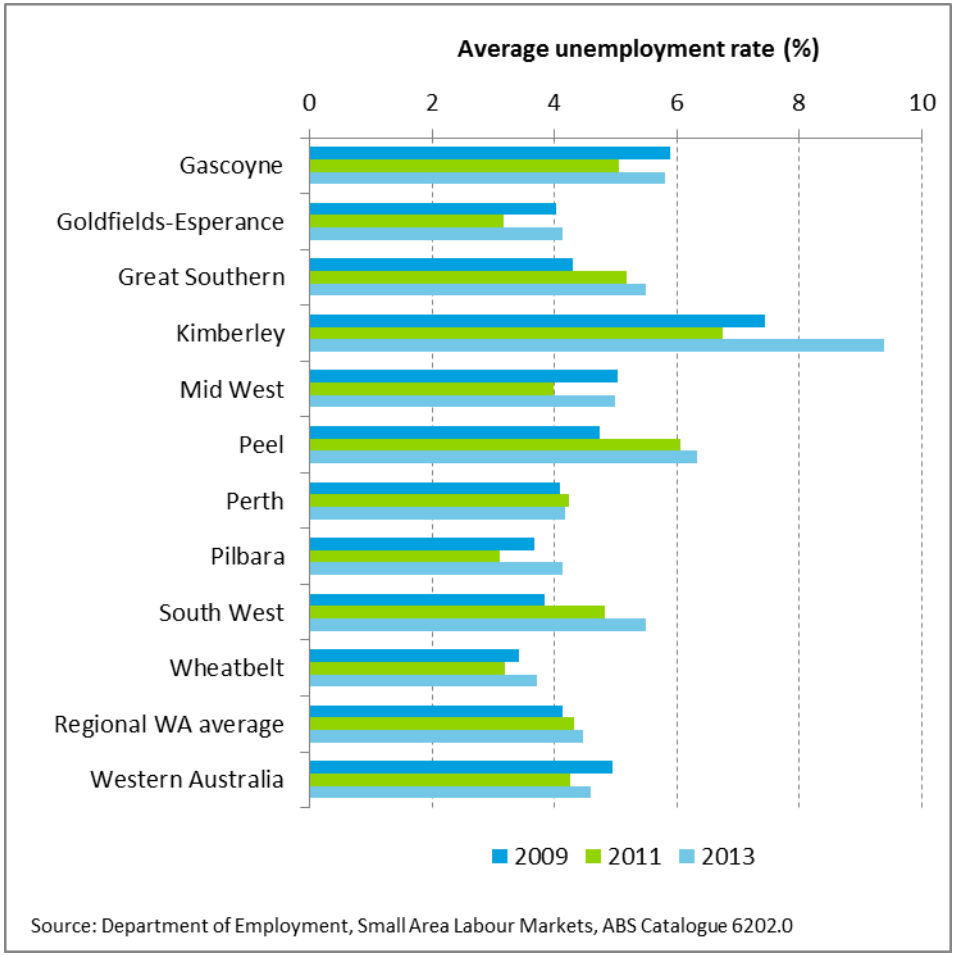
The peak of the construction phase in the resources sector saw State unemployment reach a low of 3.5% in mid-2012. However, as construction activity has tapered, the rate of unemployment has drifted higher to 5.2% in August 2014.

As at August 2014, there were approximately 72,000 unemployed persons in Western Australia, representing an increase of 8% over the past five years. Unemployment has increased most sharply in the past two years, where the number of jobless in Western Australia has increased by one third[17].

[17] ABS catalogue 6202.0

3.2.6 Unemployment in the regions

Unemployment in Western Australia's regions, selected years



Source: Department of Employment, Small Area Labour Markets, ABS Catalogue 6202.0

The weakening in economic activity is also affecting labour markets in regional Western Australia.

Unemployment rates across Western Australia's regions have increased in recent years[18]. Labour markets in the Kimberley, Great Southern, Gascoyne, Peel and South West regions all maintained average rates of unemployment in excess of the State average in 2013.

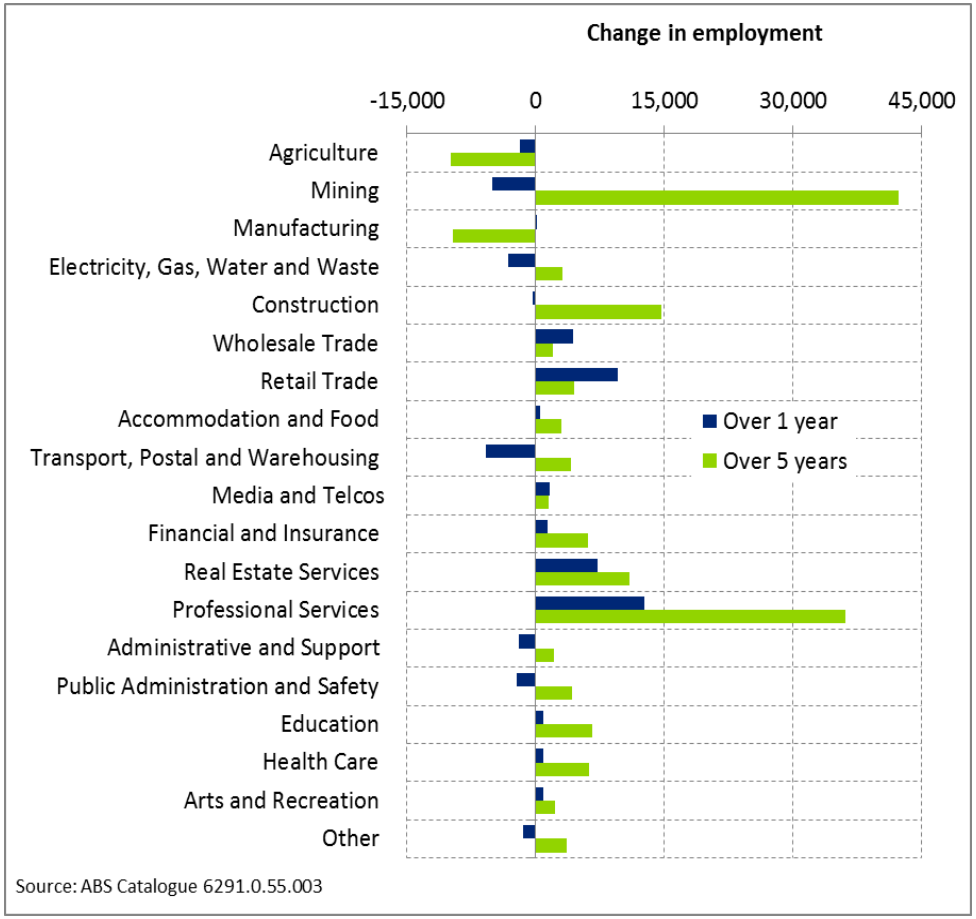
Even the traditional resources-rich regions of Goldfields-Esperance and the Pilbara, which both had some of the lowest unemployment rates in Western Australia through 2011 and 2012, experienced an increase in rates of unemployment in 2013.

The transition to the operational phase will provide new employment opportunities for residents of regional areas, although these opportunities are unlikely to be as wide ranging as during the construction phase.

[18] Labour market data at the regional level is subject to significant lags. Therefore only 2013 data were available at the time of publishing.

3.2.7 Employment

Change in Western Australian employment, by industry



Source: ABS Catalogue 6291.0.55.003

The resources sector has been the biggest job creating industry in Western Australia over the past five years.

An additional 150,000 jobs were added to the Western Australian workforce between 2009 and 2014. The resources sector was the largest contributor to this increase, accounting for 30% of this growth, or 42,000 jobs. This growth took the resources sector from the eighth to the second largest direct employer in Western Australia[19].

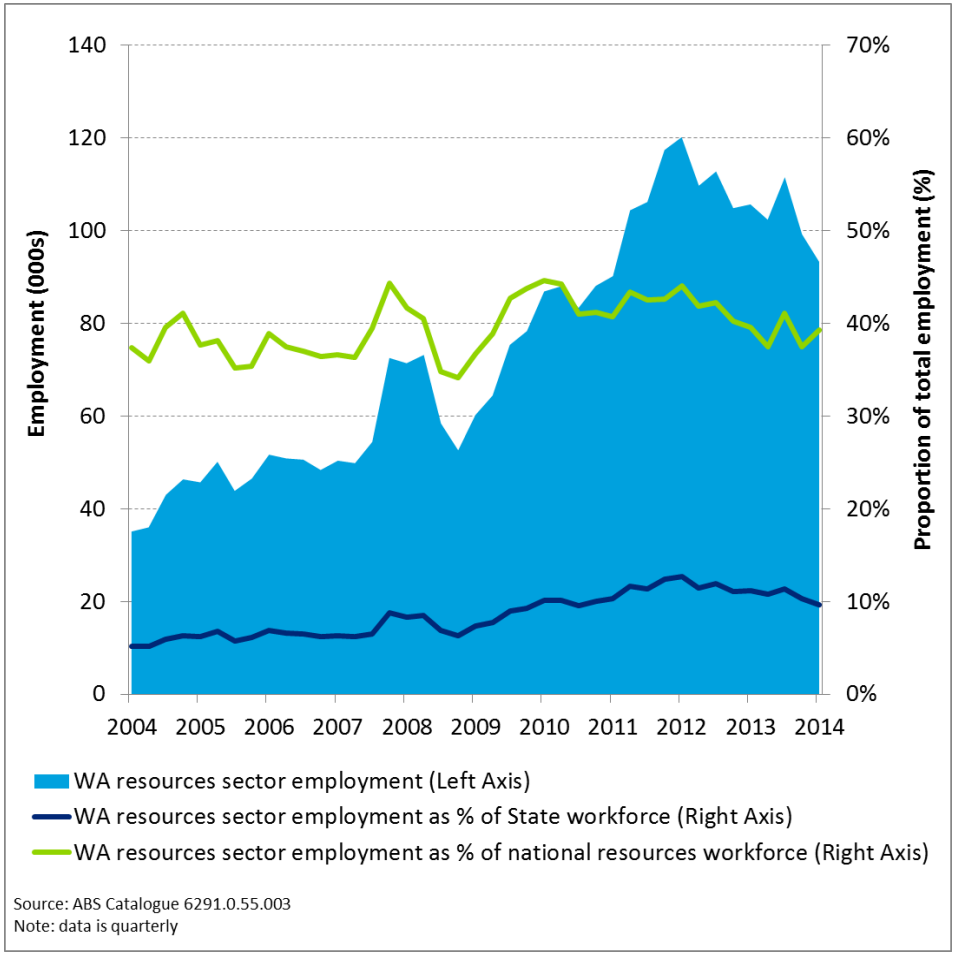
A number of other indirect jobs are also created as a result of activity in the resources sector, but these are covered under other industry classifications, meaning the footprint of the resources sector in the jobs market is larger.

Resources sector employment peaked in August 2012 at over 122,500 workers[19]. By the August quarter 2014, the resources sector workforce had fallen by around 27,000 personnel. This substantial drop was the largest of all industries in Western Australia over this period.

[19] ABS catalogue 6291.0.55.003. Note: This ABS catalogue includes oil and gas under the term 'mining' employment.

3.2.8 Resources sector employment

Employment in the Western Australian resources sector



Source: ABS Catalogue 6291.0.55.003
Note: data is quarterly

Although the size of the Western Australian resources sector workforce is decreasing, it remains at a high level compared to recent history.

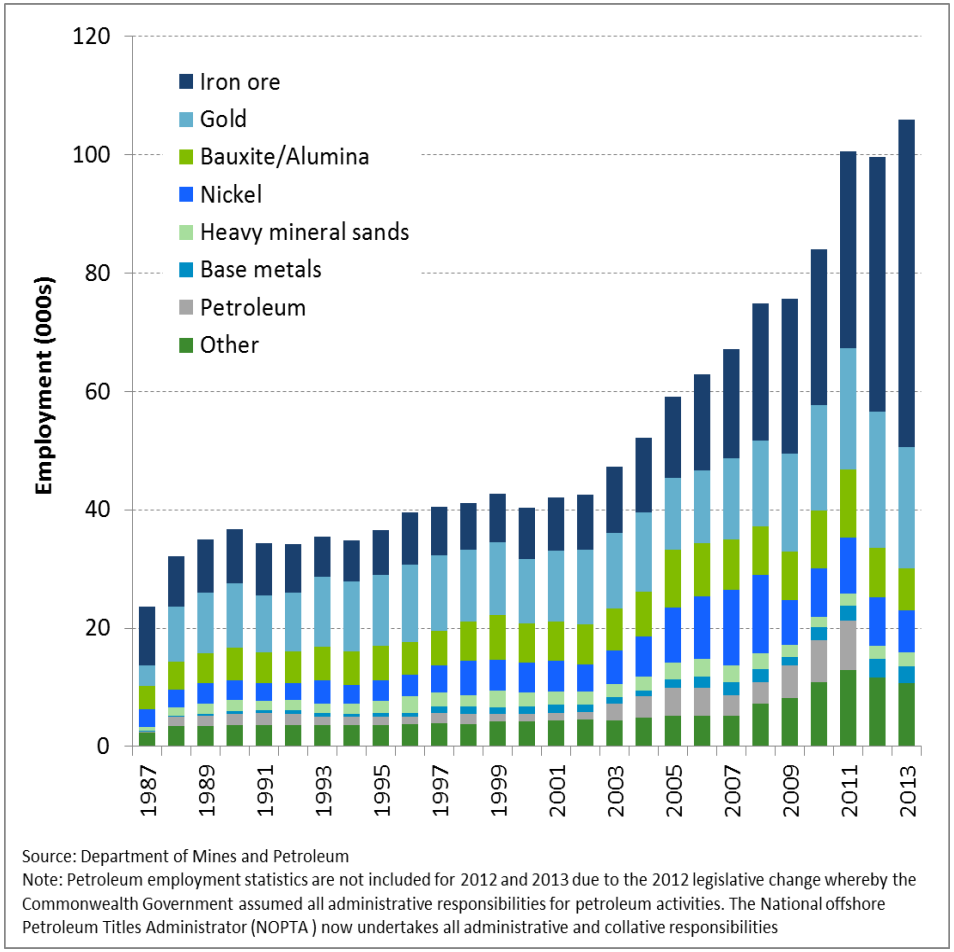
Despite the recent decline in the Western Australian resources sector workforce, the workforce is still large in the historical context. In 2004, before the significant expansion in the sector, less than 40,000 persons were employed in the resources sector. Since that time, it has grown rapidly, doubling in size since the Global Financial Crisis in 2009.

Reflecting this growth, in the August quarter 2014 the resources sector accounted for 10% of the State's workforce compared to just 5% in 2004.

However, over the past decade the State's share of the national resources sector workforce has remained broadly unchanged due to the number of resources sector jobs also created across Australia during this period.

3.2.9 Resources sector employment by sub-sector

Employment in the Western Australian resources sector, by sub-sector



Source: Department of Mines and Petroleum
Note: Petroleum employment statistics are not included for 2012 and 2013 due to the 2012 legislative change whereby the Commonwealth Government assumed all administrative responsibilities for petroleum activities. The National offshore Petroleum Titles Administrator (NOPTA) now undertakes all administrative and collative responsibilities

Previous record high iron ore prices and new mines made the iron ore sub-sector the largest employer in the resources sector.

In 2013, the iron ore sub-sector employed in excess of 55,000 workers[20] – a workforce four times larger than in 2005 and more than half of the current total resources sector workforce in Western Australia.

Before 2005, the gold sub-sector was the largest employer in the State's resources sector. The gold sub-sector is now the second largest employer, followed by alumina and nickel.

In previous years, the petroleum sub-sector had been a small but growing employer in the Western Australian resources sector. Petroleum employment numbers are not included in the Western Australian statistics for 2012 and 2013[21].

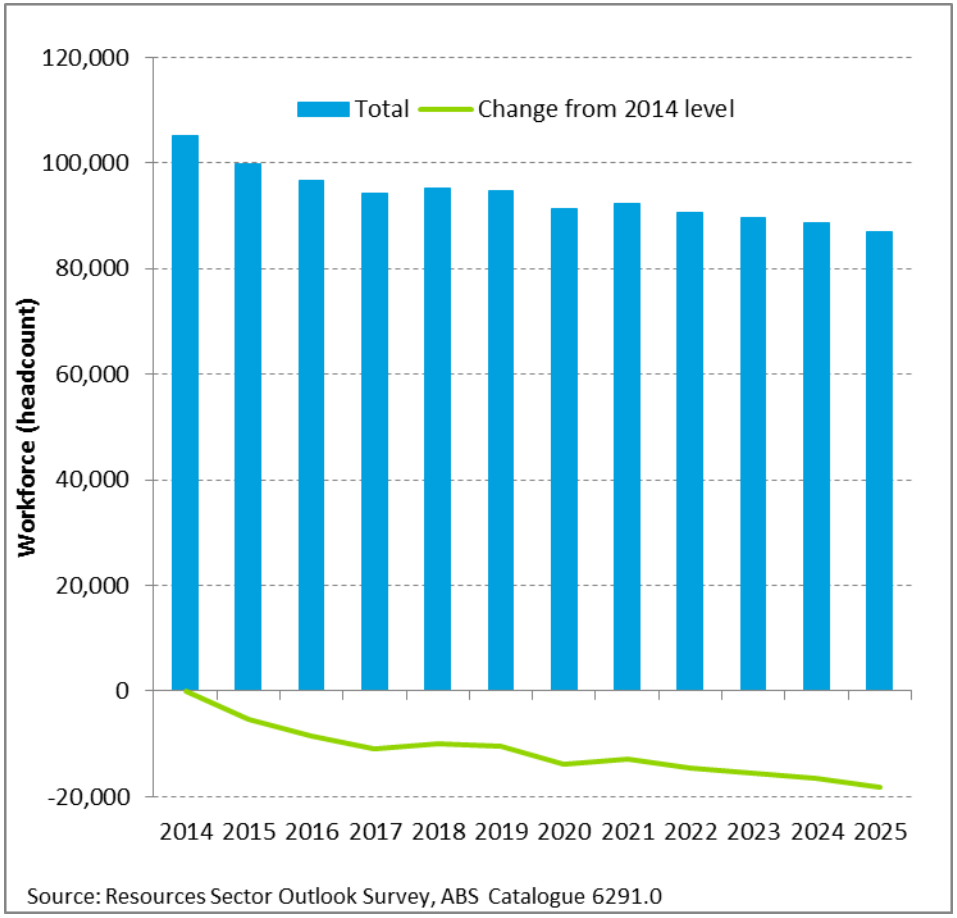
[20] This data differs from ABS data reported previously. The Department of Mines and Petroleum (DMP) collects mining employment data by commodity from monthly accident reports which are required to be submitted by all operating mines and companies carrying out exploration on mineral and mining leases under the *Mines Safety and Inspection Act 1994*. This includes the number of direct employees and contractors (including exploration personnel) working on operating mining leases. Employment data collected and published by the ABS are not available by commodity, and are classified using reference to the Australian and New Zealand Standard Industrial Classification (ANZSIC). These data are therefore not directly comparable with those collected by DMP.

[21] Petroleum employment statistics are not included for 2012 and 2013 due to the 2012 legislative change whereby the Australian Government assumed all administrative responsibilities for petroleum activities. The National Offshore Petroleum Titles Administrator (NOPTA) now undertakes all administrative and collative responsibilities, not DMP.

3.3 Future trends

3.3.1 Resources sector workforce

Western Australian resources sector workforce[22]



The total resources sector workforce is expected to steadily decline through to 2025.

The Western Australian resources sector workforce declined sharply in 2014, from 117,500 at the start of 2014 to 95,800 by August 2014 – a decline of almost 22,000.

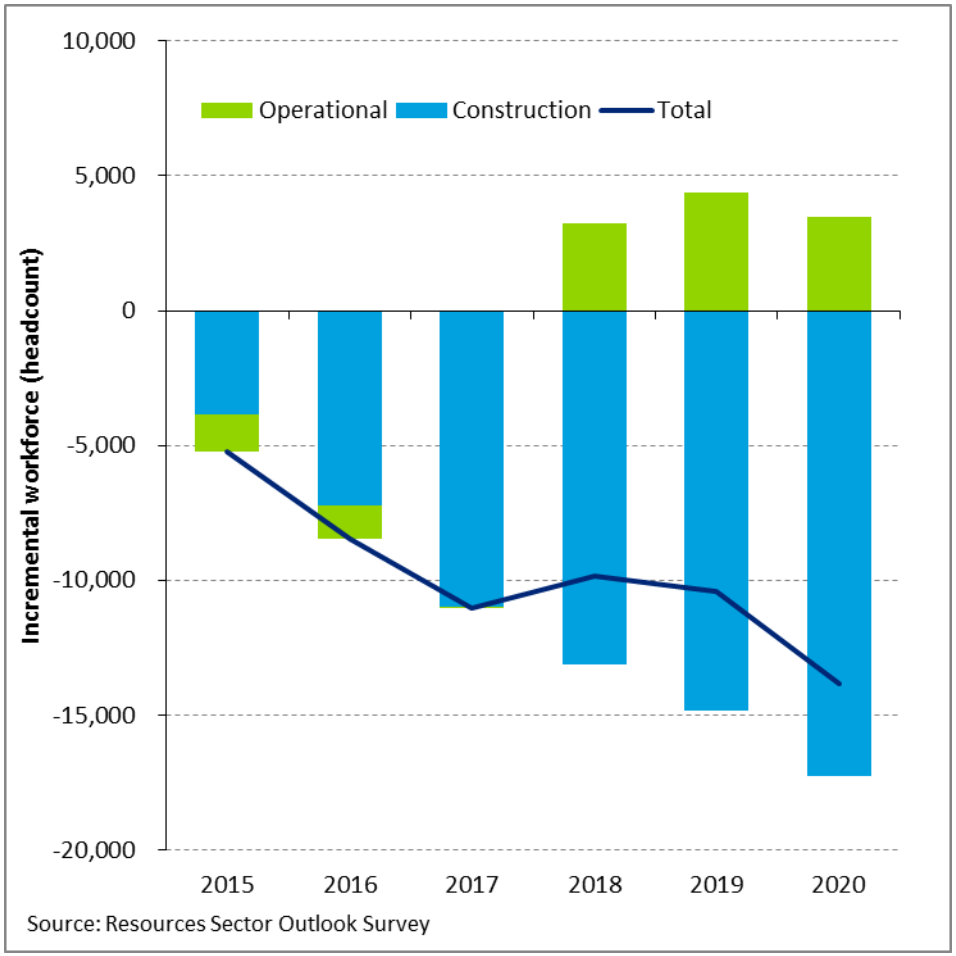
However, the workforce is not projected to decline significantly more, with a workforce of 87,000 persons expected by 2025 – a loss of a further 18,200 positions over the next 10 years from the average headcount of 105,200 in the 2014 calendar year.

This rate of workforce attrition will take the sector's total employment headcount down to a level last seen in May 2010 (however, still more than double 2004 levels), suggesting the sector is not foreseeing a significant decline in employment to pre-expansion levels.

[22] The more timely release of ABS labour force statistics allow the use of a 2014 baseline in the 'People' section (a 2013 baseline is used in other sections)

3.3.2 Construction and operational workforces

Western Australian resources sector workforce, by construction and operational, increment from 2014[23]



The overall forecast decline in the resources sector workforce is underpinned by construction related jobs. However, a slight increase in the operational workforce is forecast from 2018.

As major mineral and energy projects transition from the construction to the operational phase, the construction workforce is projected to decline through to 2020 with a forecast of 17,300 employees less than 2014 levels.

The contraction in the construction workforce will be largest in the Pilbara, Mid West and Goldfields-Esperance regions.

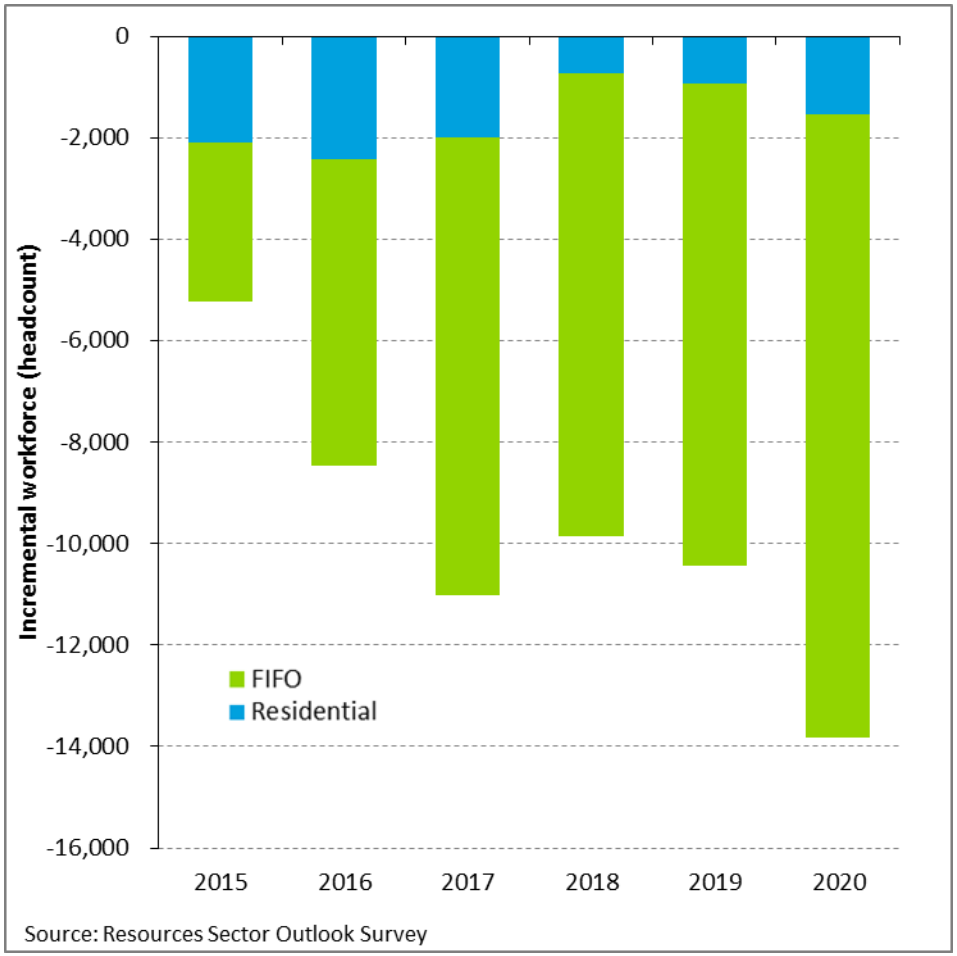
The Kimberley region is forecast to experience an increase in the construction workforce.

Despite a short term fall to 2016, the operational workforce is projected to increase to 2020. Approximately 3,500 operational roles are projected to be created between 2014 and 2020. The Pilbara will account for over 80% of the expected increase to 2020.

[23] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014

3.3.3 FIFO and residential workforces

Western Australian resources sector workforce, by FIFO and residential, increment from 2014[24]



Both FIFO and residential workforces are expected to remain below the 2014 baseline over the period to 2020.

The size of the residential resources sector workforce is expected to decrease out to 2020. On aggregate, approximately 2,400 fewer residential workers are expected by 2016 and 1,500 fewer workers by 2020 compared to 2014 levels.

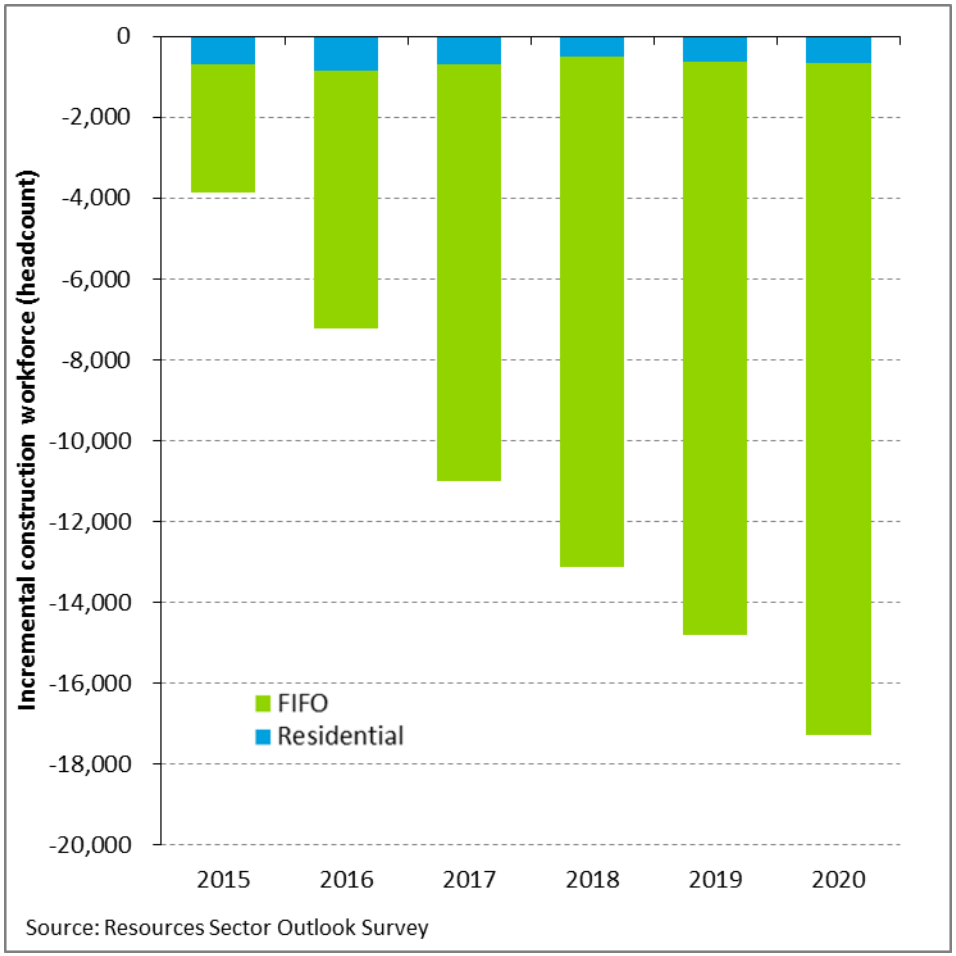
However, on a year on year basis, which examines the change between years rather than from the constant base year of 2014, the residential workforce is expected to increase from 2016.

In aggregate, these increases are offset by continued declines in the FIFO workforce. This is driven by the unwinding in construction activity, as FIFO workers make up over 80% of the construction workforce. In total, the FIFO workforce is forecast to decrease by 12,300 positions between 2014 and 2020.

[24] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.3.4 Construction workforce

Western Australian resources sector construction workforce, by FIFO and residential, increment from 2014[25]



The decline in the resources sector workforce is underpinned by a contraction in the construction workforce, which is expected to fall to less than half of its 2014 levels by 2020.

As the pipeline of new projects reduces, the construction workforce is forecast to decrease significantly year on year between 2014 and 2020. By 2020, it is estimated the construction workforce will decline in aggregate by 17,300 compared to 2014 levels.

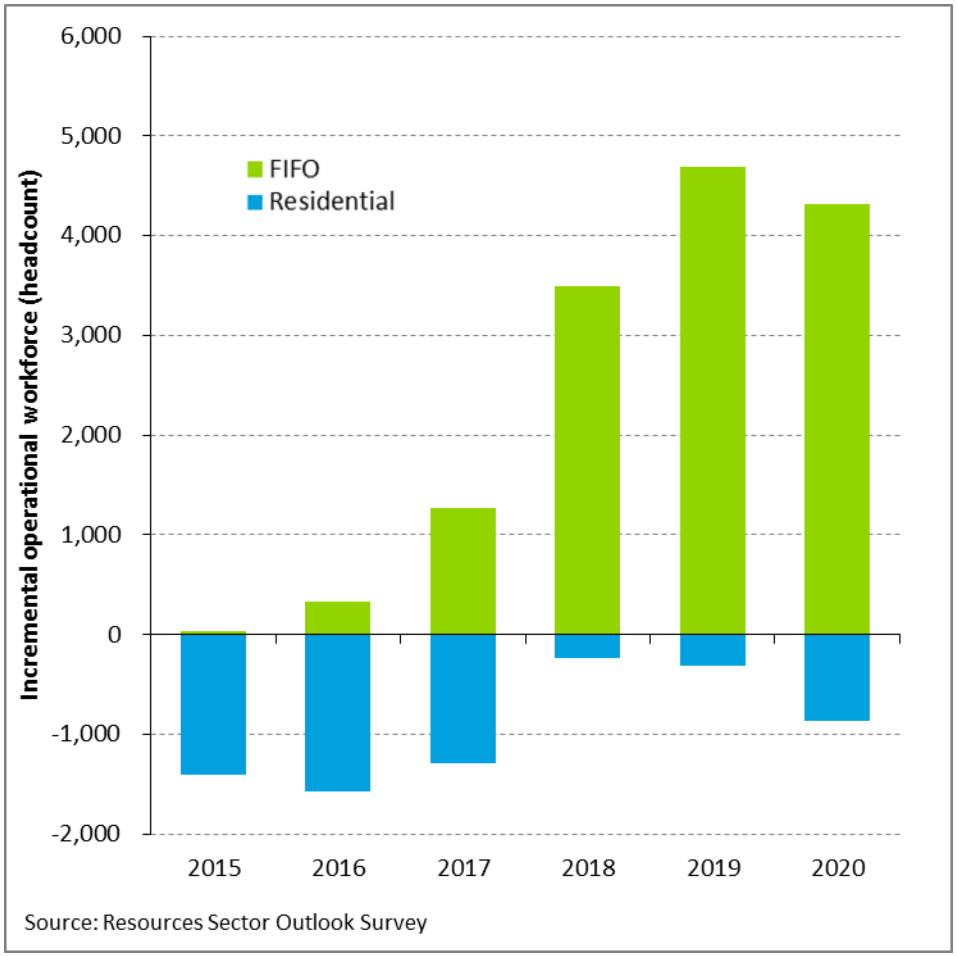
The residential construction workforce is expected to contract by 700 positions through to 2020 and the FIFO construction workforce is forecast to contract by 16,600.

As the total quantum of FIFO positions decline in the future, so too does the proportion of the construction workforce on FIFO arrangements. Approximately 75% of the construction workforce is projected to be working on FIFO arrangements in 2020, compared to 87% in 2014.

[25] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.3.5 Operational workforce

Western Australian resources sector operational workforce, by FIFO and residential, increment from 2014[26]



The projected increase in the operational workforce will be driven by workers on FIFO arrangements.

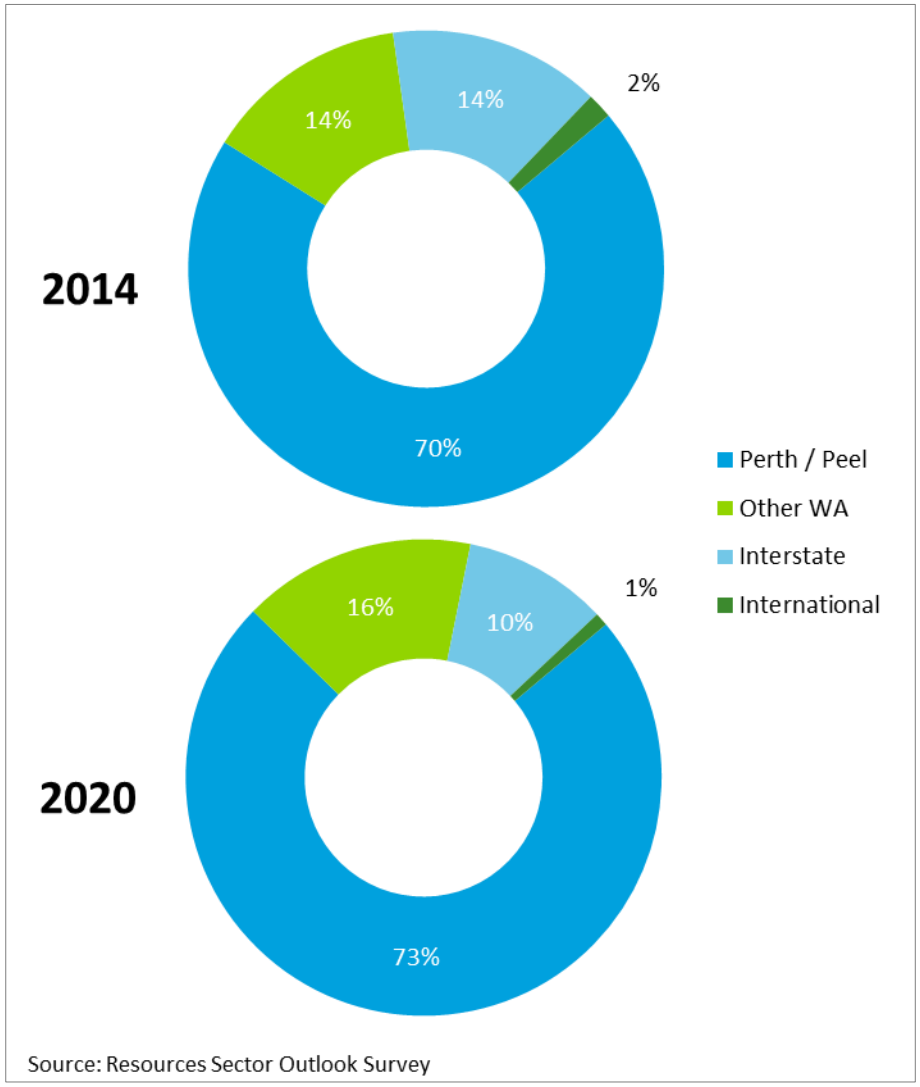
Between 2014 and 2020, the number of FIFO workers in operational roles is forecast to increase by 4,300. In contrast, the residential workforce is projected to decrease over the short term to 2016 (down by 1,600 on 2014 levels) before expanding in year on year terms during the latter years of the forecast period.

With the expected growth in the number of operational workers, it is anticipated 63% of this workforce will be on FIFO arrangements by 2020, up from 60% in 2014.

[26] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.3.6 Sources of the FIFO workforce

Western Australian resources sector, source of FIFO workforce by region



Source: Resources Sector Outlook Survey

The Perth and Peel region will remain the predominant sources of FIFO workers in 2020, while the number of interstate and international FIFO workers is forecast to decline to 2020.

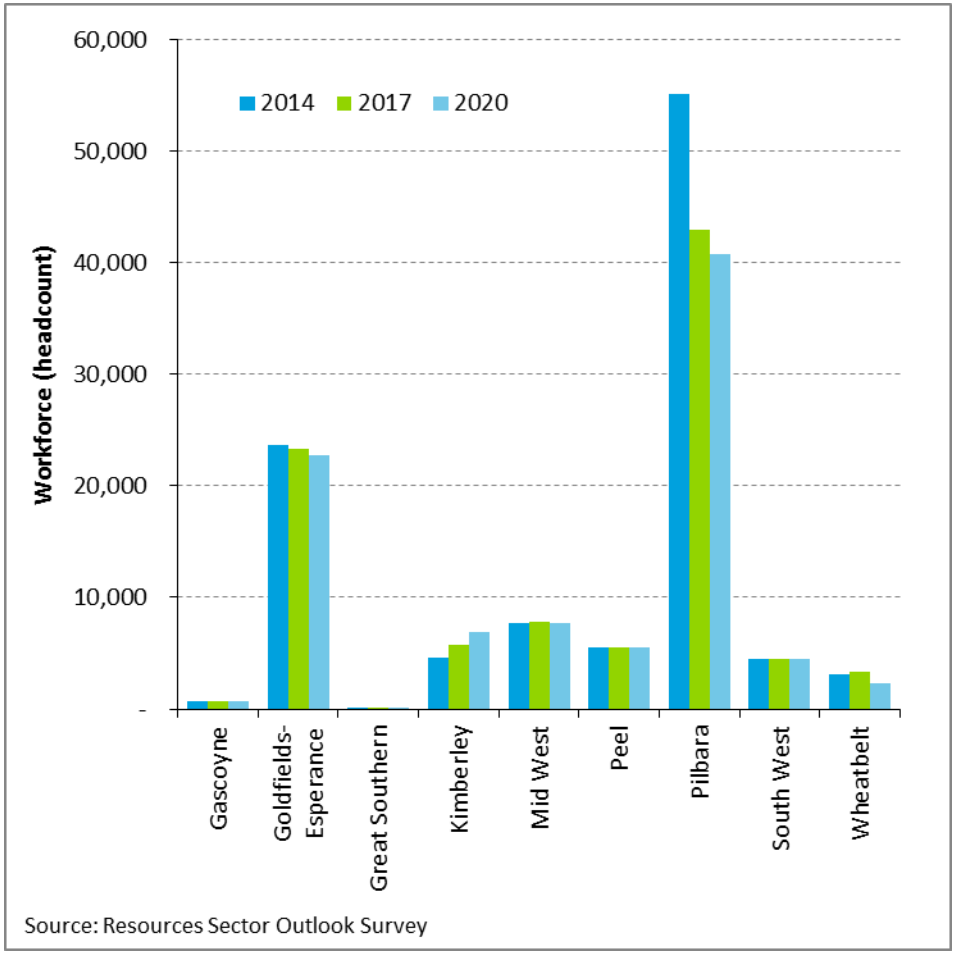
The Perth and Peel region currently contributes 70% of the FIFO workforce. This is expected to increase to 73% in 2020.

Of the other regions, the Pilbara and Great Southern/South West regions are the main sources for FIFO growth to 2020. These regions are expected to increase their shares of the FIFO workforce from these regions by 1.3% and 1.2%, respectively, by 2020.

The decrease in the interstate workforce as a source of FIFO workers is primarily due to a reduction in workers from Queensland and New South Wales. The contraction in both the interstate and international workforces predominantly reflects the contraction of the construction workforce.

3.3.7 Resources sector workforce by region

Western Australian resources sector workforce, by region



Source: Resources Sector Outlook Survey

The Pilbara is expected to experience the sharpest decline in workforce numbers as we transition to the operational phase.

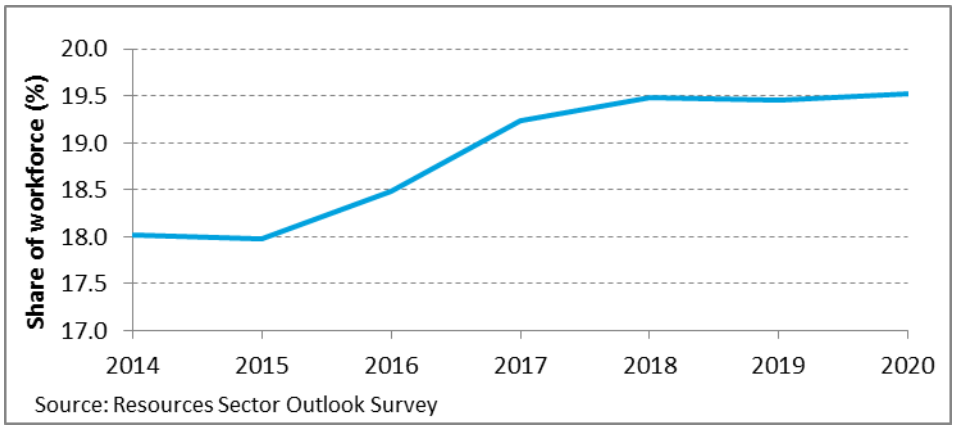
The Pilbara will remain the main location for the resources sector workforce, with an estimated 40,800 workers in 2020. However, this figure represents 14,300 fewer positions than in 2014.

Over the same period, the workforces of the Mid West, Great Southern, South West, Peel and Gascoyne regions are all expected to remain relatively stable, while the Goldfield-Esperance and Wheatbelt regions are forecast to experience slight declines.

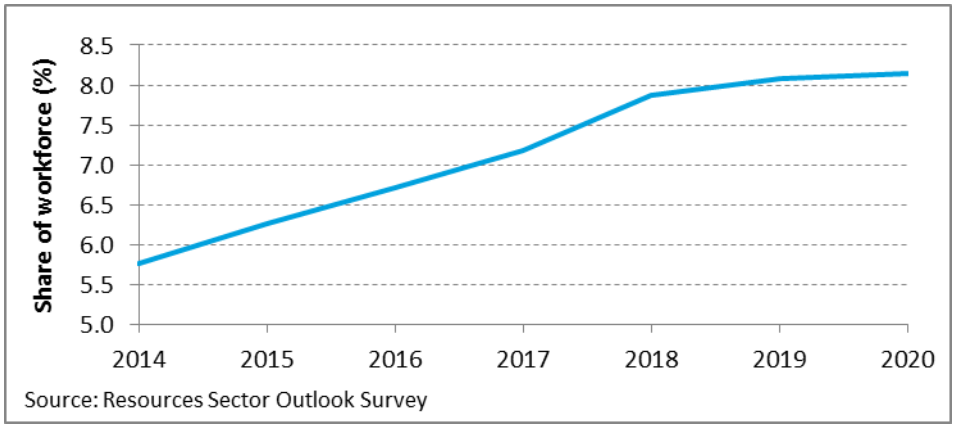
The Kimberley is the only region expected to experience growth in its resources sector workforce over the period, with an increase of 2,900 workers from 2014 to 2020.

3.3.8 Workforce diversity

Proportion of women in the Western Australian resources sector workforce



Proportion of Aboriginal persons in the Western Australian resources sector workforce



The resources sector workforce will become more diverse in the future.

The share of women in the resources sector workforce is expected to increase from 18% in 2014 to 19.5% in 2020, representing slower growth than in previous years. The number of women directly employed in the resources sector nationally more than doubled over the 10 years to August 2014[27].

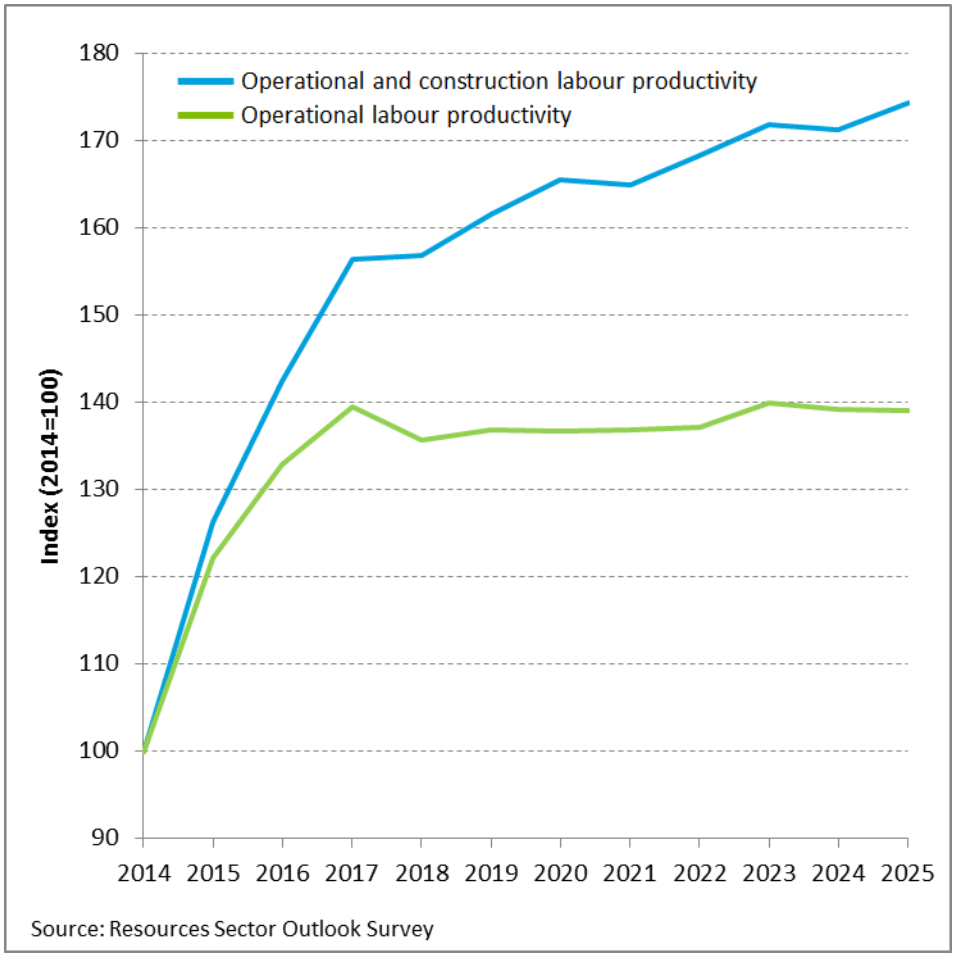
Due to the forecast decline in the total resources sector workforce over the period to 2020, the absolute number of women in the sectors workforce may fall.

The share of Aboriginal Australians in the resources sector workforce is expected to increase sharply between 2014 and 2020, from 5.8% to 8.1%. The expected proportional increase of Aboriginal Australians' share of the workforce is large enough that, even with a significant decrease in the overall workforce, the total number of Aboriginal Australian workers is still expected to rise.

[27] ABS catalogue 6291.0

3.3.9 Productivity

Index of labour productivity in the Western Australian resources sector[28]



A shrinking workforce combined with growing output is expected to yield an increase in total labour productivity in the resources sector.

As the construction workforce begins to decline from 2015, and new resources sector projects shift into the operational phase, the volume of production will increase. This is expected to result in the value of output per worker rising considerably.

In terms of productivity of the operational and construction workforces, the value of output per worker is expected to rise by over 70% by 2020. A key contributing factor to this rise is the size of the expected contraction in the construction workforce.

However, when isolating the operational workforce, attributing the value of projected future production to each operational unit of labour and indexing the unit output to the 2014 base year, a different pattern emerges. By this measure, productivity will also increase significantly in the short term (40% to 2017), but is expected to plateau over the remainder of the forecast period.

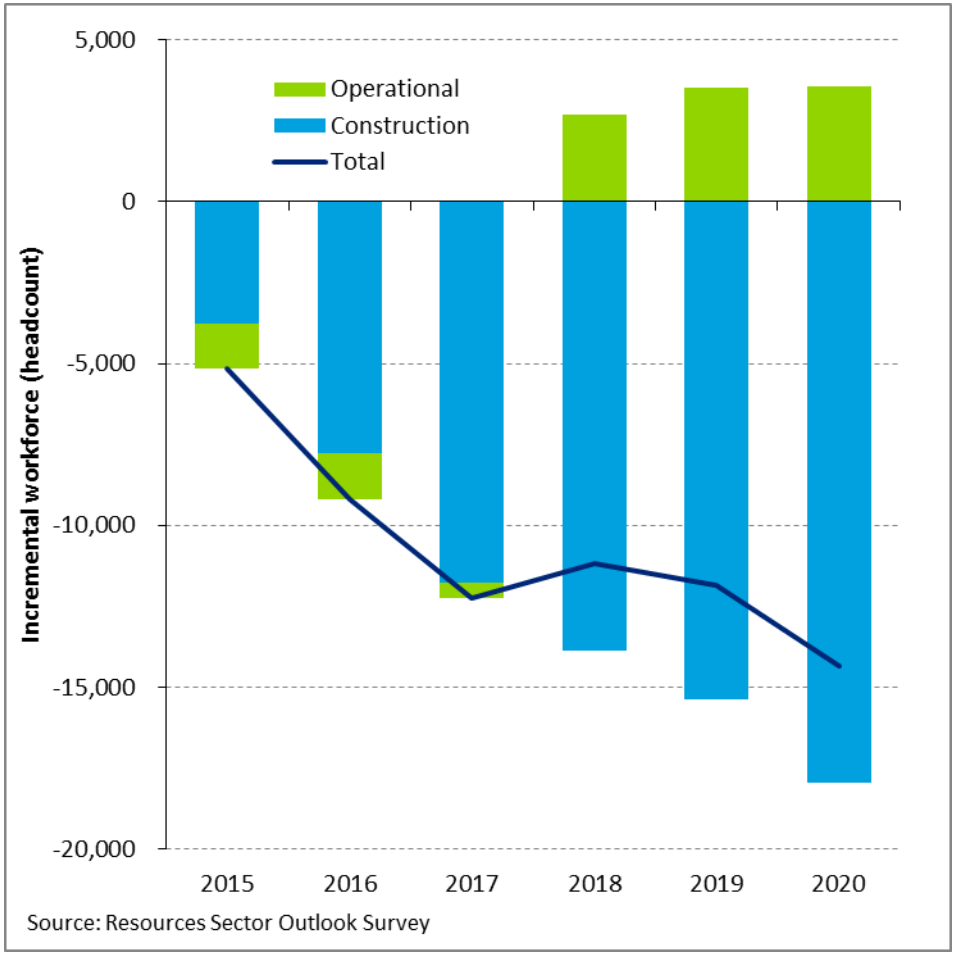
This suggests the improvement in total productivity is driven by the shrinking construction workforce beyond 2016.

[28] The index measures the change in the value of production per worker based on 2013 prices for each commodity. This ensures the productivity of the labour force is not distorted over time by commodity price movements.

3.4 Key regional trends

3.4.1 Pilbara – operational and construction workforces

Pilbara resources sector workforce, by construction and operational, increment from 2014[29]



The balance between the operational and construction workforces in the Pilbara will change significantly.

The Pilbara region accounts for the majority of the construction workforce of the Western Australian resources sector.

As major projects transition to the operational phase, the Pilbara region will experience a significant decline in the construction workforce. The Pilbara construction workforce will fall steadily from 2014 and is expected to be 17,900 lower than 2014 levels by 2020.

Construction workers are expected to fall from 36% of the total workforce to just 16% by 2020.

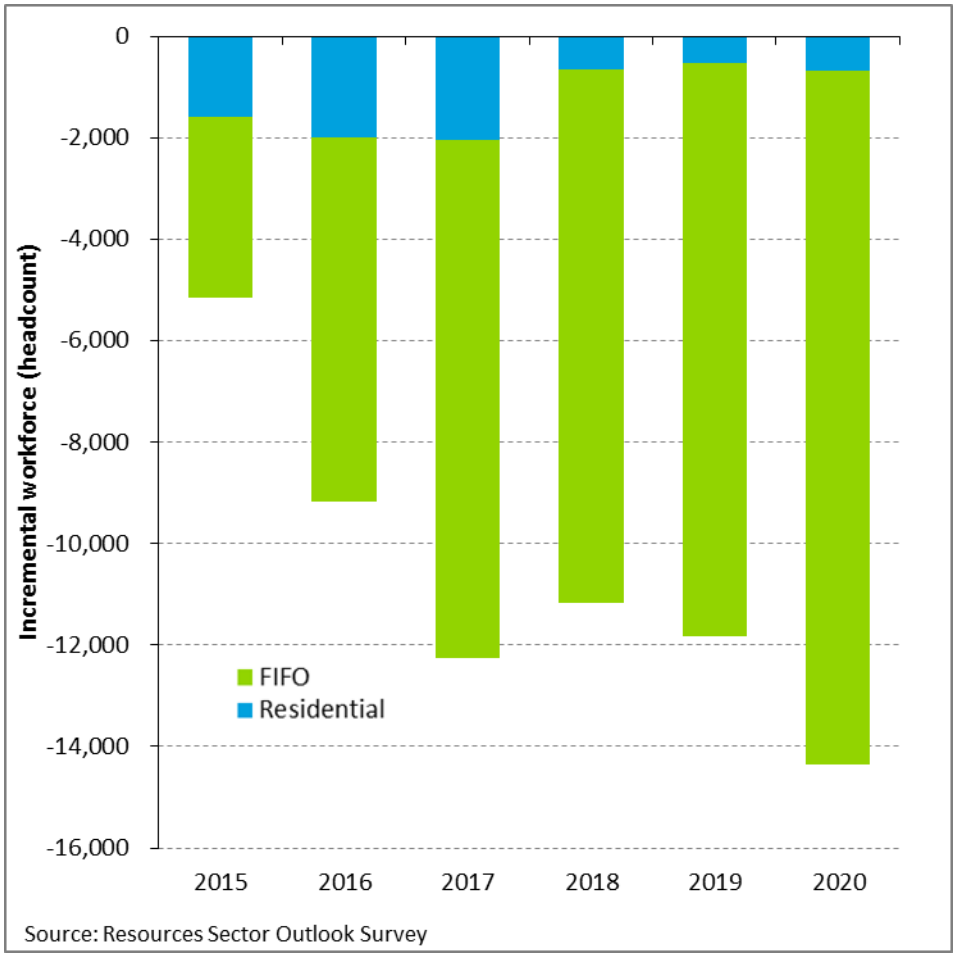
By 2020, the operational workforce is expected to increase by 3,600 workers over 2014 levels, slightly offsetting the large decline expected in the construction workforce.

In total, the Pilbara's resources sector workforce is forecast to fall by 14,300 people between 2014 and 2020, representing a loss of over a quarter of the workforce from 2014 levels.

[29] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.4.2 Pilbara – FIFO and residential workforces

Pilbara resources sector workforce, by FIFO and residential, increment from 2014[30]



The contraction of the Pilbara workforce to 2020 will be driven by a decrease in the FIFO workforce.

Over the short term, both the FIFO and residential workforces in the region are forecast to decrease. By 2017 these workforces are expected to decrease by 10,200 and 2,000, respectively, compared to 2014 levels.

After 2017, the FIFO workforce will continue to decrease and by 2020 is forecast to be 13,700 below current levels. The residential workforce is expected to grow, adding an estimated 1,400 positions between 2017 and 2020 albeit remaining marginally below 2014 levels.

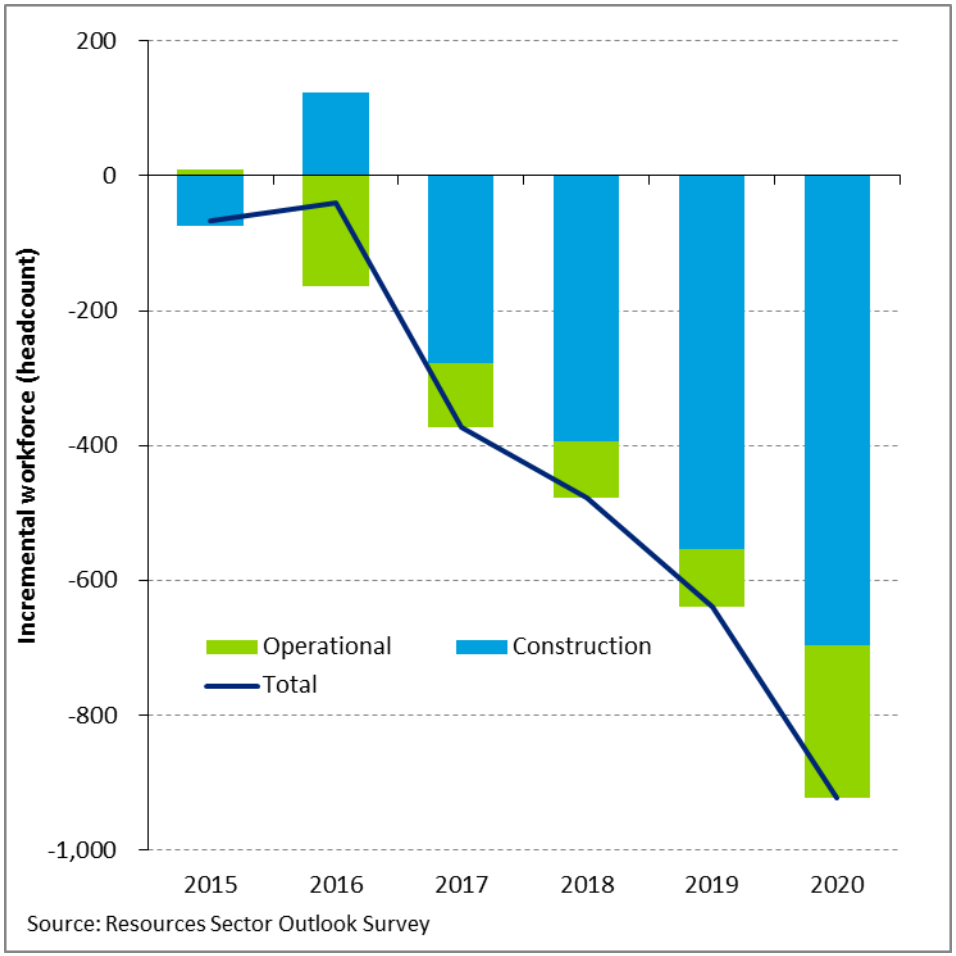
Some of the residential Pilbara workforce may transition to intra-regional FIFO arrangements, which may partially explain the decline in the residential workforce during this period.

Despite these changes, accommodation will continue to need to be provided for FIFO workers in the region. By 2020, approximately 75% of the resources sector workforce in the Pilbara is expected to be on FIFO arrangements.

[30] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.4.3 Goldfields-Esperance – total workforce

Goldfields-Esperance resources sector workforce, by construction and operational, increment from 2014[29]



The workforce projections show a difference in the timing of the shift from the construction to the operational phase for projects in the Goldfields-Esperance region compared to the Pilbara.

While the Pilbara region is experiencing a period of contraction in construction activity, construction activity appears stronger in the Goldfields-Esperance region until at least 2016. Like the Pilbara, the region's construction workforce is expected to decrease through to 2020, and is estimated to fall by 700 workers by this time against 2014 levels.

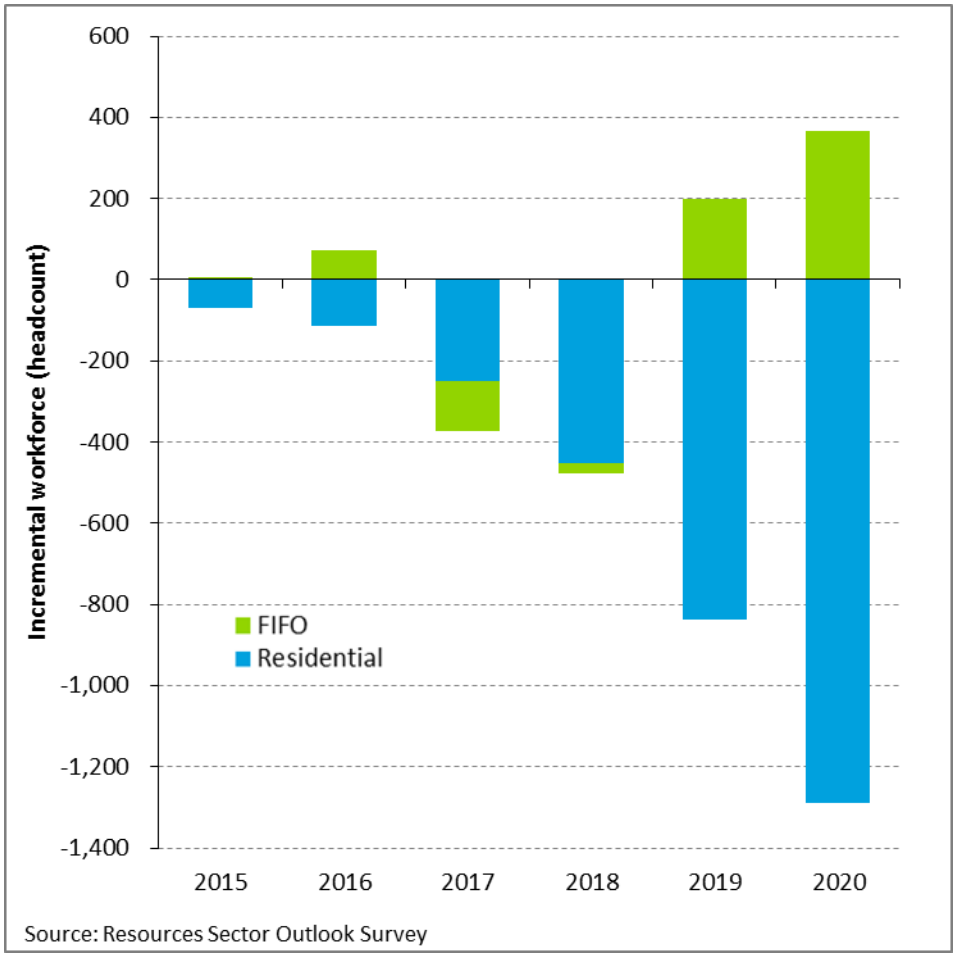
The operational workforce in the region is also expected to decline over the forecast period by approximately 200 workers. In total, the Goldfields-Esperance resources sector workforce is projected to decrease by 900 people by 2020.

Including the adjacent Wheatbelt region, the combined operational workforce of the two regions is projected to fall by 1,070 by 2020. Unlike the Goldfields-Esperance region however, the construction workforce of the Wheatbelt is expected to hold steady over the period.

[29] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.4.4 Goldfields-Esperance – FIFO and residential workforces

Goldfields-Esperance resources sector workforce, by FIFO and residential, increment from 2014[30]



Despite an overall decline in the resources sector workforce in the region, FIFO in the Goldfields-Esperance region is expected to grow through to 2020.

The FIFO workforce is projected to increase by almost 400 workers by 2020 compared to 2014 levels. However, the residential workforce is forecast to decrease through to 2020. By this time the residential workforce is forecast to be 1,300 workers less than 2014 levels.

The Perth and Peel regions will remain the main source of FIFO workers for the operational workforce in the Goldfields–Esperance region.

The expected decline in the residential workforce, which is partly offset by the increase in FIFO in the region, may reflect an overall re-structuring in working arrangements as the region's total resources workforce declines to 2020. This may include a possible shift to more intraregional FIFO arrangements among residential workers.

[30] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014.

3.4.5 Other regions

Kimberley

The resources sector workforce of the Kimberley is projected to increase by over 2,900 to 2020. This expansion will comprise 1,600 construction workers and 1,300 operational workers. FIFO workers are expected to make up almost 90% of the increase in the workforce.

Other

Other regions, including the Mid West, Gascoyne, Great Southern, Peel and South West regions are not expected to experience any material change in their resources sector workforce to 2020.

3.5 Policy implications and opportunities

Five key policy implications and opportunities have been identified from the above analysis:

1. ***The transition from the construction to the operational phase will decrease the construction based workforce.***

There are opportunities to transition construction-based roles into operational roles in the resources sector; however, this only applies to some parts of the workforce. Therefore, the overall forecast decline in the sector's workforce to 2025 is underpinned by a reduction in construction related jobs.

Although the construction workforce can be transient in nature, this decline in construction jobs may contribute to higher unemployment in Western Australia. Particularly as the resources sector generates both direct jobs in construction and indirect jobs in multiple supporting sectors of the economy related to project construction needs.

There is an opportunity for the State and Australian Governments to capitalise on the growing availability of the labour force in this segment through strategic countercyclical investment in new infrastructure. Construction of other state infrastructure may also sustain employment and economic activity.

2. ***The significant growth in the workforce over the past decade will not be unravelled by the current shift from the construction to the operational phase. Rather, the workforce is forecast to remain more than double pre-expansion levels.***

The resources sector has been the biggest job creating industry in Western Australia over the past five years. Although the workforce has shrunk in 2014, and the sector expects to continue to shed labour in net terms to 2025, employers are not foreseeing a significant decrease in employment to pre-expansion levels. Most of the employment gains realised in the last 10 years will be largely preserved.

Preserving this momentum sets a sound platform to maintain a strong base of skills, knowledge and innovation in minerals and oil and gas extraction in Western Australia.

This could form the basis for a future growth industry focussed upon the export of skills in resources extraction alongside the export of the resources themselves. Industry, governments and education and training institutions should continue to work collaboratively to accommodate this shift in the sector towards the export of skills and knowhow.

This may take the form of support for the establishment of centres of excellence, research and training centres, specialist courses and other initiatives to train, educate, and develop the human capital and capability of the resources sector globally from Western Australia. It may also require promotion of Western Australia's proficiency in mining and energy to markets around the world.

3. Accommodating the future workforce will require both FIFO and residential options.

The transition from the construction phase to the operational phase is not expected to see a decline in the use of FIFO arrangements in the resources sector. Approximately 75% of the construction workforce and 63% of the operational workforce is projected to be working on FIFO arrangements in 2020. This largely reflects the desire of the workforce to be located in Perth or other regions in the south west of the State.

Continued policy support for FIFO arrangements will be required, including approvals for existing and new transient worker accommodation sites and investment in local aviation infrastructure.

However, after an initial decline, the number of residential workers is also forecast to increase beyond 2016. There is also evidence workers living in resources sector project regions may undertake intraregional FIFO roles. Therefore, continued investment in residential infrastructure is also required.

4. New strategies will be required in the future to continue the momentum created in recent years in increasing the representation of women in the resources sector.

Gains have been made over time to increase the representation of women in the sector. The number of females working in the sector nationally has more than double over the past 10 years. To enable this momentum to continue it will be necessary for companies to re-examine existing strategies aimed at attracting and retaining women and give them renewed priority.

It is important workforce diversity remains a priority for the sector in the future to ensure companies have access to a broad skills base. Resources sector companies should examine existing programs and policies and take an innovative approach to attracting and retaining women in the sector.

5. *Operational labour productivity is projected to increase significantly over the short term. Over the medium term labour productivity will plateau and need to improve if the sector is to continue to compete effectively on the world stage.*

Although the productivity of the resources sector workforce is expected to rise as the construction workforce begins to decline and new resources sector projects shift into the operational phase, the productivity of operational labour specifically is forecast to plateau after 2017 (i.e. the gain in overall productivity is underpinned by the falling number of construction workers and significant rise in output).

Although labour productivity is only one measure of productivity, the resources sector in Western Australia will need to continue to invest in productivity enhancing measures in order to maintain a competitive global standing. Improved cost and productive efficiency will also be critical to ensure operations can continue viably in an environment of volatile commodity prices.

Efficiency drives are already underway in the sector, although the projected levelling off in operational productivity suggests more emphasis may be needed to sustain initial efficiency improvements captured through the implementation of productivity strategies.

4 Energy

Chapter contents



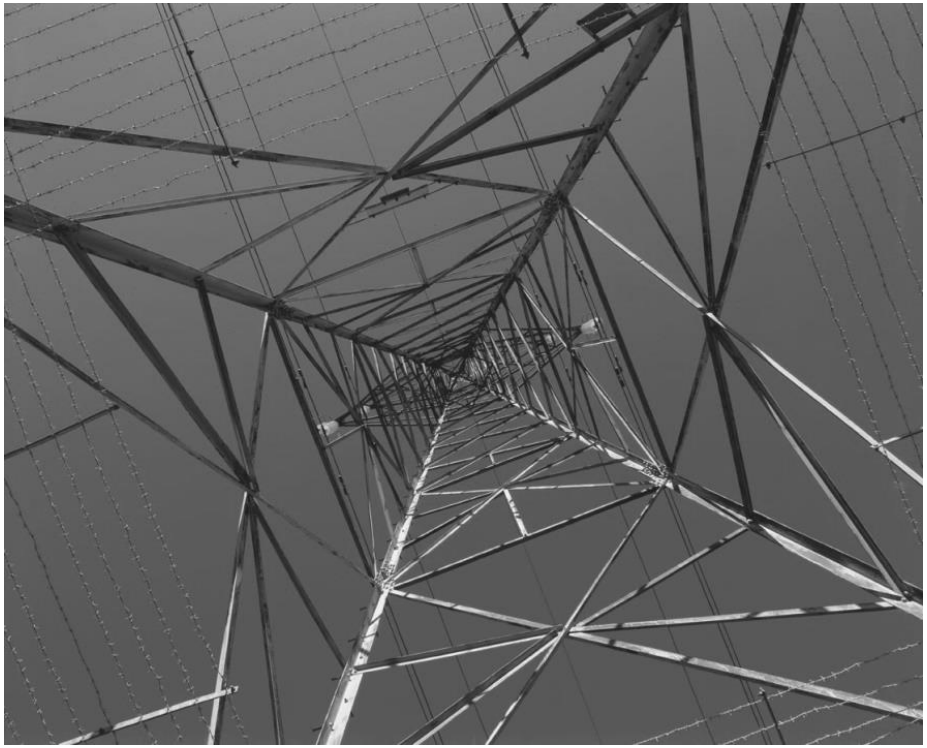

4.1 Chapter summary

Key trends

- Western Australia was one of only three States to record an increase in its energy consumption in 2012-13, increasing to 1,035 PJ and accounting for 17.6% of national energy consumption. The increase has been driven by consumption in the resources sector.
- Over the last four decades, the mix and magnitude of energy consumption in the Western Australian resources sector has changed markedly. Energy consumed has increased from 22 PJ in 1973-74 to 223 PJ in 2012-13. In this period, natural gas has emerged as the key energy source, and now comprises 43% of resources sector consumption.
- Primary energy consumption in the resources sector is expected to grow from 223 PJ in 2013 to 267 PJ by 2025, at an annualised rate of 1.5%.
- The expansion of resources sector consumption from 2013 to 2020 will be driven by a 41 PJ increase in natural gas. The use of diesel is also expected to rise by 14 PJ over this period. These incremental changes should see natural gas replace diesel as the main source of energy in the sector by 2020.
- The forecast rise in gas consumption could result in tight market conditions in the medium term according to the Independent Market Operator's (IMO) forecast 'low' supply scenario outlined in the January 2014 *Gas Statement of Opportunities* (GSOO).
- With regard to electricity, Western Australia consumed 32,270 GWh in 2012-13, up by 2.6% from the previous financial year. In the last 10 years consumption has grown at an annual rate of 5%.
- In the last two decades, electricity consumption in the State's resources sector has risen from 3,700 GWh to 11,700 GWh. The sector's sharp growth in consumption reflects the record investment in minerals production capacity expansion in recent years.
- Electricity consumption in the resources sector is expected to grow from 11,712 GWh in 2013 to 17,362 GWh by 2025, representing an annualised rate of growth of 3.3%.
- The growth in resources sector consumption to 2020 will be sourced primarily from self-generated electricity increasing by 3,300 GWh to 2020 over 2013 levels. Purchased electricity is also envisaged to increase by 2,300 GWh over 2013 levels.
- Consumption of diesel is forecast to decline as a fuel source for electricity generation, from 16% of consumption in 2013 to 9% by 2020. This is forecast to be replaced by natural gas-fired generation (increasing from 82% to 87%).

Regional overview

- Energy consumption in the Pilbara is expected to increase as a number of key operators ramp up production. By 2020, the use of natural gas is forecast to rise by 41 PJ above 2013 levels, while diesel is expected to increase by 20 PJ.
- By 2020, the resources sector in the Pilbara is expected to source an extra 2,300 GWh in self-generated electricity and 1,750 GWh in purchased electricity compared to 2013 levels.
- Energy consumption in the Goldfields-Esperance region is expected to rise in the short term, before falling 7 PJ below 2013 levels by 2020. The decline will be driven by a reduction in the consumption of diesel.
- Similarly, electricity consumption is expected to rise in the Goldfields-Esperance region over the short term, by 450 GWh in 2014 over 2013 levels. Unlike energy consumption, electricity consumption is forecast to maintain this increment through to 2020.
- The Mid West is projected to see a significant increase in electricity consumption from 2020. By 2020 it is forecast to reach 520 GWh above 2013 levels. However, the change in overall primary energy consumption is expected to be negligible during this period.



Summary of policy implications and opportunities

1. **The energy mix within the resources sector over the medium term is forecast to change from diesel to natural gas.**

   While Western Australia has utilised gas-fired electricity generation for a number of years, facilitating the uptake of gas in mobile plant creates a new opportunity for the State to position itself as a leader in related technologies.

   Governments should seek to work collaboratively with industry to support emerging technologies which enable use of natural gas in mobile plant.

2. **Significant forecast growth in natural gas consumption in Western Australia supports the development of shale and tight gas resources.**

   Under a low supply scenario the domestic market for gas may experience tight conditions in the medium term. As such the State Government should ensure a streamlined approvals process for new processing and pipeline capacity.

   In particular, the State's significant resources of shale and tight gas in the Canning Basin may have a role to play in meeting future demand for natural gas. Governments can also assist in unlocking these reserves by continuing to focus efforts on reducing cost and regulatory barriers to improve commercially viability.

3. **Electricity consumption is projected to increase in the Pilbara, with growth underpinned by both self-generation and purchased sources.**

   Current forecasts illustrate a growing trend towards purchased sources of electricity. The shift to increased purchases in the north west of the State (in particular) has occurred with minimal direct government intervention, illustrating the importance of allowing commercial arrangements to determine the development of the Pilbara's system of power supply, including interconnectivity.

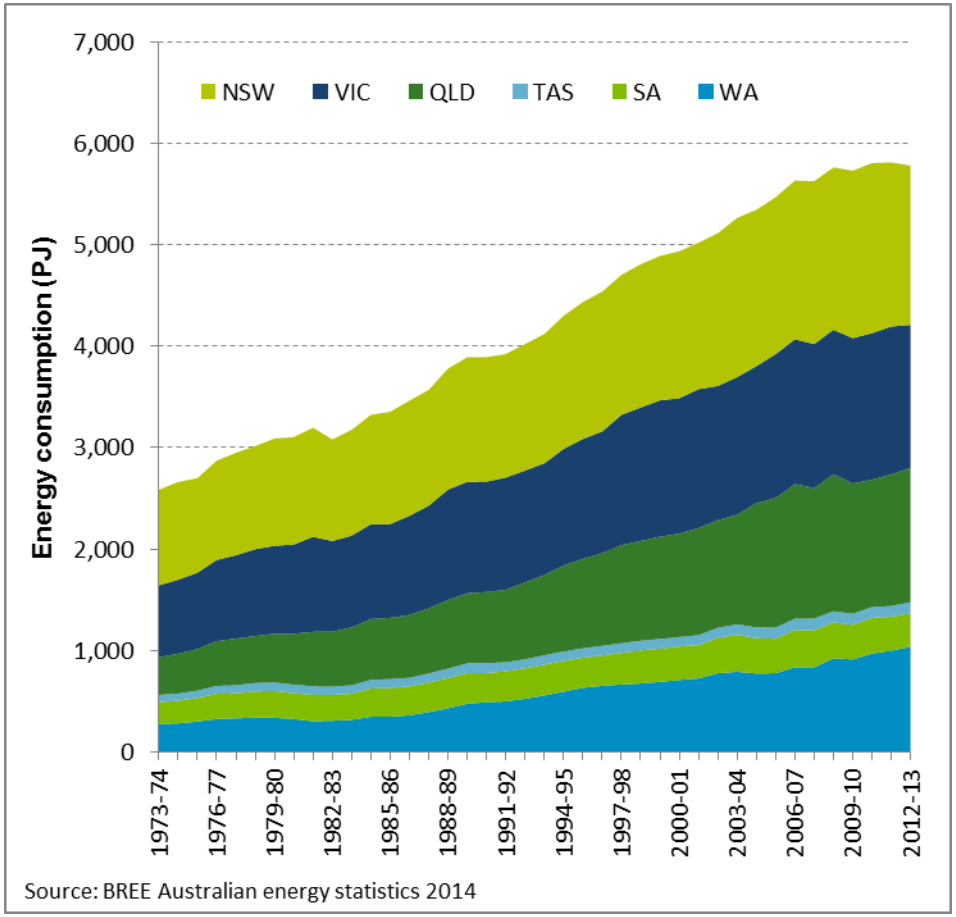
4. **The Electricity Market Review may have important implications for industrial users in the SWIS.**

   Although most of the electricity consumed in the resources sector does not originate in the SWIS, the review may have consequences for those participants in the sector that draw energy from the SWIS, as well as companies in the broader supply chain. Any reforms which lower energy costs will help to improve the competitiveness of the resources sector.

4.2 Past trends - Energy

4.2.1 National energy consumption

Net energy consumption, by Australian state



Source: BREE Australian energy statistics 2014

Western Australia was one of only three States to record an increase in its energy consumption in 2012-13.

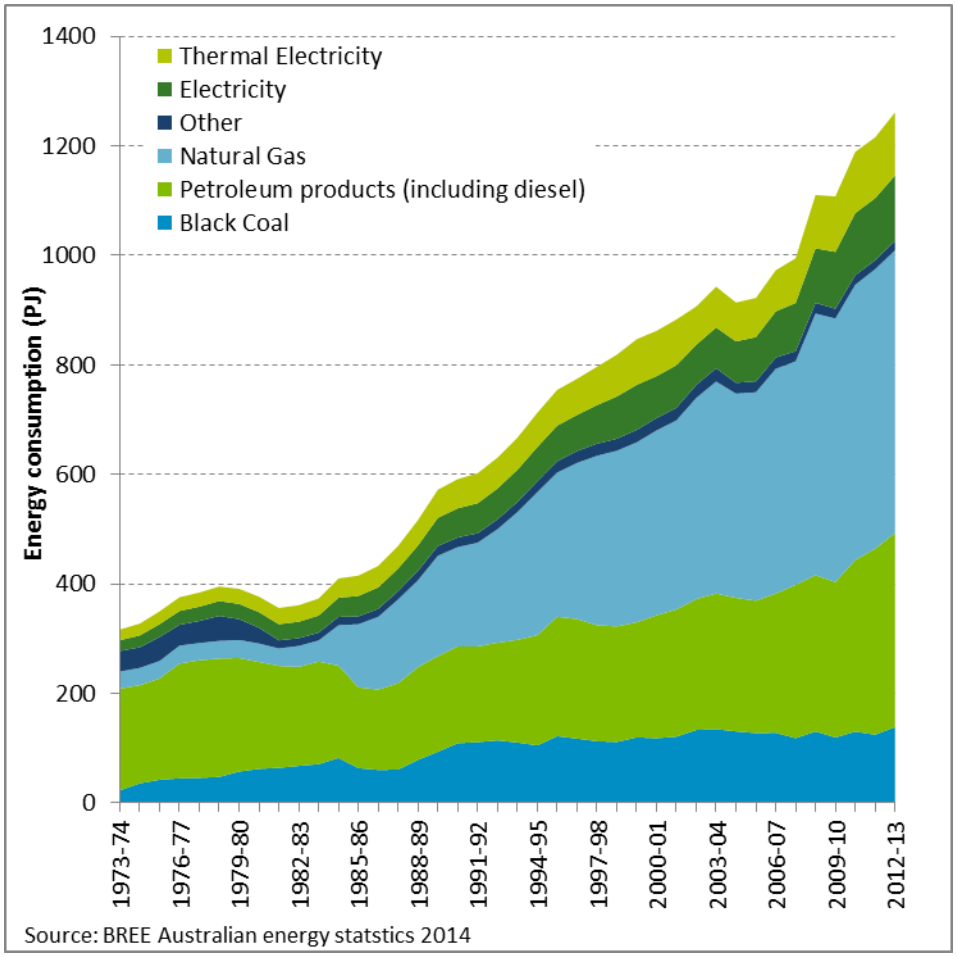
Western Australia consumed 1,035 petajoules (PJ) of energy in 2012-13. Australian energy consumption grew at a compound annual growth rate of 1.3% in the last decade to 5,884 PJ. Over the same period, Western Australian consumption grew at 3.0%, more than double the national average.

As a result, Western Australia's share of national energy consumption has grown from 12.8% to 17.6%[31]. A comparison to the State's share of the national population, which is currently 10.9%[32], highlights the relative energy intensity of Western Australia's largest value-adding industries, including the resources sector.

[31] BREE Australian energy statistics 2014
[32] ABS catalogue 3101.0

4.2.2 Western Australian energy consumption

Western Australian gross energy consumption, by fuel type



Source: BREE Australian energy statstics 2014

Natural gas continues to increase in importance as the major energy source in Western Australia.

Approximately 516 PJ of natural gas was consumed in Western Australia in 2012-13, 41% of total energy consumption[33].

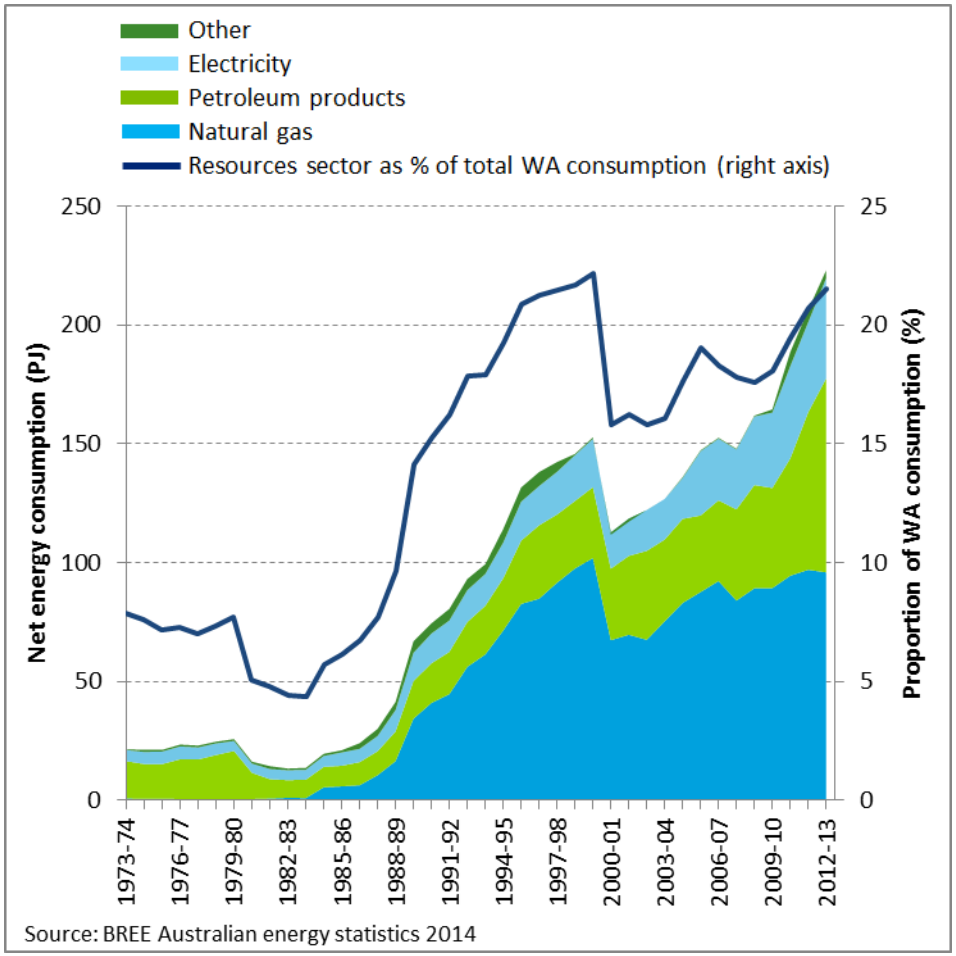
Petroleum products (mostly diesel) and black coal are the next two largest energy sources, accounting for a combined 355 PJ.

In the last 20 years, natural gas has increased its shares of total energy consumption from 33% to 41% (a CAGR of 4.7%). Petroleum products have also grown over this period (a CAGR of 3.5%); however their share of the State's overall energy mix has decreased from 34% to 32%. Black coal has decreased its share over the same period from 22% to 13%.

[33] BREE Australian energy statistics 2014

4.2.3 Resources sector energy consumption

Western Australian resources sector net energy consumption, by fuel type



The mix and magnitude of energy consumption in the Western Australian resources sector have changed markedly over the last four decades.

Energy consumed by the resources sector has increased from 22 PJ in 1973-74 to 223 PJ in 2012-13 almost tripling the sector's share of total Western Australian energy consumption, from 7.8% to 21.2%[34].

During the same period, natural gas has emerged as the key energy source consumed by the resources sector. Natural gas consumption has increased its share of energy consumption from negligible in 1973-74 to 43% in 2012-13.

However, petroleum products still play a major role, with consumption of these inputs having increased by 420% over the same period to 82 PJ in 2012-13.

[34] BREE Australian energy statistics 2014

4.2.4 Natural gas – domestic gas supply

Sources of domestic supply by supplier

Company	*Estimated Average Supply to Domestic Market (TJ/day)*
NWS North West Shelf JV (Operator Woodside)	443.6
Apache Energy	197.0
Santos	183.1
BHP Billiton	156.9
Kufpec	10.1
Origin Energy	6.8
AWE Limited	5.8
Empire Oil and Gas	5.8
ERM Power	1.8

Source: Independent Market Operator Gas Statement of Opportunities 2014

Potential domestic gas production facilities

Company	*Operator*	*Anticipated Completion*
Gorgon Domestic	Chevron	2016 (Tranche 1) and 2021 (Tranche 2)
Wheatstone Domestic	Chevron	2018
Warro	Transerv Energy	Currently under evaluation
Pluto Domestic	Woodside	Currently under evaluation
Yullerro / Valhalla	Buru Energy	Currently under evaluation

Source: Independent Market Operator Gas Statement of Opportunities 2014

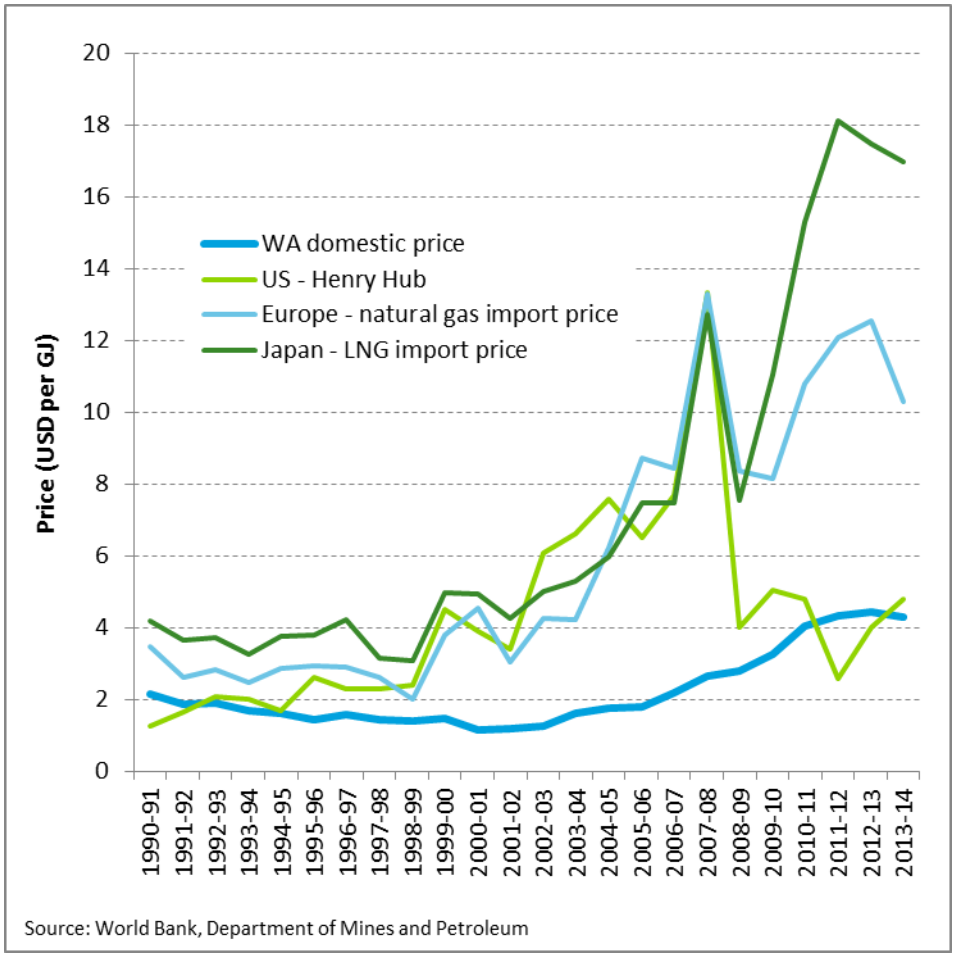
Nine participants currently supply Western Australia's domestic gas market – approximately 1,000 terajoules per day (TJ/d).

This supply is provided into the market via eight domestic gas production facilities. In the future, the State's gas production capacity is expected to expand, with the development of additional production facilities at Chevron's Gorgon and Wheatstone gas projects.

Other proposed facilities are still awaiting final investment decision and will only proceed subject to commercial viability.

4.2.5 Natural gas – price conditions

Western Australian domestic natural gas prices and key global prices



Source: World Bank, Department of Mines and Petroleum

Wholesale natural gas prices in Western Australia have increased in recent years as legacy contracts expire and new supply is priced higher.

The Western Australian domestic market has been characterised by long term bilateral contracts. Historically, many of Western Australia's large domestic gas consumers have been supplied via long term contracts with the North West Shelf Joint Venture.

These legacy contracts were indexed to local inflation indicators and averaged around AUD$2-3 per GJ[35]. However, a number of these contracts have expired and more are expected to expire in 2020[36].

New contracts are expected to be higher than historical prices. However, it is difficult to determine accurate wholesale prices in the Western Australian domestic gas market due to the relatively few market participants and comparatively small volumes traded through spot market platforms.

The number of participants in the domestic market is increasing and further improvements to market transparency and liquidity will foster further competition and price discovery.

[35] Economics and Industry Standing Committee, 2011, Inquiry into domestic gas prices. Report No. 6 in the 38th Parliament

[36] IMO Gas Statement of Opportunities, 2014

4.2.6 Natural gas – transmission pipelines

Major operational and planned transmission pipelines

Pipeline	*Operator*	*Capacity (TJ/d)*	*Length (km)*	*Completed/ Planned Completion*
Dampier to Bunbury	DBNGP Transmission	845	1,828	1984
Great Northern	Buru Energy	~200	~550-630	Planned
Pilbara Pipeline System	APA Group (Epic Energy)	166	219	1995
Goldfields Gas	APA Group	155	1,380	1995
Parmelia Pipeline	APA Group	65.4	417	1971
Fortescue River Gas	DDG Fortescue River Pty Ltd	64	270	2015
Tropicana Gas Pipeline	APA Group	TBC	292	2016

Source: IMO Gas Statement of Opportunities 2014, Deloitte Access Economics

Western Australia has four main gas transmission pipelines which transport gas from processing facilities in the North West to regions around the State.

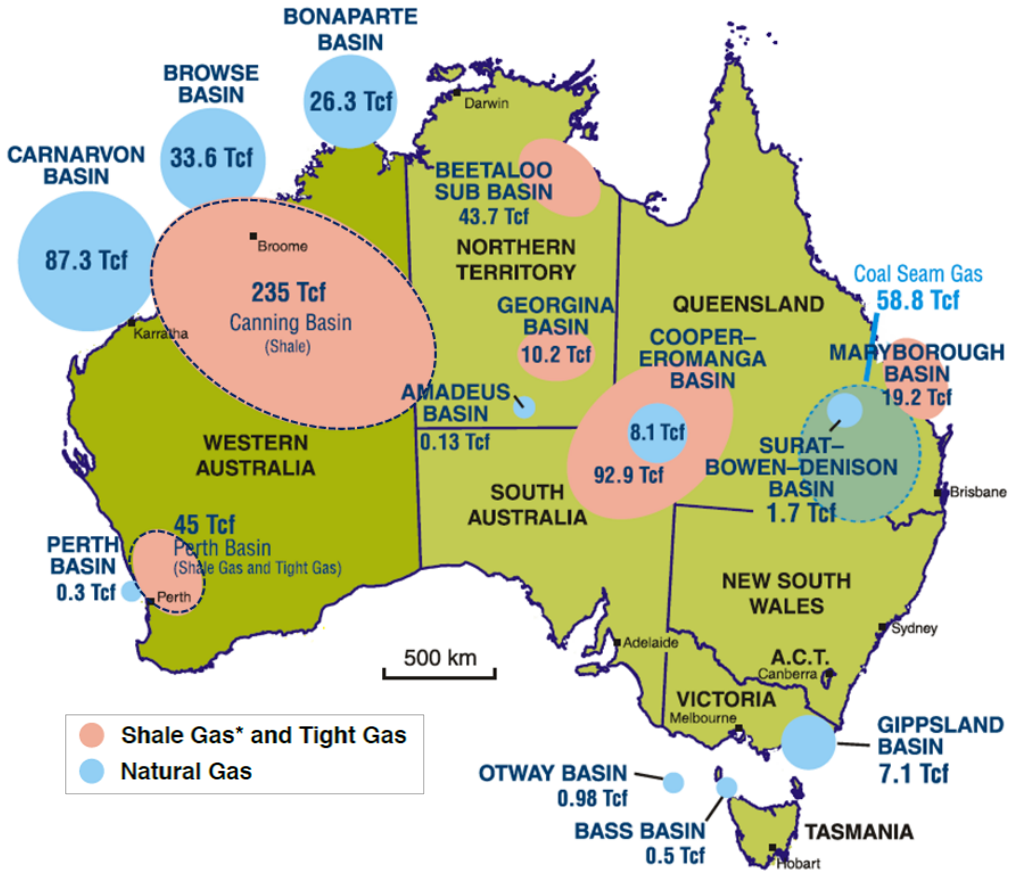
The Dampier to Bunbury Natural Gas Pipeline (DBNGP), Goldfields Gas Pipeline, Parmelia Pipeline and the Pilbara Pipeline systems are the State's major transmission pipelines.

The State's largest pipeline, the DBNGP, has the capacity to ship almost 845 TJ/d. Between them, the DBNGP and the Goldfields Gas Pipeline are estimated to transport approximately 90% of domestic gas produced in Western Australia.

Looking forward, the Great Northern Pipeline, proposed by a consortium led by Buru Energy, is planned to transport shale and tight gas reserves from the Canning Basin. Once developed it will become the State's second largest transmission pipeline (with a nameplate capacity 200 TJ/d).

4.2.7 Natural gas - shale and tight gas

Australian natural gas resources, July 2013



Source: Department of Mines and Petroleum, EnergyQuest.
Note: Data is current as at July 2013, and shale gas and tight gas volumes are estimates only
*From US EIA world shale gas and oil resources assessment 2013

Although most of the State's gas production for domestic consumption and export is from offshore fields, there are potentially significant onshore shale and tight gas resources in Western Australia.

Indications suggest there is potentially twice as much gas available onshore in Western Australia as there is offshore[37].

The onshore Canning Basin potentially contains up to 235 trillion cubic feet (TCF) of recoverable shale and tight gas (accounting for 85% of total estimated shale and tight gas deposits in the State, and over half of all estimated unconventional gas resources in Australia). This is equivalent to almost 500 years of domestic gas supply based on current consumption levels[38] and would make the basin one of the five biggest shale and tight gas resources in the world[39].

Successful commercialisation of this resource presents a major opportunity for Western Australia's oil and gas sector. However, the region surrounding the Canning Basin is challenging due to its remoteness, limited availability of services, absence of major infrastructure and adverse weather conditions. All these aspects add to the cost of exploration and development in the region.

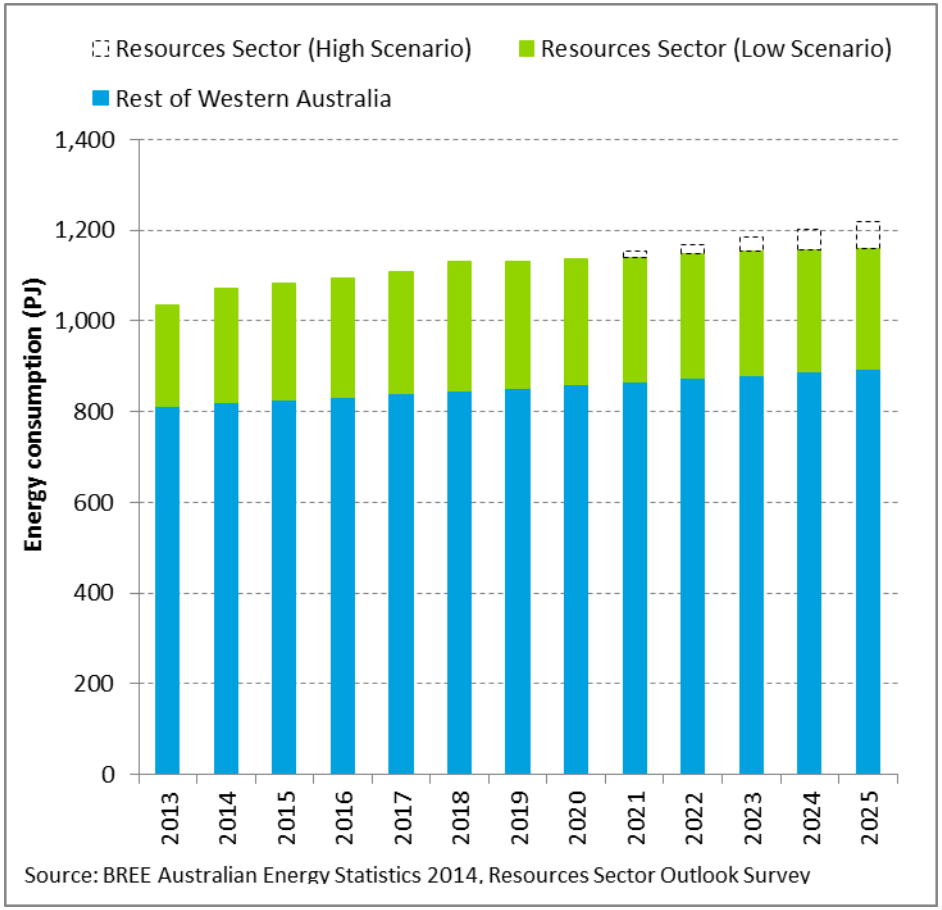
The remainder of the State's recoverable shale and tight gas reserves are located in the Perth Basin, which contains an estimated 45 TCF of unconventional gas. Infrastructure in the Perth Basin is well developed, being located closer to Perth.

[37] Department of Mines and Petroleum, EnergyQuest
[38] Department of Mines and Petroleum, *Progress for Canning Basin Exploration*, November 2013
[39] Emerging Unconventional Shale Plays in Western Australia, Ameed Ghori, Senior Geologist, Department of Mines and Petroleum of Western Australia, 2013 APPEA Journal

4.3 Future trends – Energy

4.3.1 Western Australian consumption

Western Australian energy consumption[40]



Primary energy consumption in the Western Australian resources sector is forecast to continue on an upward growth trajectory.

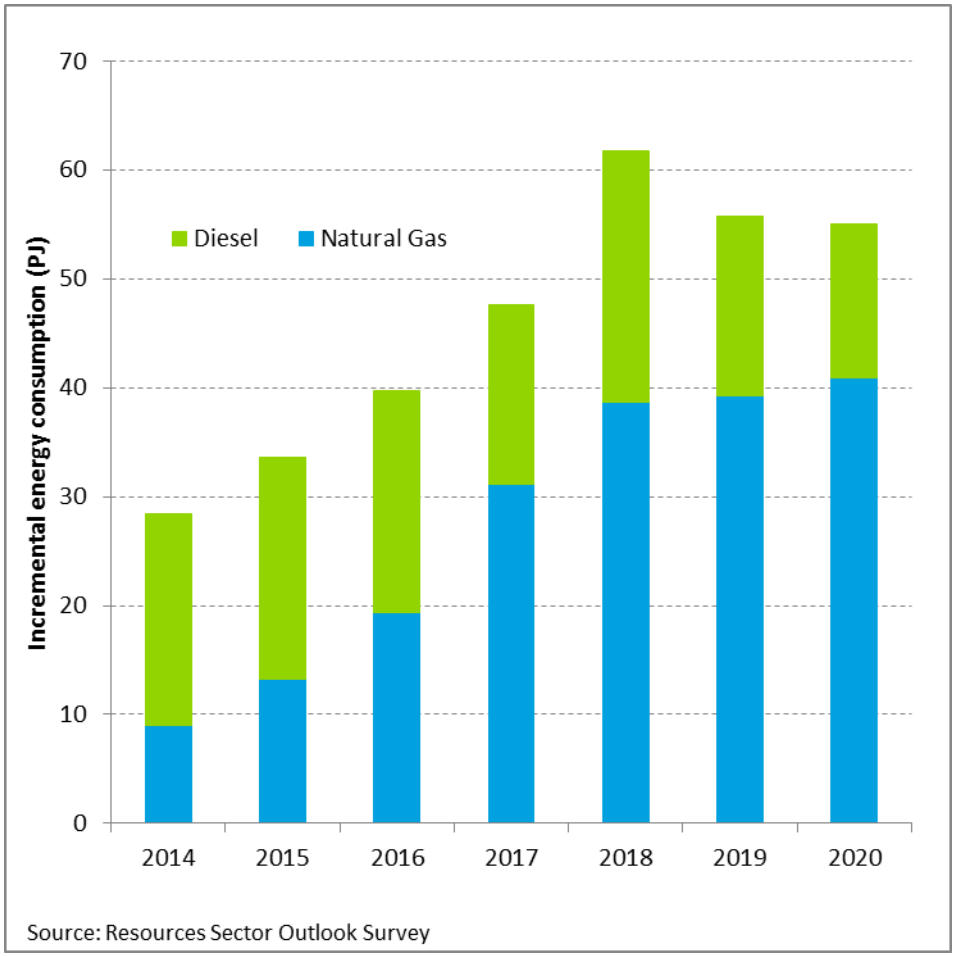
Primary energy consumption in the resources sector (excluding gas used in gas production and processing) is expected to grow from 223 PJ in 2013 to 267 PJ by 2025, at an annualised rate of 1.5%. This forecast rate of growth is substantially higher than the forecast rate of increase by the Bureau of Resource and Energy Economics (BREE) for the broader Western Australian economy as part of its national energy projections of 0.8%.

Under the low scenario, total energy consumption in Western Australia is forecast to reach 1,160 PJ by 2025, and 1,219 PJ under the high scenario.

[40] Growth in consumption in the 'rest of Western Australia' is increased beyond 2020 by the rate estimated by BREE in its Australian Energy projections, at 0.8%. The low scenario contains the forecast energy demand indicated by the sector; the high scenario assumes the average annual growth rate for the resource sector between 2013 and 2020 continues through to 2025.

4.3.2 Energy consumption

Western Australian resources sector energy consumption, increment from 2013[41]



As primary energy consumption in the resources sector expands in the future, the sector is expected to show an increasing preference for natural gas over diesel.

Demand for both diesel and natural gas in the resources sector is forecast to rise significantly in the short term. By 2016, usage of both fuels will have increased by approximately 20 PJ each.

Beyond 2016, a shift in demand is expected. Consumption of natural gas is projected to continue its upward trend and, by 2020, is forecast to rise by 41 PJ compared to 2013 consumption. However, much of this increase will represent a switch away from diesel. By 2020, consumption of diesel is forecast to be only 14 PJ above 2013 levels, representing an aggregate drop from 2016.

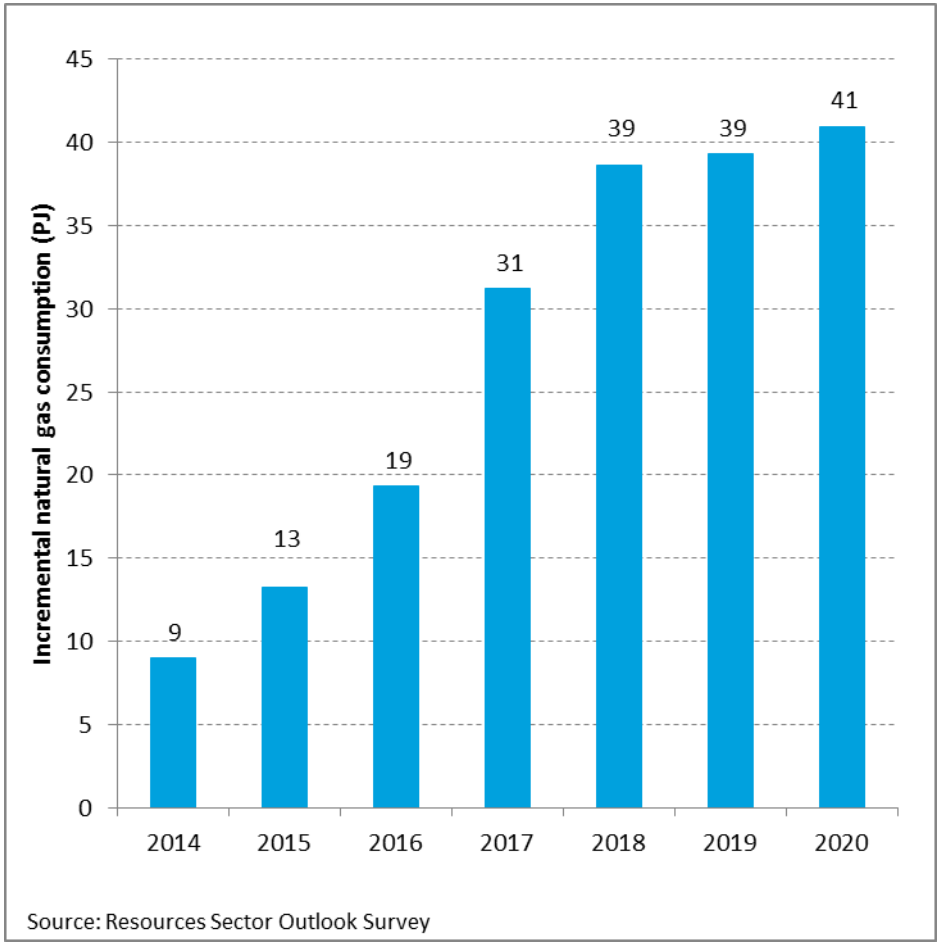
The incremental changes in demand from 2013 should see natural gas replace diesel as the main source of energy in the resources sector by 2020. Examining these two fuels alone, it is estimated that the proportion of natural gas will rise from 48% to 52% over this period, while diesel will shrink from 52% to 48%.

Other fuel sources are forecast to remain negligible as a proportion of total resources sector energy consumption.

[41] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

4.3.3 Natural gas consumption

Western Australian resources sector natural gas consumption, increment from 2013[42]



Consumption of natural gas in the resources sector is forecast to rise substantially over the medium term, driven by increasing onsite electricity generation and use in mobile plant.

Approximately 41 PJ of additional gas is forecast to be consumed by the resources sector in 2020 compared to 2013 levels.

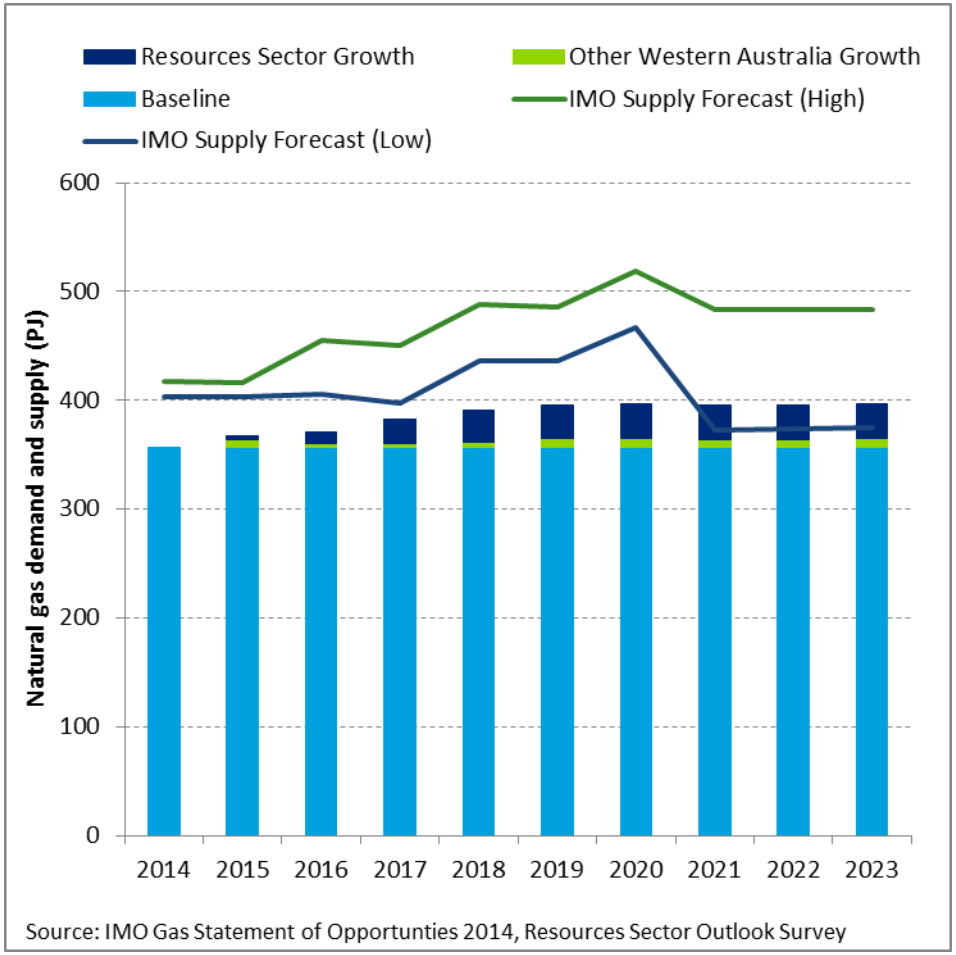
Stronger demand for natural gas will be driven by increased onsite electricity generation and by the operation of mobile plant and equipment.

This forecast differs from projections prepared by the IMO in their January 2014 GSOO, where the base demand scenario shows total demand for natural gas in Western Australia increasing by 13 PJ between 2014 and 2020. The difference in forecasts may reflect that the IMO only incorporates switching to natural gas in forecasts once a decision has been announced by an operator.

[42] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

4.3.4 Natural gas demand and supply

Total Western Australian natural gas demand and supply forecast



Source: IMO Gas Statement of Opportunties 2014, Resources Sector Outlook Survey

The forecast for a sharp rise in gas consumption by the resources sector suggests tight market conditions could emerge in the medium term.

In its 2014 GSOO, the IMO developed a potential high and low gas supply scenario for Western Australia to 2023 to reflect uncertainties in future supply dynamics.

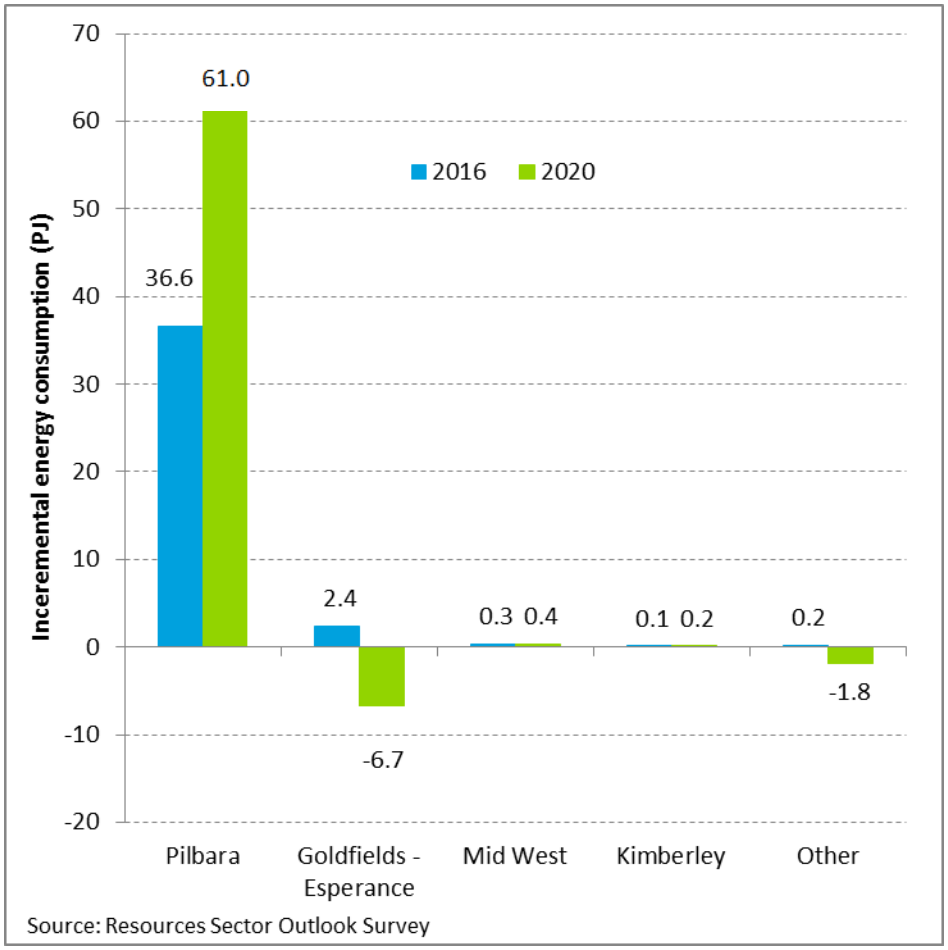
Overlaying these supply scenarios with the Resources Sector Outlook demand forecast[43] shows the potential for some market tightness to emerge in the early 2020s under the low supply scenario.

As with all forecasts, should the IMO's assumptions not be met, the supply outcomes could differ substantially from the high and low supply cases presented.

[43] Baseline demand is established from the IMO's GSOO estimate. Resource sector natural gas demand is shown at the rate indicated by the Resources Sector Outlook Survey. Other Western Australian natural gas demand is shown at a rate derived from GSOO forecasts.

4.3.5 Regional energy consumption

Western Australian regional resources sector energy consumption, increment from 2013[44]



The Pilbara is forecast to see a significant increase in primary energy consumption to 2020.

Forecast growth in primary energy consumption in the Pilbara region is underpinned by the completion of mining and energy expansion projects.

Consumption is expected to rise as new production capacity in the region comes online and as some existing projects switch to gas over time. An additional 36.6 PJ of energy is forecast to be consumed by resources sector companies in the Pilbara by 2016 compared to 2013, and an additional 61 PJ by 2020 from 2013 levels.

Operators in the Goldfields-Esperance region are also expected to increase their energy consumption by 2.4 PJ to 2016. However, by 2020 energy consumption in the region is forecast to fall below 2013 levels.

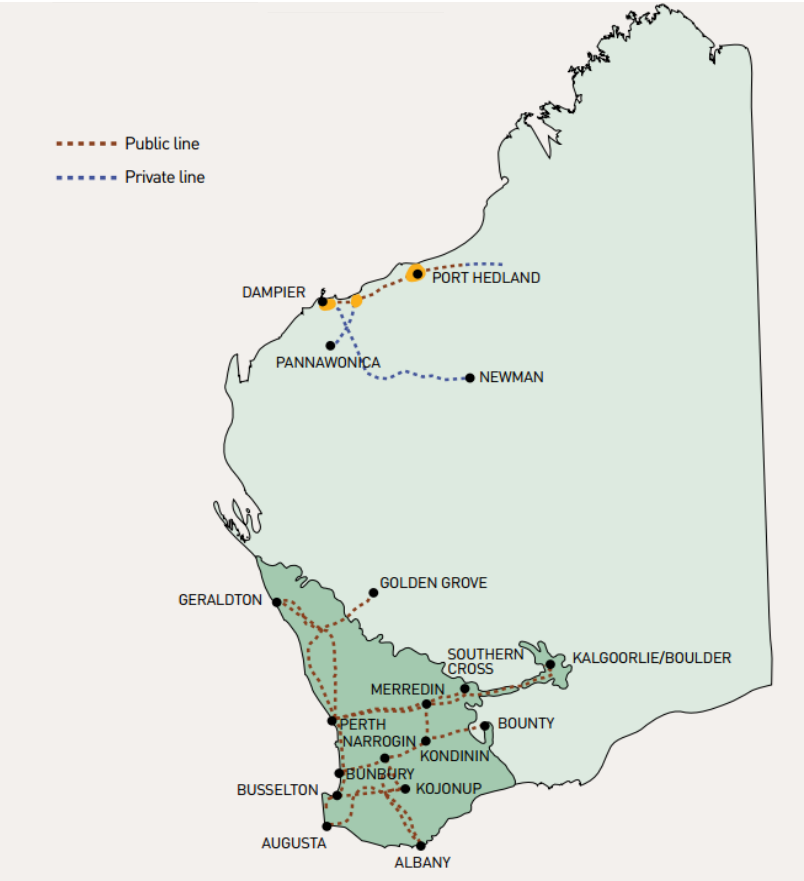
The Mid West and Kimberley regions are forecast to see a small increase in energy consumption to 2020. Although operators in the South West are large energy consumers, their energy demands are estimated to remain steady over the forecast period.

[44] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013. 'Other' includes the Gascoyne, Great Southern, Peel, South West and Wheatbelt regions

4.4 Past trends – Electricity

4.4.1 Electricity market

Electricity infrastructure map, Western Australia



Source: Australian Energy Regulator

[45] Western Power Annual Report 2013
[46] Horizon Annual Report 2012-13

Western Australia has several distinct electricity infrastructure systems that reflect the geography, industry and demographic profile of the State. The primary network in Western Australia is the SWIS.

The SWIS serves approximately 927,000 residential customers, 94,000 small to medium enterprises and 29,000 large commercial customers. The network was estimated to have a generation capacity of 6,087 Megawatts (MW) in 2013-14, with 7,400 km of transmission lines and 902,200 km of distribution lines. In 2013, the SWIS was estimated to have transported 17,083 gigawatt hours (GWh) of electricity.[45]

Western Australia has several other publicly and privately owned electricity networks and systems, principally around the regional centres of Karratha, Port Hedland, Kununurra and Esperance. There are a further 32 isolated systems supplying other regional towns and remote communities.[46]

In March 2014, the State Government launched the Electricity Market Review to examine the structure of the electricity sector across generation, wholesale and retail markets within the SWIS, and to consider the incentives for industry participants to make efficient investments and minimise costs. The review may have important implications for the resources sector, particularly in terms of competition and the related cost of electricity.

4.4.2 Western Australian electricity consumption

Western Australian electricity consumption, by fuel source (GWh)

	2010-11	*2011-12*	*2012-13*
Non Renewable Fuels	30,911	30,565	31,823
Black Coal	10,352	10,783	10,277
Natural Gas	18,116	17,538	17,645
Other	2,443	2,244	3,900
Renewable Fuels	751	879	1,448
Biogas	112	126	108
Wind	441	422	669
Hydro	-	-	221
Solar PV	198	331	449
Total State Consumption	31,662	31,444	32,270
Proportion Consumed from Renewables	2.4%	2.8%	4.4%

Source: BREE Energy Statistics 2014

Western Australia has seen strong growth in electricity consumption in the past 10 years, although its renewable generation profile remains different from Australia overall.

Western Australia generates 53% of its electricity needs from natural gas and 31% from black coal, with the remainder generated from oil products and renewable sources.

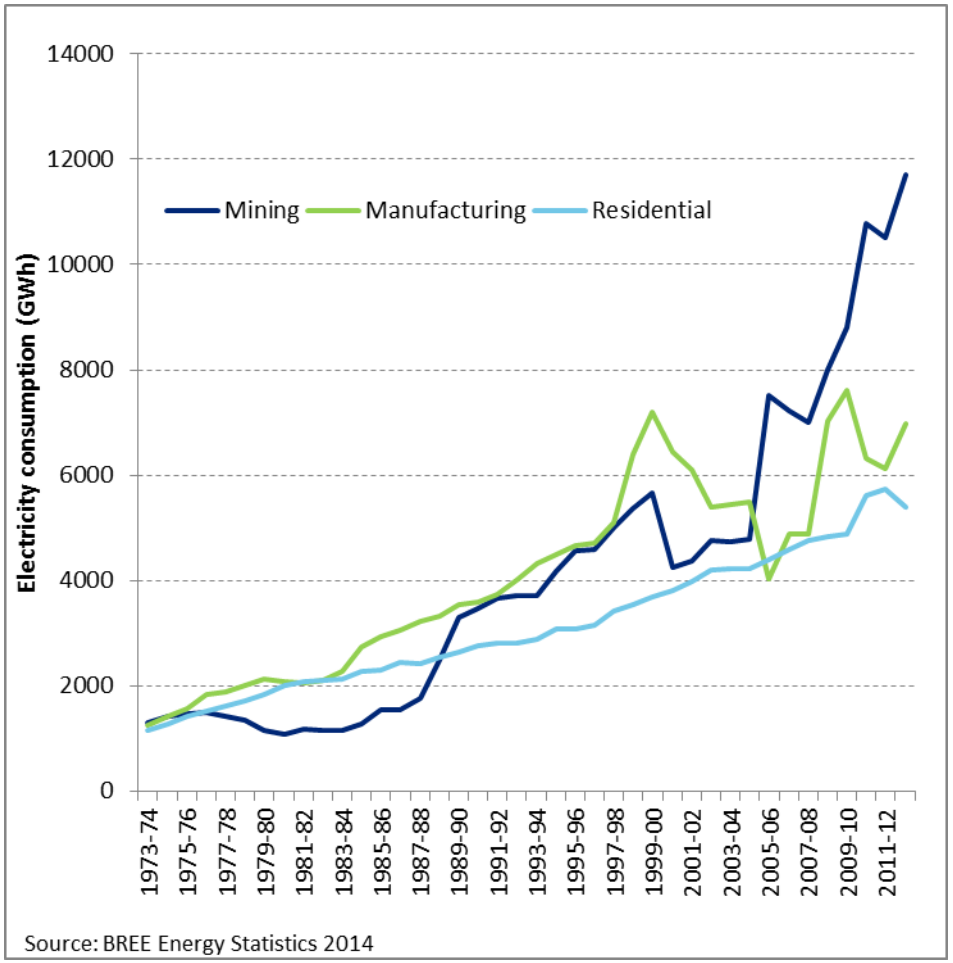
In 2012-13, Western Australia consumed a total of 32,270 GWh of electricity, up 2.6% from the previous financial year. This follows a marginal decline in 2011-12 of 0.6%.

Over a longer term, Western Australia has recorded strong growth in electricity consumption with an annualised growth rate of 5.0% over the last 10 years to 2012-13.

Renewable sources of energy for electricity generation in the State remain only a small percentage of total generation sources. Just 4.4% of the total load came from renewable sources in 2012-13 in Western Australia compared to a share of 13.1% of generation in the broader Australian market.

4.4.3 Electricity consumption by industry

Western Australian electricity consumption, by industry



The record investment in minerals production capacity expansion in the resources sector in recent years is reflected in an increasing share of State electricity consumption.

In the last two decades, electricity consumption in the State's resources sector has risen from 3,700 GWh to 11,700 GWh. In the last decade electricity consumption in the sector has accelerated (CAGR of 9.3%).

Comparatively, electricity consumption by the manufacturing sector has increased from 4,000 GWh to 7,000 GWh over the last 20 years.

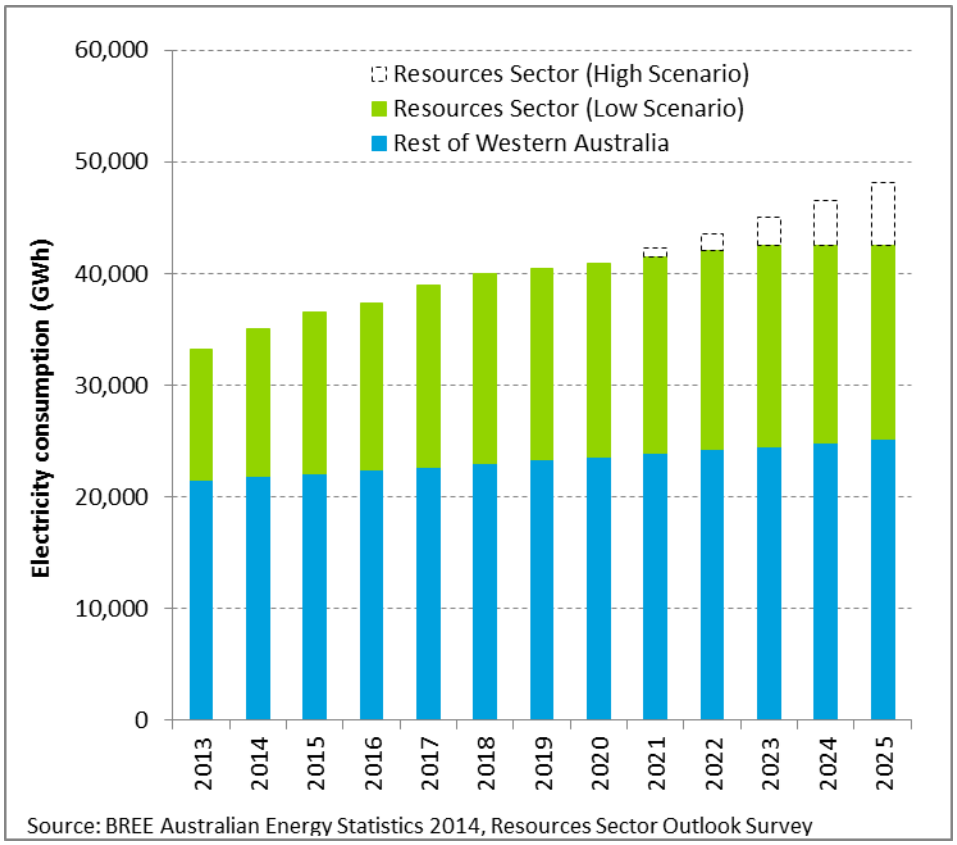
Residential consumption has increased steadily over the last 10 years. The annualised rate of residential consumption growth of 2.5% is consistent with population growth in Western Australia over the same period which has grown at 2.6% per annum[47].

[47] ABS catalogue 3101.0

4.5 Future trends – Electricity

4.5.1 Western Australian consumption

Western Australian electricity consumption[48]



Source: BREE Australian Energy Statistics 2014, Resources Sector Outlook Survey

Electricity consumption in the State's resources sector is projected to continue on a steady growth trajectory in future.

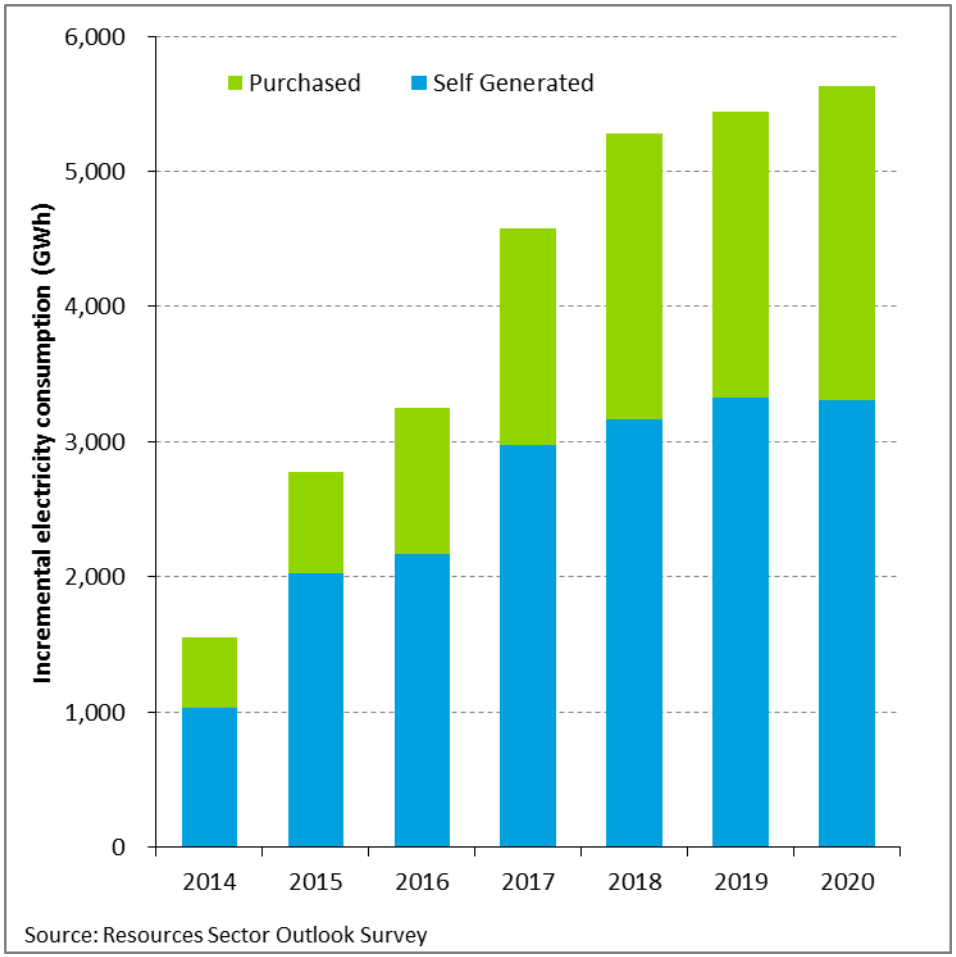
Electricity consumption in the resources sector is expected to grow from 11,712 GWh in 2013 to 17,362 GWh by 2025, representing an annualised rate of growth of 3.3%.

Under the low scenario for consumption in the resources sector, total Western Australian electricity consumption is expected to reach 42,535 GWh in 2020. Under the high scenario, electricity consumption would be 48,122 GWh.

[48] Forecasts provided by survey respondents beyond 2020 were not considered sufficiently reliable due to challenges in compiling long term forecasts of energy consumption. Therefore, a 'high' and a 'low' scenario were developed for projections beyond 2020. For both scenarios, growth in electricity consumption beyond 2020 in the 'rest of Western Australia' is elevated by 1.3% p.a. – the growth rate estimated by BREE in its Australian Energy projections. For the low scenario, the resources sector component is elevated by the rate of industrial consumption growth, also estimated by BREE. For the high scenario, a consumption growth rate for the resources sector of 5.7% per annum is applied, being the rate of growth forecast by survey respondents for the period 2013 to 2020.

4.5.2 Electricity consumption

Western Australian resources sector electricity consumption, increment from 2013[49]



Projected growth in electricity consumption by the resources sector is driven by incremental increases in both self-generated and purchased electricity.

Electricity consumption by the resources sector in Western Australia is forecast to rise by 5,600 GWh by 2020 compared to 2013 levels. This growth represents 73% of the State's forecasts electricity growth.

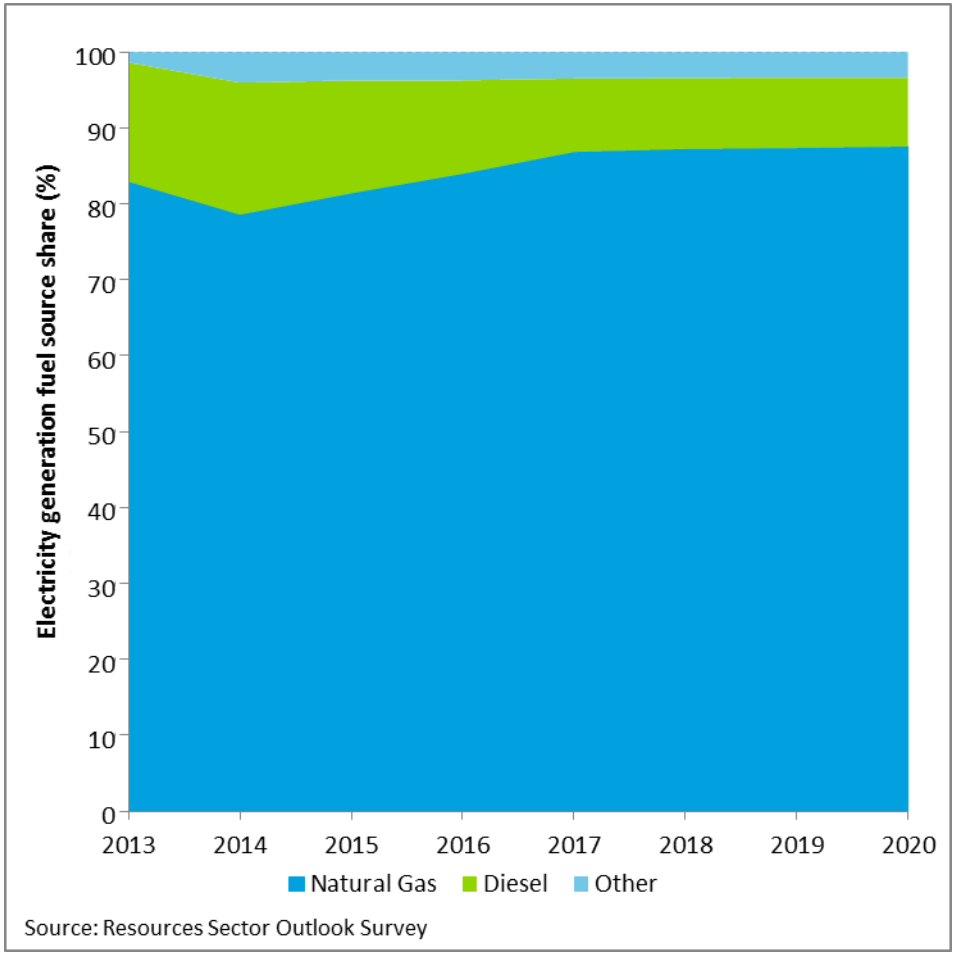
Self-generated electricity is expected to rise by over 3,300 GWh by 2020 compared to 2013 levels.

While self-generated electricity has historically tended to characterise growth in electricity consumption in the resources sector, purchased electricity is now also envisaged to escalate over the same period by 2,300 GWh above 2013 levels.

[49] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

4.5.3 Self-generated electricity fuel sources

Western Australian resources sector self-generated electricity, share by fuel type



Source: Resources Sector Outlook Survey

Diesel is forecast to decline as a fuel source for self-generated electricity through to 2020.

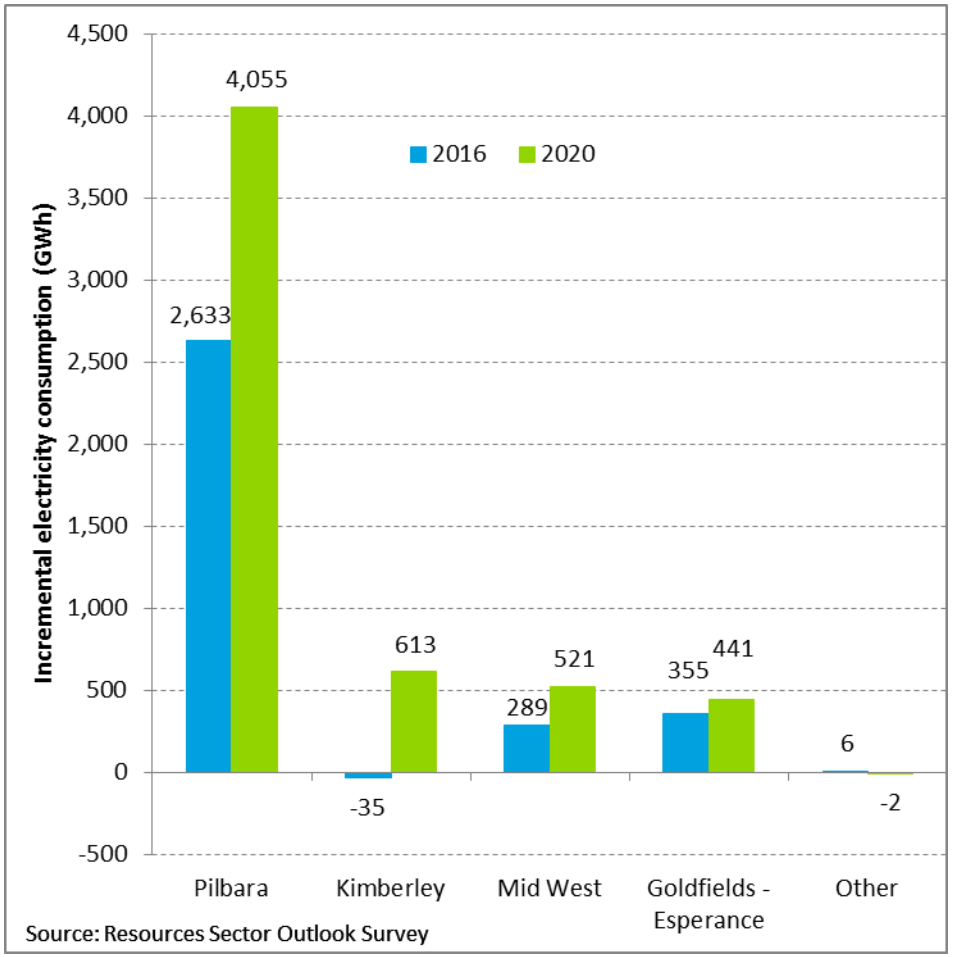
In addition to a declining reliance on diesel as a fuel source for mobile plant, diesel use for self-generated electricity is forecast to decline from 16% in 2013 to 9% in 2020.

The use of natural gas in self-generated electricity production is projected to increase from just under 82% of total generation in 2013 to 87% by 2020.

Other sources of energy for self-generation such as solar generation are expected to remain small at around 4% of total generation by 2020.

4.5.4 Regional electricity consumption

Western Australian resources sector electricity consumption by region, increment from 2013[50]



Forecast growth in electricity consumption in Western Australia's resources sector is underpinned by higher consumption in the Pilbara.

Electricity consumption in the Pilbara is expected to increase by over 4,000 GWh to 2020, accounting for more than 70% of the projected incremental demand in the resources sector over this period.

The Kimberley, Mid West and Goldfields-Esperance regions are also forecast to increase their consumption of electricity through to 2020 by 613 GWh, 521 GWh and 441 GWh, respectively.

Similar to total energy demand, electricity consumption in the South West is forecast to remain fairly constant through to 2020 compared to 2013 levels.

Through to 2020, more than 90% of the projected demand for electricity in the resources sector is forecast to originate from regions outside the SWIS geographical area[51].

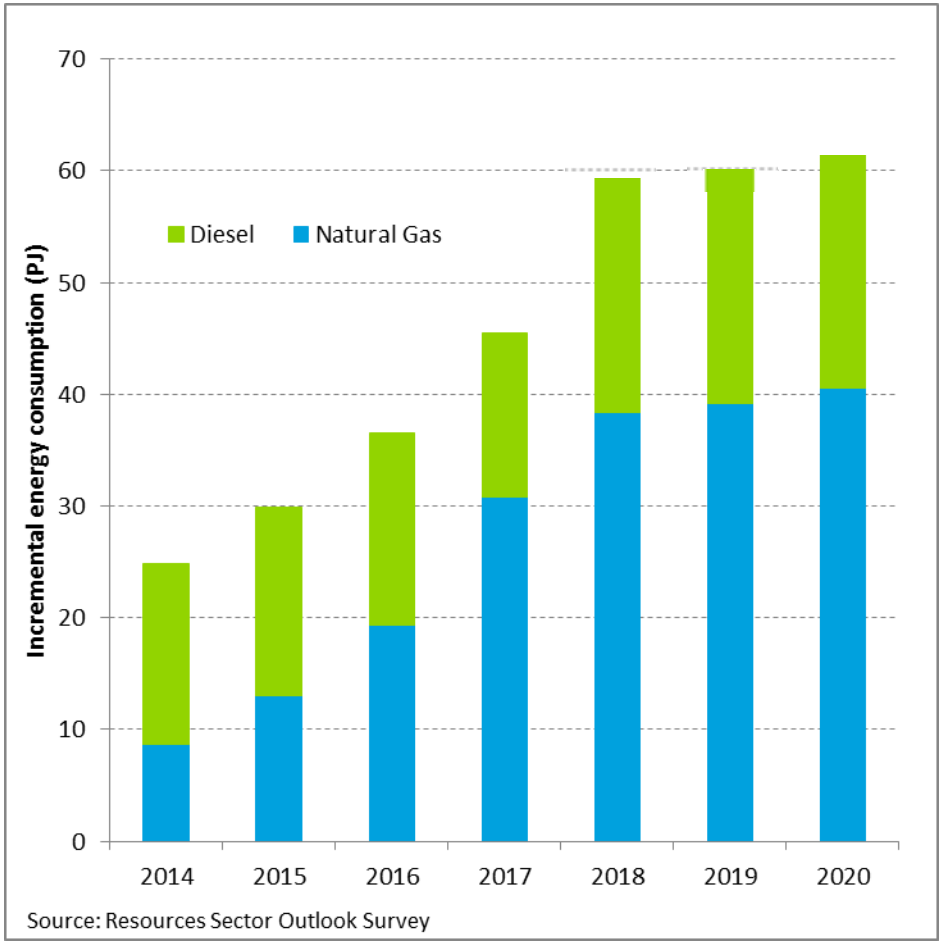
[50] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013. 'Other' includes the Gascoyne, Great Southern, Peel, South West and Wheatbelt regions

[51] SWIS geographical area includes the Goldfields-Esperance, Great Southern, Peel, Perth and South West.

4.6 Key regional trends

4.6.1 Pilbara – Energy consumption

Pilbara resources sector energy consumption, by fuel type, increment from 2013[52]



Primary energy consumption in the Pilbara is expected to increase as a number of key producers continue to bring new capacity online.

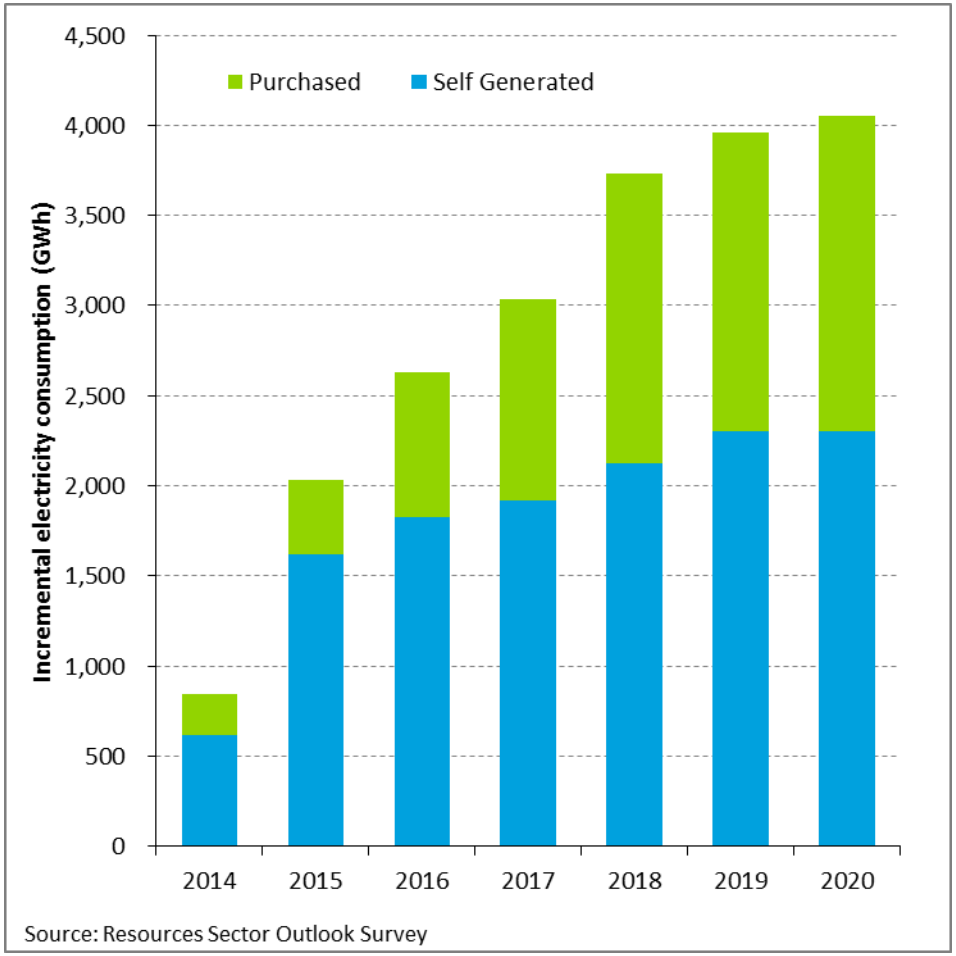
In the short term diesel will drive a large portion of the incremental demand for energy in the region. The use of diesel is expected to increase by 17 PJ to 2016 from 2013 levels. In the medium term, the growth of diesel as a fuel source is expected to slow, and is projected to be gradually replaced by natural gas.

By 2020, the use of natural gas is forecast to rise by 41 PJ above 2013 levels, more than double the expected incremental growth in diesel (which is projected to rise by 20 PJ over 2013 levels).

[52] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

4.6.2 Pilbara – Electricity consumption

Pilbara resources sector electricity consumption, increment from 2013[53]



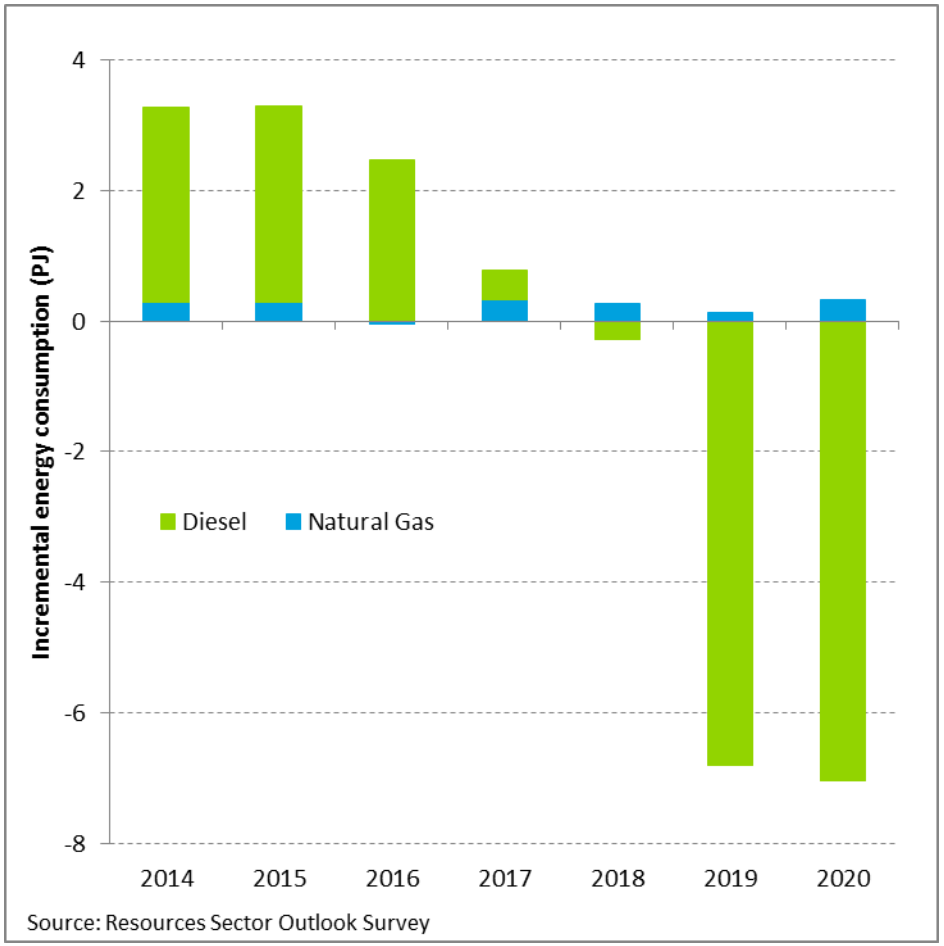
Higher forecast demand for energy in the Pilbara is underpinned by growing electricity consumption.

The resources sector in the Pilbara is expected to source more electricity over the forecast period via both self-generation and purchased sources as projects move into operation. By 2020, these sources are expected to be 2,300 GWh and 1,750 GWh higher, respectively, above 2013 levels.

[53] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

4.6.3 Goldfields-Esperance

Goldfields-Esperance resources sector energy consumption, increment from 2013[54]



A short term rise in energy consumption in the Goldfields-Esperance region is expected to be offset by a significant fall over the medium term.

Energy

The projected decline in primary energy consumption in this region will be driven by changes in consumption of diesel, with the use of natural gas remaining largely unchanged.

Electricity

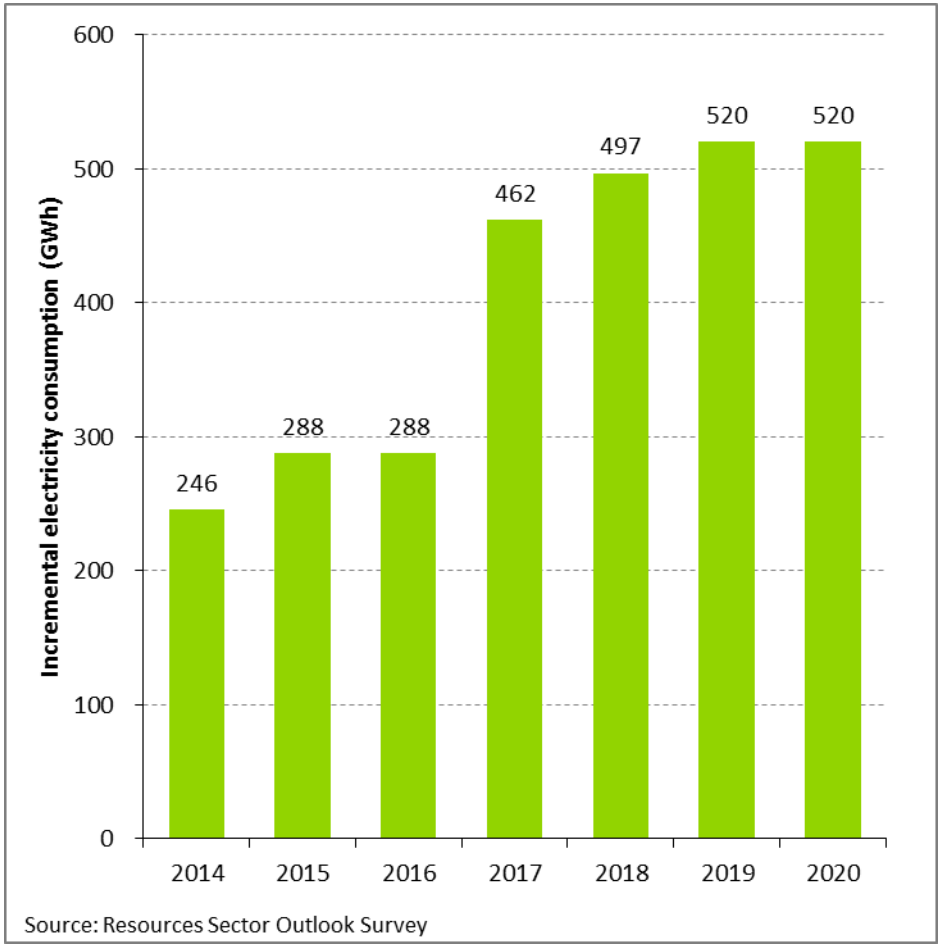
Similarly, electricity consumption associated with the resources sector in the region is expected to increase over the short term. In 2014, it is forecast to rise by 450 GWh above 2013 levels however, unlike overall energy consumption, electricity consumption is forecast to maintain this increment through to 2020. Changes in electricity consumption in the region will almost entirely be sourced from self-generated sources.

This mismatch between electricity consumption and primary energy consumption in the region is likely to be due to electricity consumption in the region comprising only a small proportion of total energy consumption.

[54] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013.

4.6.4 Mid West

Mid West resources sector electricity consumption (purchased), increment from 2013[55]



[55] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013.

[56] As the demand survey focussed specifically on resources companies and not suppliers to the electricity grid, the corresponding increase in primary energy consumption from an increase in electricity consumption sourced from the grid does not appear in the survey results.

The Mid West is projected to record a significant increase in electricity consumption from 2013.

Energy

Despite an increase in electricity consumption, the change in overall primary energy consumption in the region is expected to be negligible during this period.

Electricity

By 2020 however, electricity consumption is forecast to reach 520 GWh above 2013 levels. The projected incremental increase in electricity consumption in the Mid West is expected to be driven by purchased sources as there is growth in the region.

This mismatch between electricity consumption and primary energy consumption in the region is likely to be due to the majority of electricity consumption in the region being sourced from the grid[56].

4.6.5 Other regions

South West

Although in aggregate the South West is a large energy and electricity consumer in the resources sector, there is no material change in energy and electricity consumption projected over the forecast period.

Kimberley

Electricity consumption is projected to increase by over 600 GWh to 2020. Primary energy consumption is expected to increase by just 0.2 PJ over the same period.

Other

Other regions, including the Gascoyne, Great Southern, Peel/Perth and Wheatbelt are not expected to experience any material changes in their energy and electricity consumption over the forecast period.

4.7 Policy implications and opportunities

Four key policy implications and opportunities have been identified from the above analysis:

1. The energy mix within the resources sector over the medium term is forecast to change from diesel to natural gas.

The resources sector continues to demonstrate a preference for natural gas over diesel as a fuel source. Consumption of gas in the resources sector is projected to rise from a share of 48% in 2013 to just over 52% by 2020. This is driven by use in onsite electricity generation and in mobile plant.

While Western Australia has utilised gas-fired electricity generation for a number of years, facilitating the uptake of gas in mobile plant creates a new opportunity for the State to position itself as a leader in related technologies. For example, the establishment of virtual pipelines and the development of CNG and small-scale LNG supply chains may be important to the increased uptake of natural gas to fuel mobile plant.

Governments should seek to work collaboratively with the sector to support emerging technologies which enable the use of natural gas in mobile plant.

The government also has a role to play through its traditional trade promotion functions to market Western Australia for its clean energy supply, from shipments of LNG to the expertise and capabilities necessary to use that energy in both power generation and mobile plant.

2. Significant forecast growth in natural gas in Western Australia, which may result in market tightness, supports the development of onshore gas resources.

The shift toward natural gas from diesel, together with expanding production, is expected to underpin a significant increase in natural gas consumption within the sector beyond 2016. This forecast increase is higher than projections prepared by the IMO in its January 2014 GSOO. Notably, the IMO forecast for energy consumption among operating projects only includes switching to natural gas once a decision has been announced by an operator.

Factors which influence how quickly operators may switch to natural gas include the direction of market prices and the speed in which pipeline capacity can be secured. Availability of supply is also a consideration in the current market, with various technical and regulatory factors causing uncertainty about continued supply to the domestic market by incumbent suppliers.

The IMO high supply scenario overlaid with the Outlook demand forecast indicates domestic supply is projected to sit comfortably above forecast domestic demand by 2023. However, under the low supply scenario the demand forecast indicates the possibility the domestic market for gas may experience tight conditions in the early 2020s.

This may have flow on impacts in terms of higher energy prices for industrial and commercial consumers in Western Australia. As such, the State Government should ensure approvals processes for new processing and pipeline capacity are streamlined and efficient so potential market tightness is not exacerbated by delays to new supply.

In particular, the State's significant resources of onshore gas in the Canning and Perth Basins may have a role to play in meeting future demand for natural gas. The region surrounding the Canning Basin in particular is challenging to operate in due to its remoteness, limited availability of services, absence of major infrastructure and adverse weather conditions.

Governments can also assist in unlocking these reserves by continuing to focus efforts on reducing cost and regulatory barriers to improve commercially viability. This may involve provision of infrastructure to support exploration and development, providing long term tenure over exploration permits, and through temporary royalty concessions.

3. Electricity consumption is projected to increase in the Pilbara, with growth underpinned by both self-generation and purchased sources.

Electricity generation in the Pilbara is forecast to rise by more than 4,000 PJ between 2013 and 2020. Generation in this region has historically been dominated by self-generated electricity rather than purchased sources. However, current forecasts illustrate a growing trend towards purchased sources.

The shift to increased purchases in the north west has occurred with minimal direct government intervention, illustrating the importance of allowing commercial arrangements to determine the development of the Pilbara's system of power supply, including interconnectivity.

4. The Electricity Market Review may have important implications for industrial users in the SWIS.

Although most of the electricity consumed by the resources sector does not originate in the SWIS, the review may have consequences for those participants in the sector that draw energy from the SWIS, as well as those companies that support the resources sector through the supply of ancillary services.

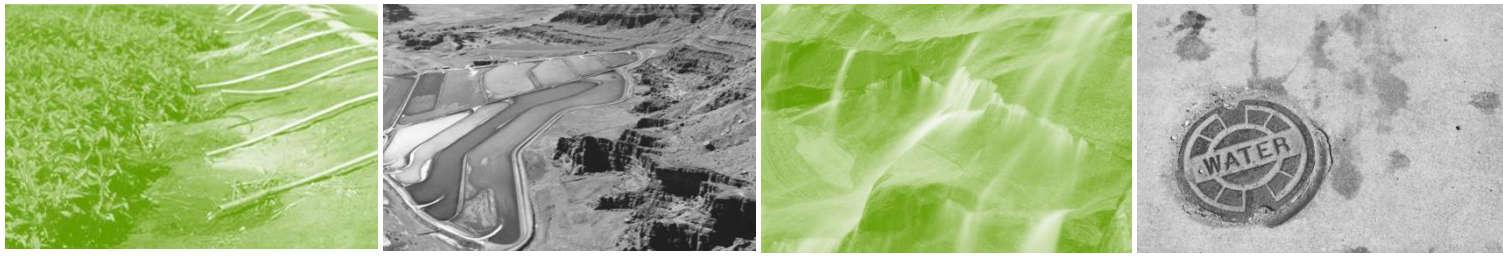
The review has canvassed the possibility of reducing market concentration in the wholesale electricity market, where Synergy controls approximately 76% of capacity credits. In particular, greater competition could be achieved through a structural separation of Synergy into several generators and retailers, and the privatisation of the utilities created. Structural separation and privatisation would lead to improved efficiency and downward pressure on generation costs[57].

Energy costs are a key component of the cost of doing business in Western Australia. As the average cost of electricity in the SWIS is projected to increase by up to 20% in the next four years[57], reforms which lower energy costs will help to improve the competitiveness of Western Australia's resources sector.

[57] Discussion Paper, Electricity Market Review Steering Committee, 25 July 2014

5 Water

Chapter contents



5.1 Chapter summary

Key trends

- In 2013, 1,710 GL of water was abstracted in Western Australia. The most significant water abstraction occurred in the Perth urban area, accounting for 29% of total abstraction. Significant amounts are also abstracted in the Pilbara (23%), South West (13%), and Kimberley (11%) regions of the State.
- The mining, agricultural and residential sectors are the major abstracters of water in Western Australia, comprising 31%, 25% and 22%, respectively, of total abstraction.
- Water abstraction in the resources sector is expected to increase from 530 GL in 2013 to 692 GL by 2020, representing an annual rate of increase of 3.9%.
- Dewatering in the resources sector will increase significantly in the future. It is forecast to rise by 115 GL above 2013 levels by 2020. However, the volume of dewatering is expected to be highly volatile from year to year.
- Water use for mine operations will increase by 60 GL over the period from 2013 to 2020. Groundwater reinjection is also projected to increase significantly by 55 GL largely in line with the forecast increase in dewatering.

Regional overview

- Resources sector abstraction in the Pilbara is expected to increase from 350 GL in 2013 to 491 GL in 2020. In the Pilbara region, 80% of water is abstracted for the purposes of dewatering, a significantly greater proportion than the rest of the State.
- After increasing from 100 GL in 2013 to a peak above 103 GL in 2015, water abstraction in the Goldfields-Esperance region is expected to fall to 102 GL by 2017. Water abstracted in the region for the purpose of dewatering is predominantly returned to surface water rather than reinjected.

Summary of policy implications and opportunities

1. **Water scarcity requires market mechanisms to efficiently allocate supply, where markets are possible.**

   While cases of water scarcity are limited, market mechanisms can be used to efficiently allocate water where residential, commercial and mining interests intersect.

   The State Government's intentions to introduce new water resources management legislation – which seeks to enable market mechanisms alongside other tools for water allocation and management – is supported and encouraged.

2. **The volume of dewater surplus to mine needs may provide a supply for beneficial purposes, but volatility of supply and water quality are key constraints which will impact the viability of options.**

   While the amount of dewatering surplus is significant, its volatility must be considered against the reliability of supply required by potential users. Availability of water after mine closure must also be considered.

   It is possible these barriers may be overcome with the development of suitable commercial models to reflect supply variability and appropriate priority of use. Specifically, beneficial use projects need to be able to accept and adequately price the risks related to security of supply arising from supply driven water sources, without compromising the mine plan.

   Additionally, although the volume of dewatering may be significant, the quality of water abstracted may mean it is unsuitable for proponent or third party beneficial use.

   Some mine operations abstract highly saline water unfit for use without appropriate treatment. Water surplus to mine needs may also contain traces of mineral resources or introduced chemicals, which may add costs to third party use.

3. **Cumulative effects remain a priority issue, but further work is needed to ensure an appropriate management framework is developed.**

   While there is forecast to be an increasing volume of abstraction in the mining sector, high level data capture cannot identify potential areas of adverse cumulative effects. A deeper granularity of analysis is required on a catchment-by-catchment basis to identify potential areas of adverse cumulative effects.

   Existing regulatory arrangements are unclear on how to identify values at risk, manage cumulative effects across multiple contributors, and how management responses should be developed collaboratively.

   Management of effects requires government leadership paired with collaboration within the sector.

5.2 Past trends

5.2.1 Water definitions

The Minerals Council of Australia's Water Accounting Framework informed the water categories used in the water component of the CME demand survey.

The Minerals Council of Australia uses an Input-Output framework to measure and monitor water quantity. As a result, inputs and outputs for each reporting entity must balance and are referred to as 'Sources' and 'Destinations' respectively.

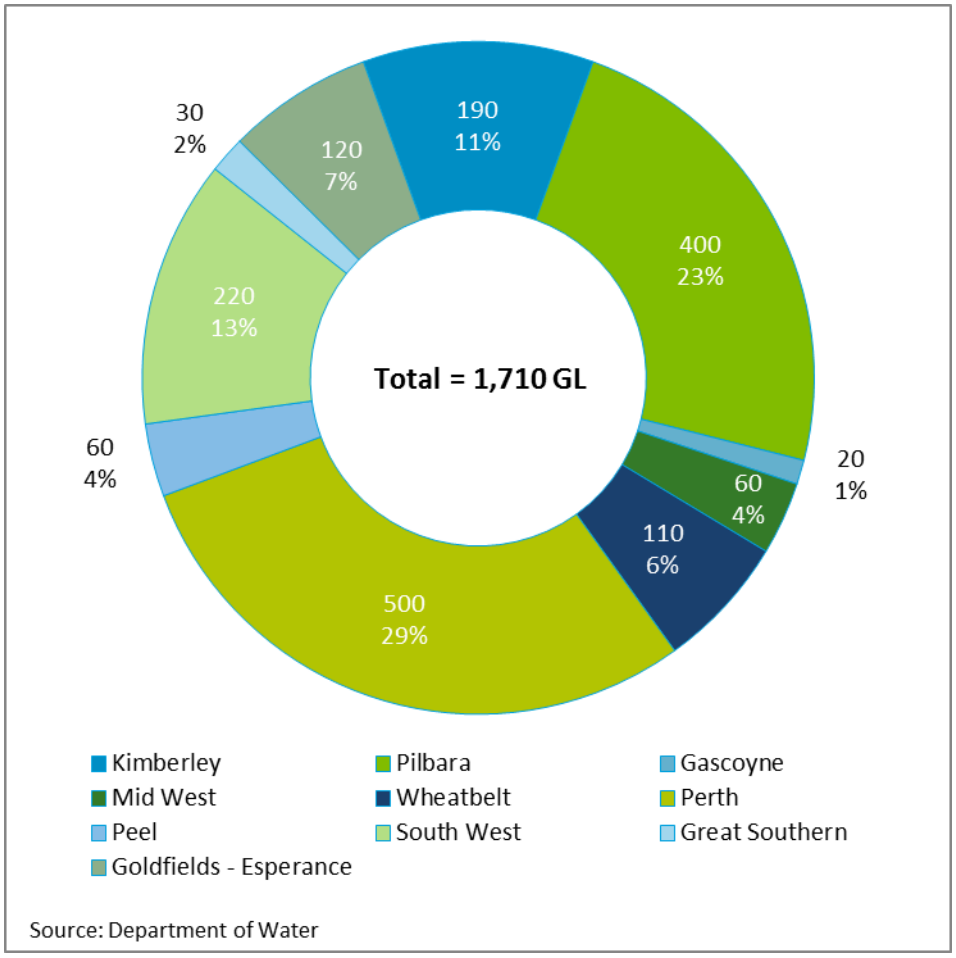
Demand survey water categories

Sources	Definition
Surface Water	Precipitation and runoff, rivers and creeks, external surface water storages
Dewatering	Groundwater aquifer interception
Other Groundwater	Bore field abstraction (excluding dewatering), ore entrainment and other
Sea Water	Estuary, desalination and sea/ ocean
Third Party	Contract / municipal, waste water etc. (including provision from licensed water service providers)

Destinations	Definition
Surface Water	Discharge, environmental flows
Groundwater Reinjection	Aquifer reinjection
Mine Operations	Consumption on site for processing, dust suppression and other operational purposes (including on-site drinking water)
Other Groundwater	Other including seepage
Third party Beneficial Use	Supply to third parties for irrigation, town supply, industrial consumption
Own Beneficial Use	Self-supply for irrigation, town supply, industrial consumption
Sea Water	Estuary, sea /ocean
Other Use	Evaporation, entrained water in waste material and concentrate

5.2.2 Water abstraction by region

Western Australian water abstraction by region, 2013 estimate (GL, %)[58]



In 2013, 1,710 GL of water was abstracted in Western Australia.

The Perth urban area had the highest level of water abstraction in Western Australia, accounting for 29% (500 GL) of the State total.

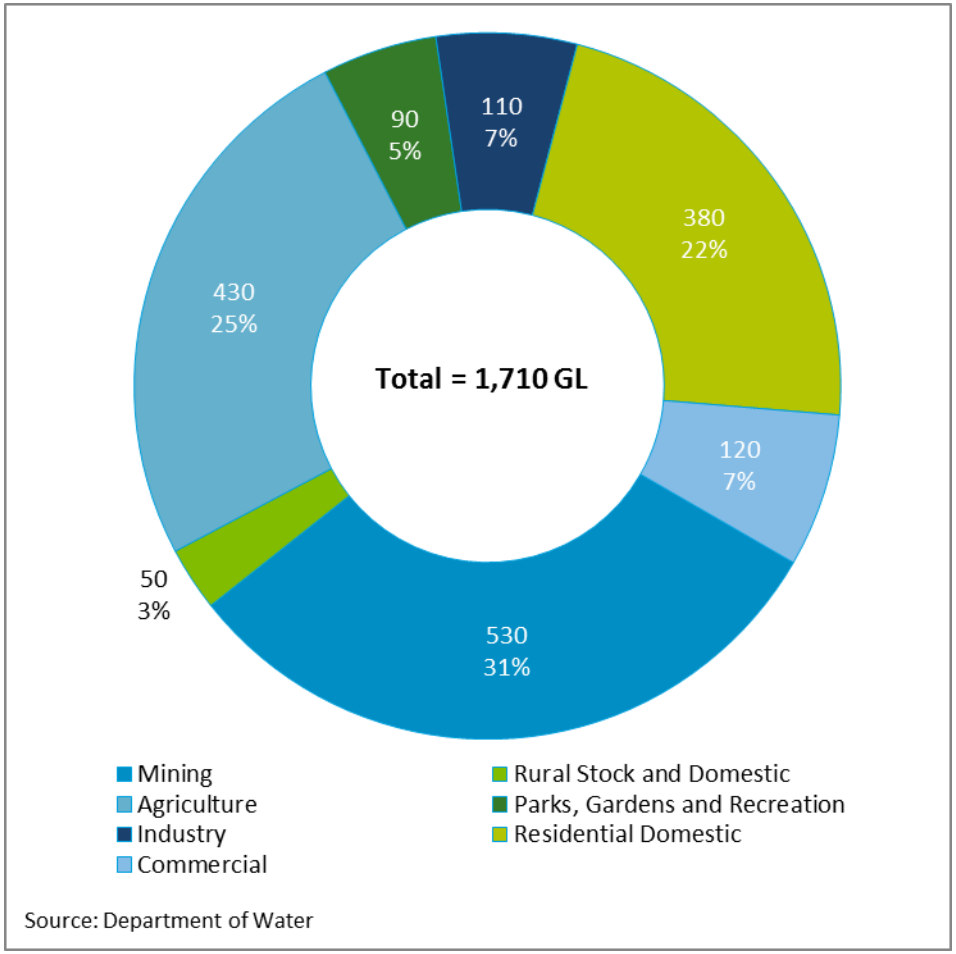
Significant water abstraction also occurs in the Pilbara (400 GL), South West (220 GL), and Kimberley (190 GL). This reflects the presence of water-intensive industries in these areas, mainly within the resources and agriculture sectors.

The Goldfields-Esperance region accounted for 7% of water abstraction.

[58] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown

5.2.3 Water abstraction by sector

Western Australian water abstraction by sector, 2013 estimate (GL, %)[59]



Source: Department of Water

The mining, agricultural and residential sectors account for significant levels of water abstraction in Western Australia, at 31%, 25% and 22%, respectively.

Although mining and agriculture water abstraction are similar in terms of their absolute size, significant differences emerge when comparing the relative size of the industries and the value they generate for the Western Australian economy.

Estimates suggest every GL of water abstracted by the mining sector yields approximately $163 million of gross value add for the State economy. However, this metric is much lower for the agricultural sector, where an approximate yield of $6 million of gross value added is generated for every GL of abstraction[60].

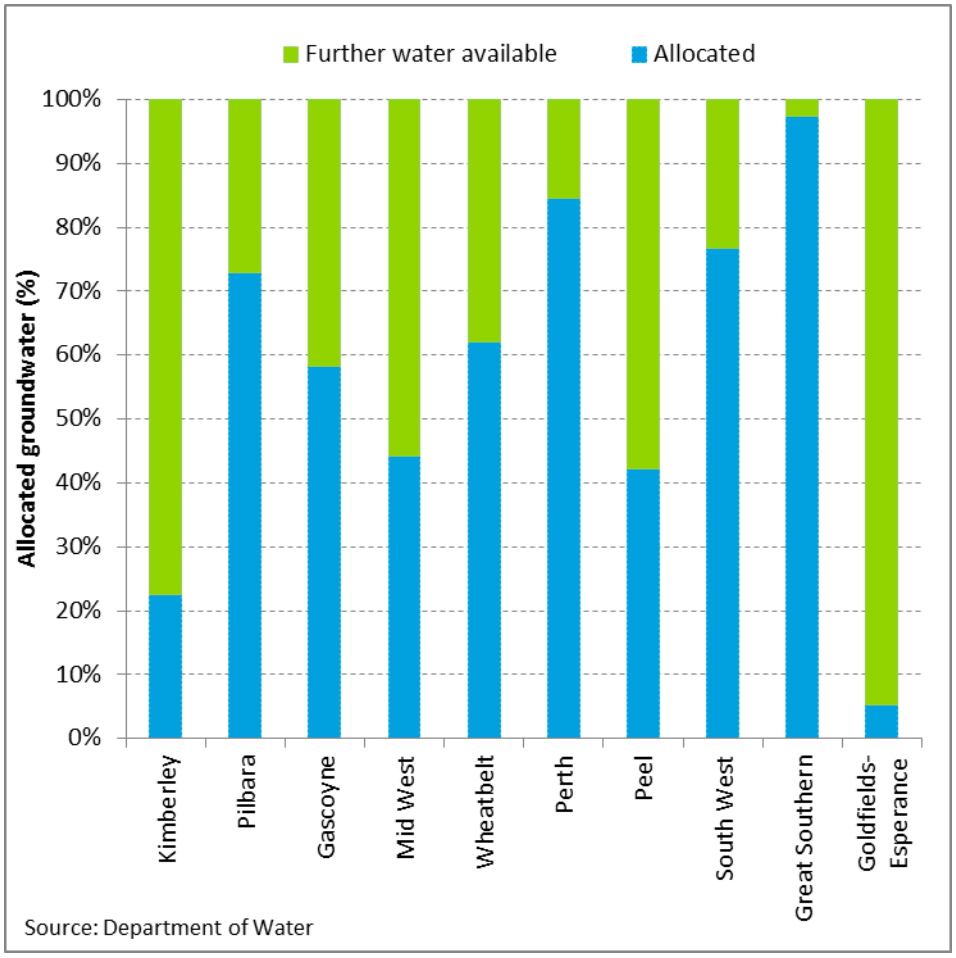
It is important to note water abstraction does not necessarily equate to water use in each sector. This is particularly true in the resources sector, where significant portions of water abstraction (particularly in below water table mining operations) are not required for use and are reinjected or discharged as a result.

[59] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown.

[60] Estimates are derived using gross value added data from ABS State Accounts, catalogue 5220.0. Gross value added is a measure of economic value.

5.2.4 Groundwater allocation and availability

Western Australian groundwater allocation status, 2014, by region



Groundwater allocation in the Perth, Great Southern and South West regions are reaching their maximum limits.

The Department of Water sets allocation limits to manage the volume of water that can be abstracted or taken from a resource annually. This ensures water resources are not depleted in the long term.

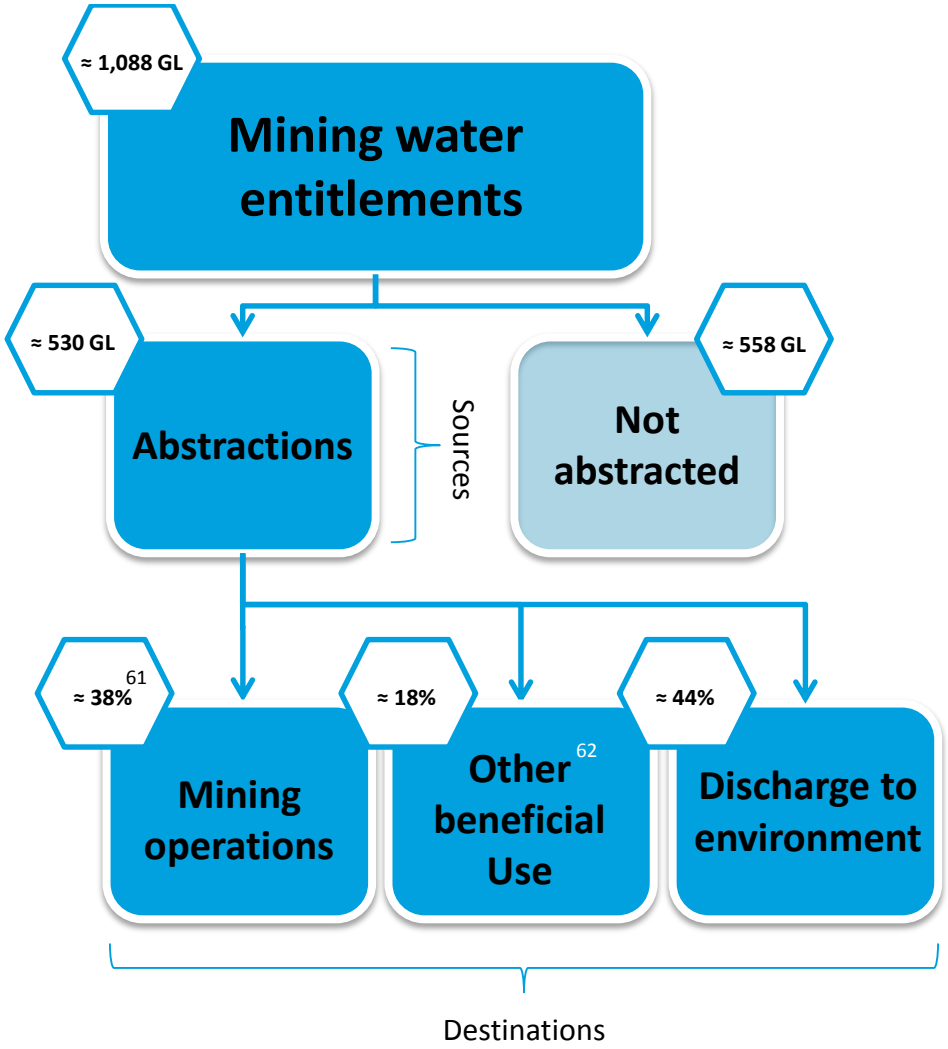
Groundwater from sedimentary basins forms a reliable water source for much of Western Australia.

In some regions additional groundwater is available for general purpose licensing however, the location of supply may not align with areas of demand resulting in the potential for supply shortages. This is particularly true in the population centres of the Pilbara, Karratha and Port Hedland specifically. The Department of Water has sought to address these issues of supply with the release of the *Pilbara regional water supply strategy*.

Fractured rock groundwater resources, where water information is site specific and/or water abstraction is relatively isolated, do not form part of allocation limits. The majority of groundwater abstraction in the Western Australian mining sector is sourced from fractured rock groundwater resources, rather than from sedimentary basins.

5.2.5 Differentiating entitlements, abstraction and use in mining

Abstraction and use in mining



Source: Resources Sector Outlook Survey, Department of Water

The mining sector abstracted just less than half of its water entitlements in 2013.

The mining industry held around 1,088 GL of water entitlements in Western Australia in 2013. A water entitlement, in the form of a time limited abstraction licence, allows the holder of the entitlement to abstract a specified amount of water during the licence period. In the Western Australian resources sector, the majority of these are for fractured rock aquifers.

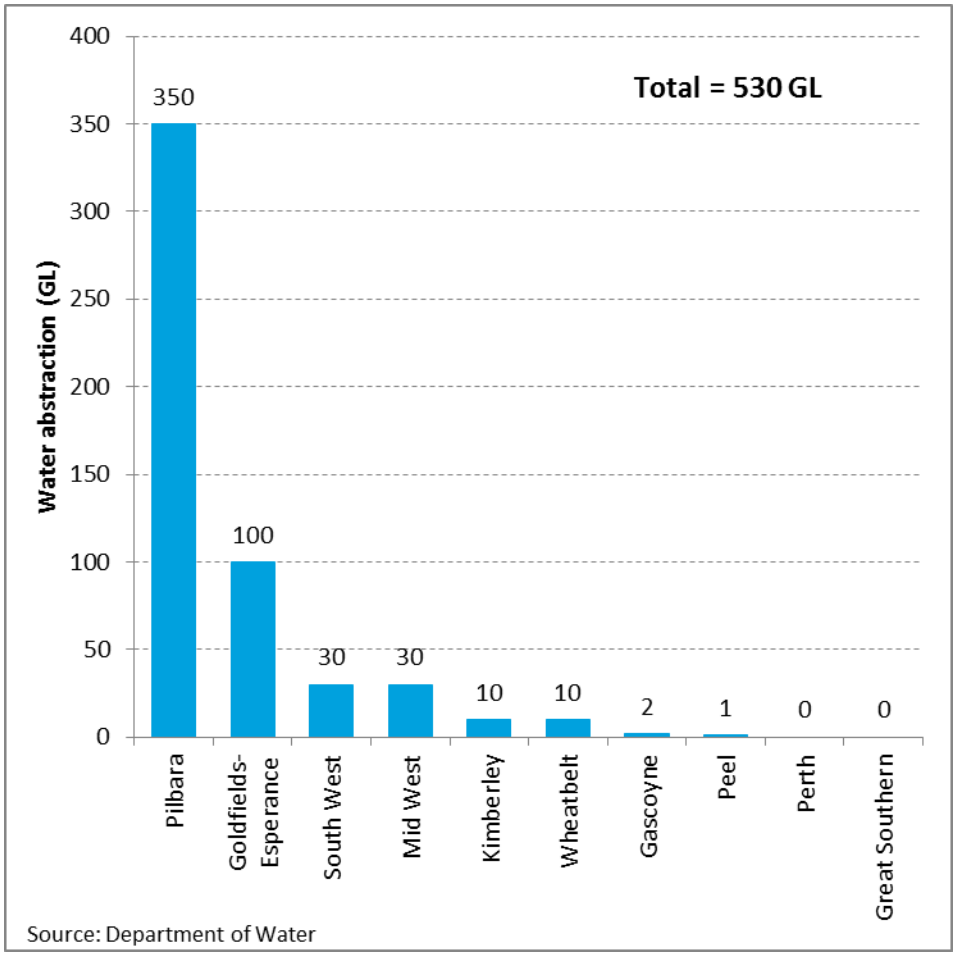
Mining entitlement holders were expected to abstract 530 GL of their total entitlement in 2013. Entitlement holders tend to abstract less than their entitlement as the entitlement is based on the maximum predicted abstraction to meet peak dewatering requirements or operational water needs. Actual abstraction will vary throughout the life of mine and in response to rainfall conditions. The resources sector typically abstracts water from groundwater sources for the purposes of dewatering and bore field abstraction.

Just over half of abstracted water is expected to be employed for mine operations or beneficial use. Abstracted water can be used for mining operations and beneficial use, or returned to the environment through reinjection to aquifers or discharge to rivers and creeks. The water quality of the source (e.g. total dissolved solids, chemical composition), is often a key determining factor in the ability to employ water for beneficial use.

[61] Proportion of abstraction
[62] Beneficial use refers to abstracted water not used for the purposes of the mine plan

5.2.6 Resources sector abstraction by region

Western Australian resources sector water abstraction, 2013, by region[63]



In 2013, water abstraction by the resources sector was 530 GL, with 66% abstracted in the Pilbara.

Resources sector water abstraction makes up 350 GL of the total 400 GL abstracted in the Pilbara region.

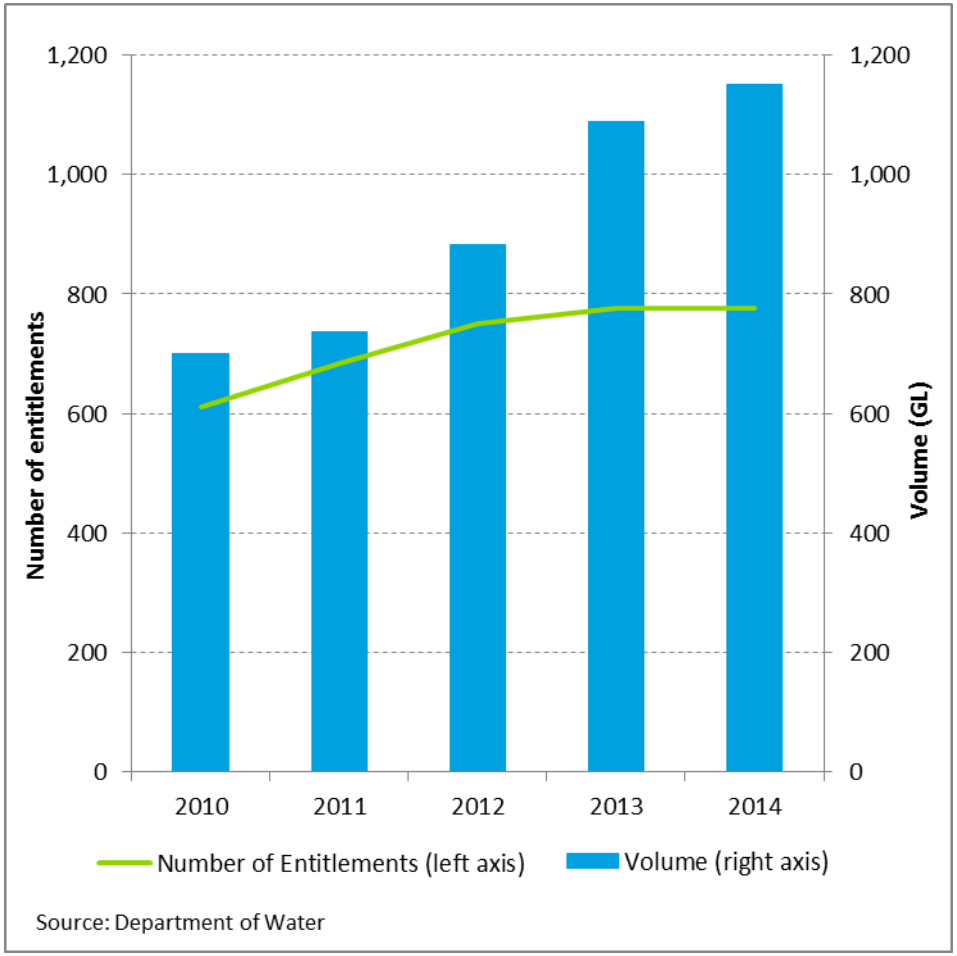
The resources sector in the Goldfields-Esperance region also makes up a significant proportion of the region's water abstraction, 100 GL of a total 120 GL.

The South West and Mid-West account for a significant proportion of the remainder of abstraction in the resources sector, with each region abstracting 30 GL each, although they represent a much smaller proportional contribution to their respective regional abstraction volumes (14% and 15%, respectively).

[63] Regional abstraction is rounded to the nearest whole number such that the sum of each region's abstraction may not equal the total

5.2.7 Water entitlements in the resources sector

Western Australian resources sector water entitlements



Both the number and volume of resources sector water entitlements have increased significantly since the beginning of the decade.

The total volume attached to entitlements granted to the resources sector has risen from 699 GL in 2010 to 1,150 GL in 2014. This accounted for 36% of the total volume related to all entitlements in Western Australia[64]. Almost 800 entitlements were active for the resources sector in 2014.

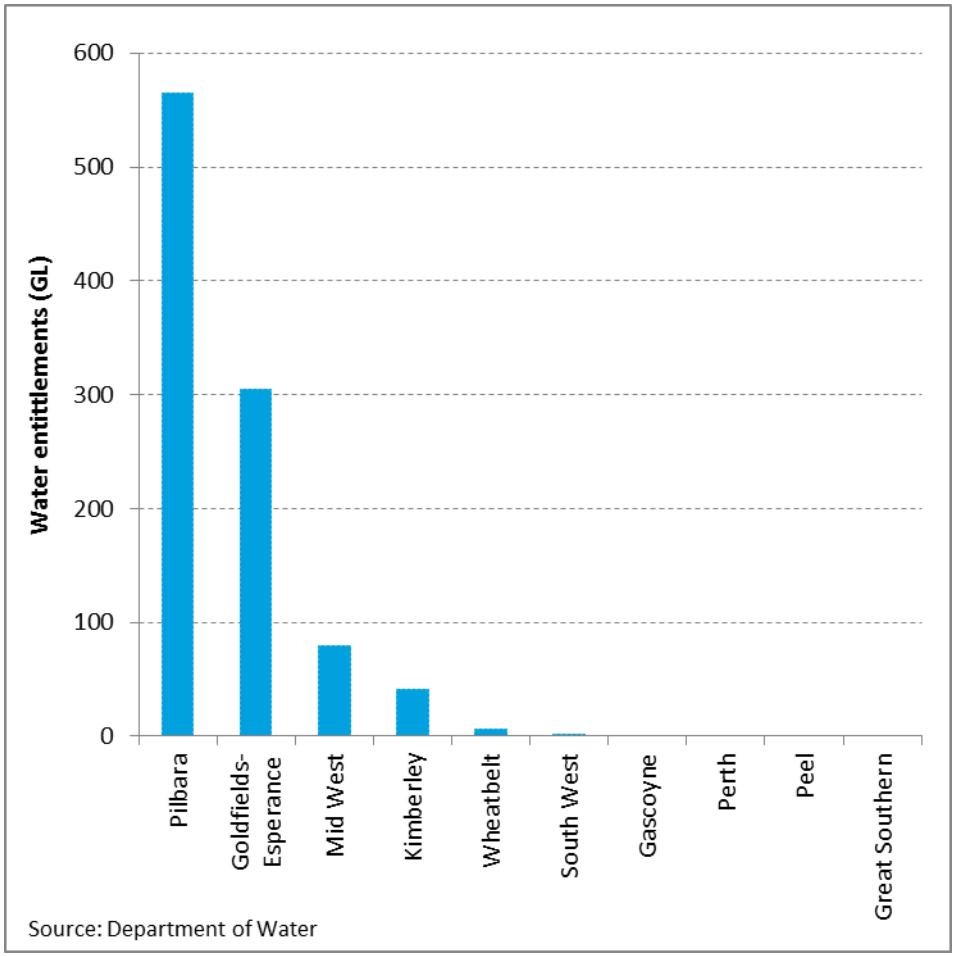
This growth is underpinned by the broader growth in the resources sector, as both new mines have been commissioned by existing operators and new entrants enter the market. Volumes have also increased as innovation in mining techniques have enabled below water table mining, requiring dewatering.

It is important to note the resources sector only abstracts a portion of its total volume of entitlements, as the entitlement is based on the maximum predicted abstraction to meet peak dewatering requirements or operational water needs.

[64] Department of Water

5.2.8 Fractured rock water entitlements

Western Australian resources sector water entitlements for fractured rock aquifers, 2013, by region



Of the 1,150 GL in water entitlements held by the resources sector in 2014, 997 GL or 90% are fractured rock water entitlements.

The majority of these fractured rock water entitlements are held in the Pilbara region with 565 GL. The Goldfields-Esperance (300 GL) and Mid West (79 GL) regions also have significant water entitlements in fractured rock aquifers.

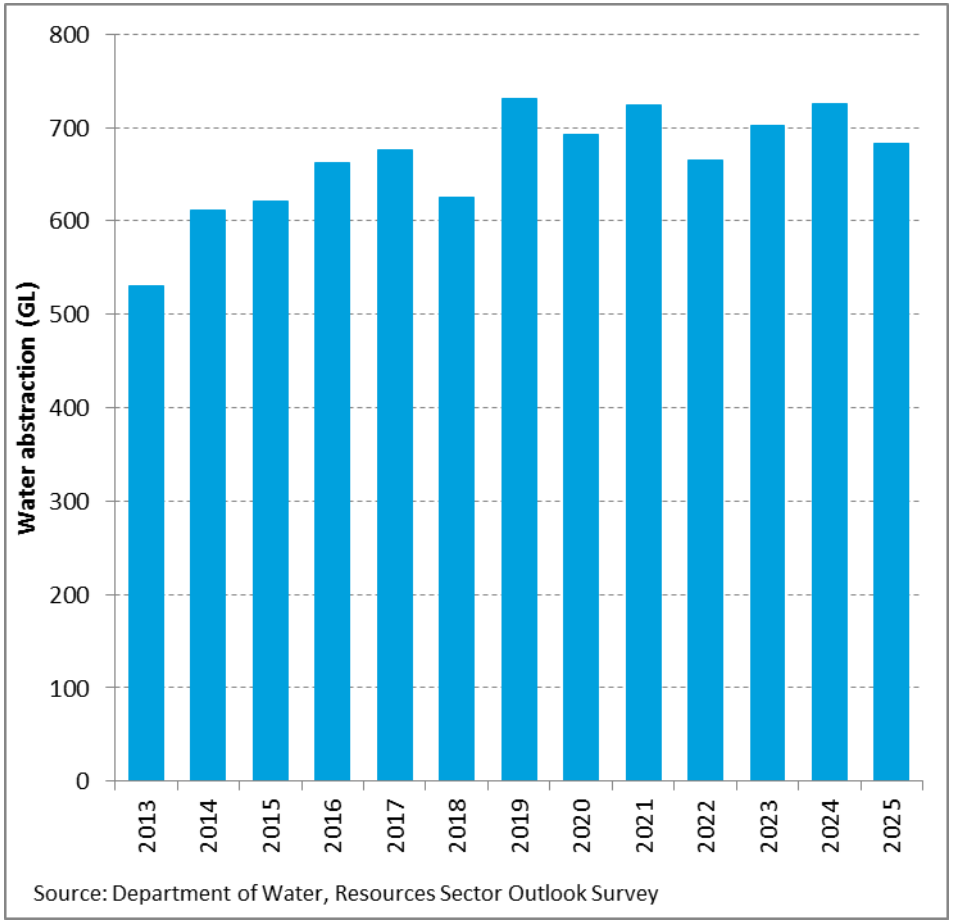
Fractured rock water entitlements are not subject to regional allocation limits as it is difficult to assess the characteristics of an aquifer, including boundary definition and the sustainable amount of water that can be taken each year.

Instead, licences for fractured rock water resources are assessed on a case-by-case basis to develop licence conditions specific to each aquifer.

5.3 Future trends

5.3.1 Resources sector water abstraction

Western Australian resources sector abstraction



Source: Department of Water, Resources Sector Outlook Survey

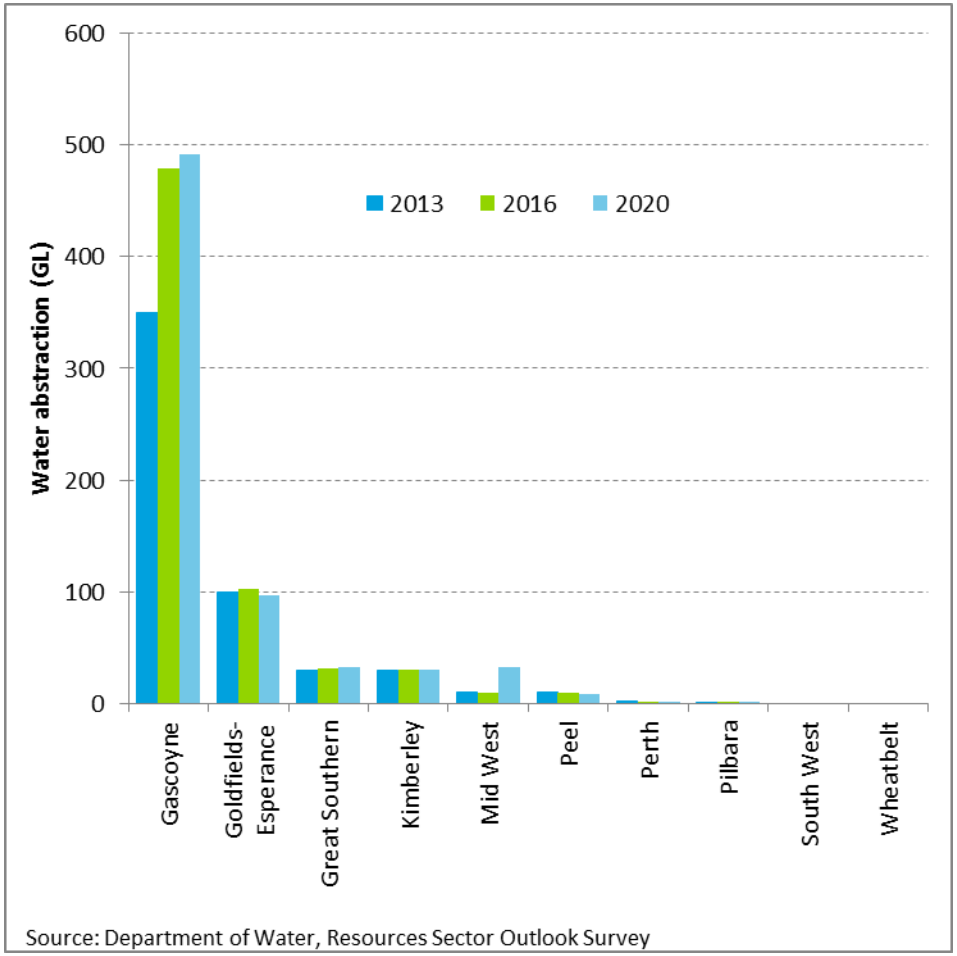
Water abstraction in the resources sector could increase significantly in the future as a number of large Pilbara resources projects ramp up to full capacity.

Abstraction is projected to increase from 530 GL in 2013 to 731 GL by 2019, representing a compound annual growth rate of 5.4%, before declining to 692 GL in 2020. Over the long term, water abstraction is expected to fall slightly to 682 GL by 2025.

The increase in water abstraction is driven by demand for water for mine operations and dewatering. However, a significant portion (approximately 44%) of this water will not be consumed and will be returned to the environment including via groundwater reinjection and discharge to surface water.

5.3.2 Regional water abstraction

Western Australian resources sector water abstraction, by region



Source: Department of Water, Resources Sector Outlook Survey

The Pilbara region will drive the rise in resources sector water abstraction.

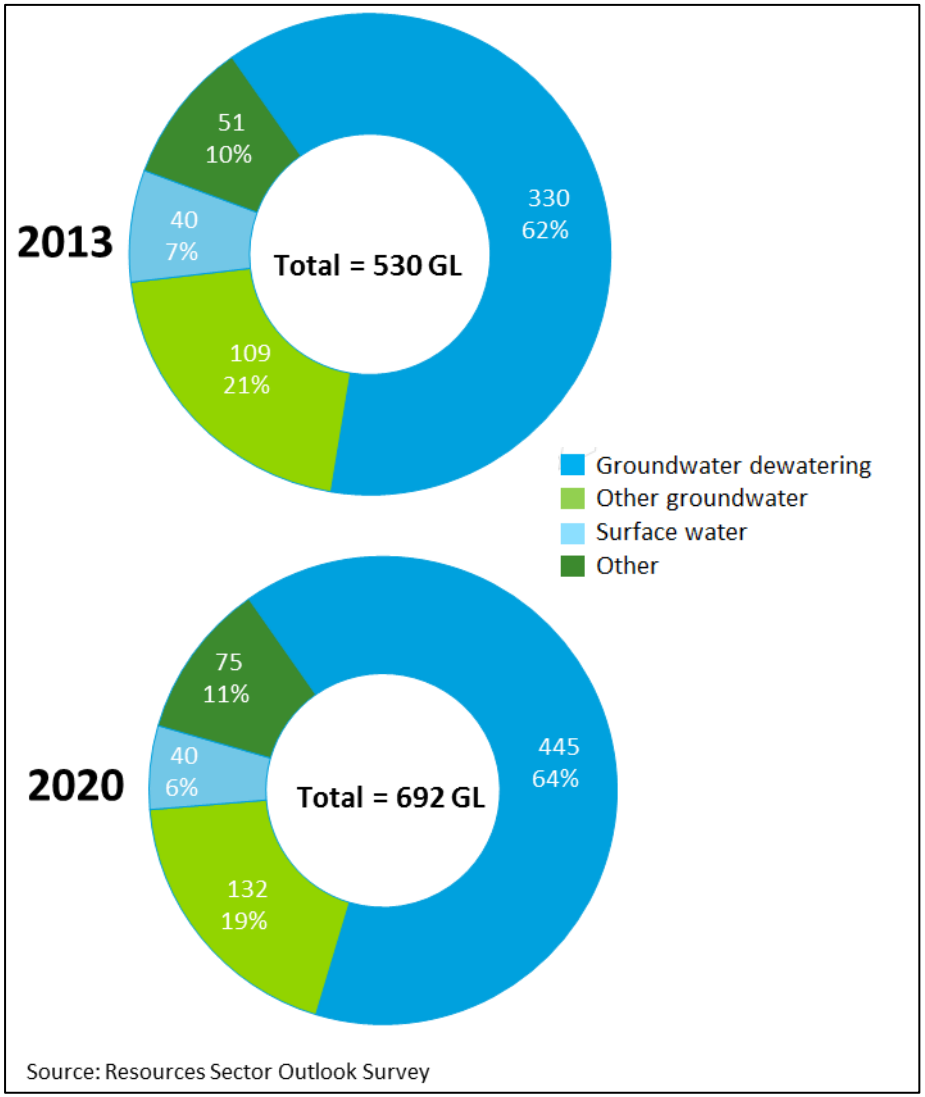
From a baseline of 350 GL in 2013, abstraction in the Pilbara is projected to rise to 479 GL by 2016, and then 491 GL by 2020. Over this seven year period, the compound annual growth rate in water abstraction is expected to be approximately 5.0%.

The Goldfields-Esperance region, which has the second greatest resources sector water abstraction, is forecast to see a slight decrease to 2020, from 100 GL to 97 GL.

Water abstraction in the Kimberley is forecast to increase from 10 GL in 2013 to 33 GL by 2020.

5.3.3 Sources of abstraction

Western Australian resources sector sources of abstraction (GL, %)[65]



Source: Resources Sector Outlook Survey

Water abstracted in the resources sector is largely sourced via groundwater for mine operations and dewatering purposes.

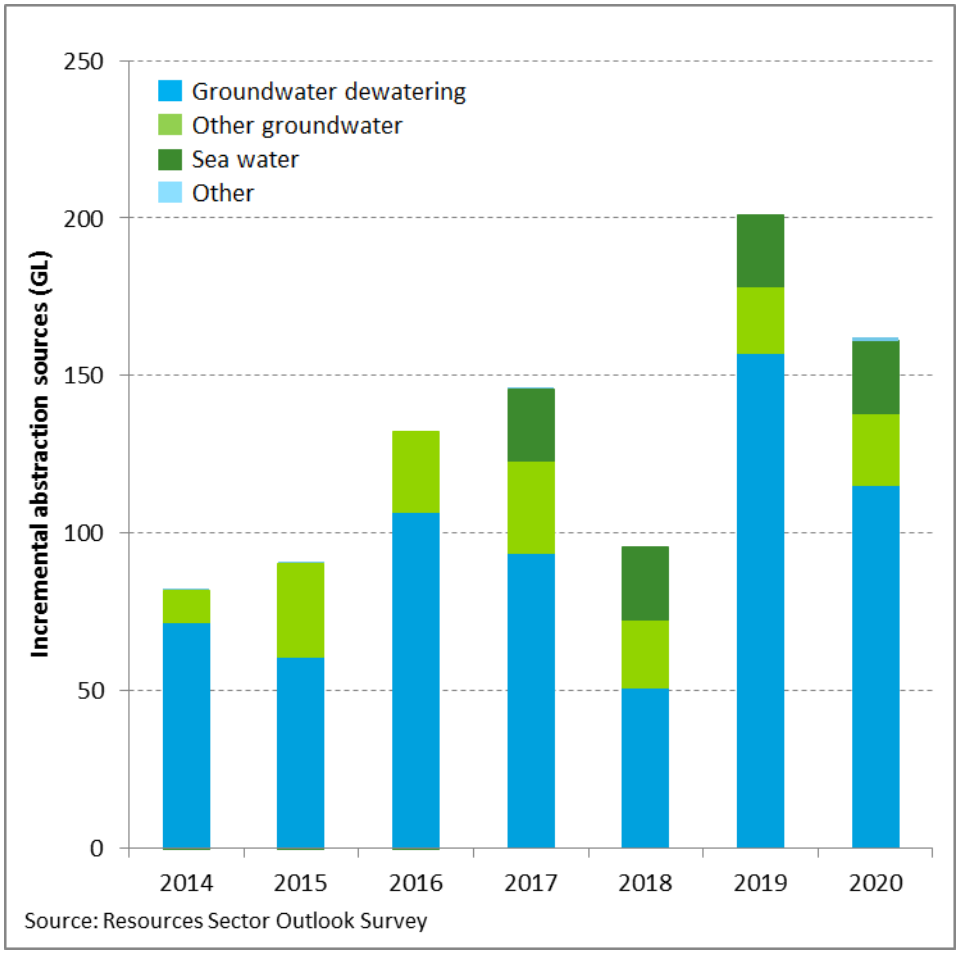
Of the 530 GL abstracted by the resources sector in 2013, 62% was expected to be sourced for dewatering purposes. Both groundwater dewatering and other groundwater equate to 83% of water sourced. In future, groundwater abstraction for dewatering purposes is expected to marginally increase to 64% by 2020.

The forecast growth in the volume of dewatering is underpinned by broader growth in the resources sector, as both new mines have been commissioned by existing operators and as new entrants enter the market. Volumes have also increased as innovation in mining techniques have enabled below water table mining, requiring dewatering.

[65] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown. 'Other' includes 'Sea Water, 'Third Party' and the general option, 'Other'.

5.3.4 Changes in water abstraction sources

Western Australian resources sector sources of abstraction, increment from 2013[66]



Dewatering in the resources sector will increase significantly by 2020 and is forecast to be 115 GL above 2013 levels.

Dewatering is projected to represent over 70% of the resources sector's incremental water abstraction through the period 2013 to 2020. While increasing, the quantum of water abstracted for the purposes of dewatering is expected to be highly volatile.

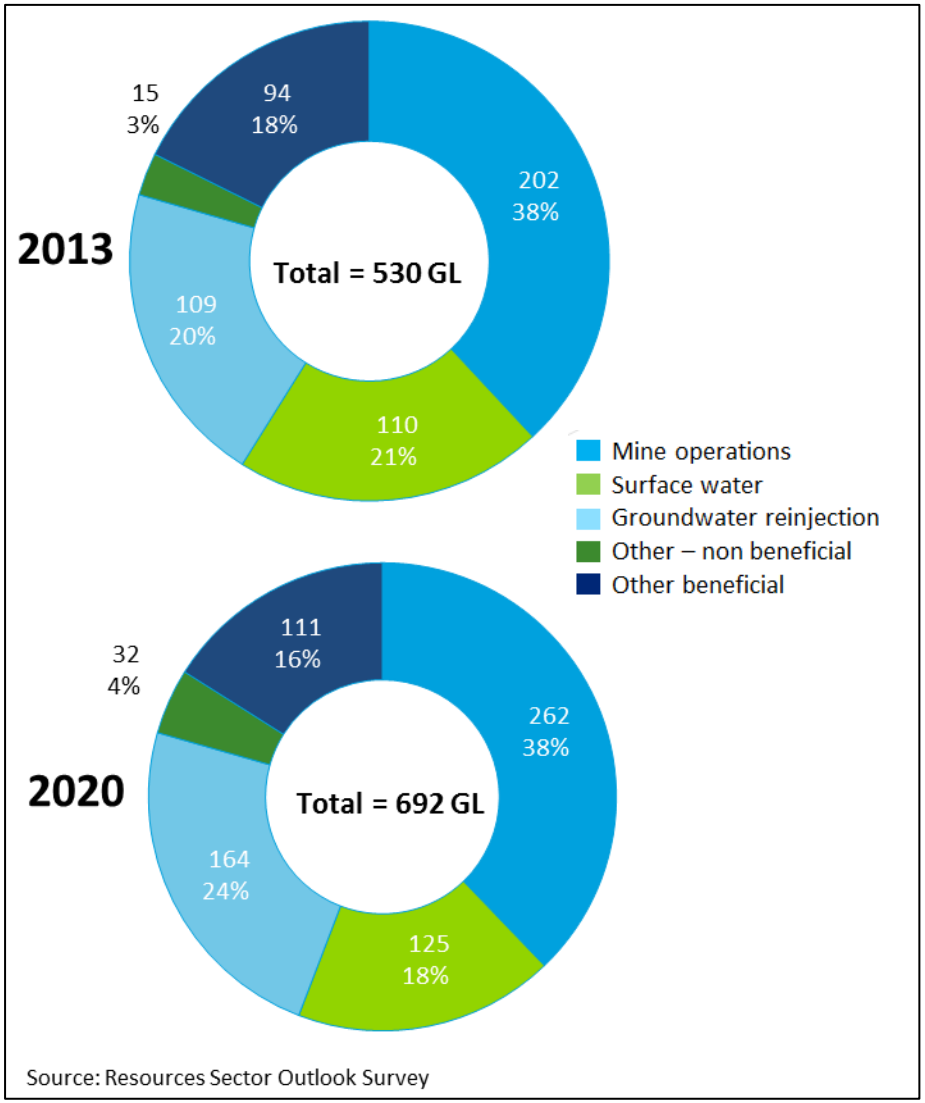
Both other groundwater and sea water sources driven by the emergence of several offshore projects and magnetite ore processing requirements are also expected to increase from 2017 through to 2020, each by approximately 23 GL over 2013 levels.

Other sources[66] of water are not reflected on the graph as there is no forecast incremental change expected from 2013 levels.

[66] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013. 'Other' includes 'Surface Water', 'Third Party' and the general option, 'Other'

5.3.5 Destinations

Western Australian resources sector water destinations (GL, %)[67]



Source: Resources Sector Outlook Survey

The major destination for abstracted water was for mine operations in 2013, accounting for 38% of all water used.

Water returned to the environment (including groundwater reinjection, surface water, and other non-beneficial) comprised 44% of all water destinations.

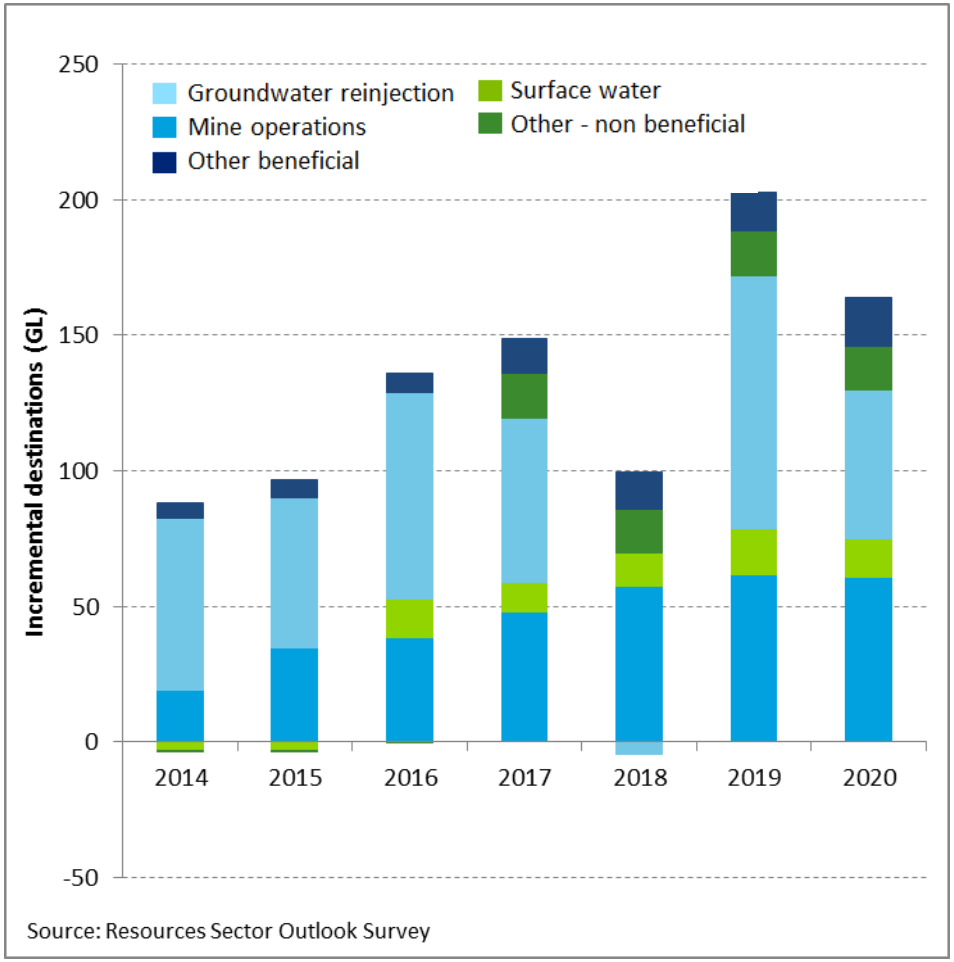
Over the forecast period to 2020, groundwater reinjection is expected to increase as a share of the overall destination of water from 20% to 24%, while surface water decreases in share from 21% to 18%. Most other categories are expected to stay relatively constant.

It is notable that the growth in mine operations as a destination to 2020 of 60 GL is almost as large as the volume of groundwater reinjection of 55 GL to 2020. This reflects both the growth in production in the resources sector, requiring greater usage for operations, but also the larger volume of dewatering expected, some of which is reinjected.

[67] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown. "Other – Beneficial" includes "Third Party Beneficial", "Own Beneficial Use" and "Other Use". "Other – Non Beneficial" includes "Other Groundwater" and "Sea Water".

5.3.6 Changes in water destinations

Western Australian resources sector water destinations, increment from 2013[68]



Water abstracted for mine operations and ground water reinjection is forecast to increase significantly to 2020.

Water use for mine operations will increase by 60 GL over the period from 2013 to 2020.

Groundwater reinjection is also projected to rise significantly over the period from 2013. It moves largely in line with the forecast increase in dewatering, with beneficial use increasing, but at a much slower rate.

In some circumstances water abstracted for the purposes of dewatering may be low quality and unfit for beneficial use. In other cases, the hydrogeological characteristics of an aquifer may not always enable water to be reinjected.

Like dewatering, the incremental change in groundwater reinjection is highly sensitive and volatile in response to the operations of a number of large projects.

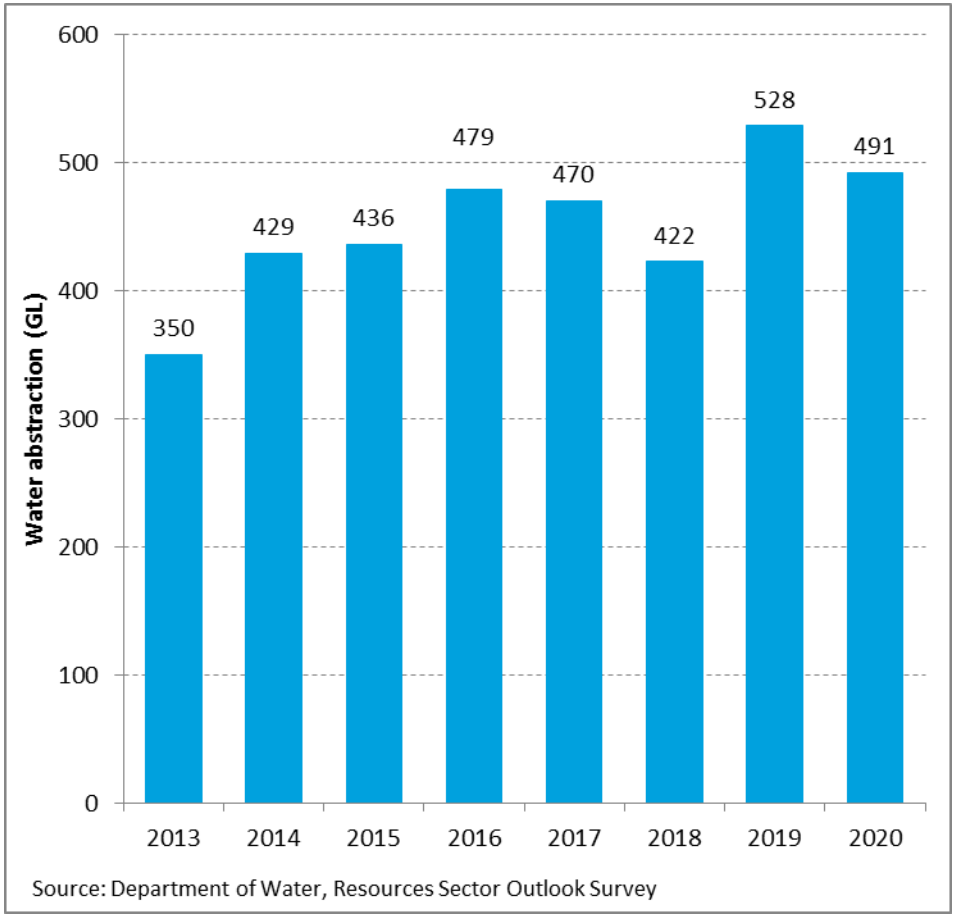
There is a proportionally smaller, though still significant, increase in the size of the other destinations of water abstraction over this period.

[68] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

5.4 Key regional trends

5.4.1 Pilbara – Water abstraction

Pilbara resources sector water abstraction



Resources sector abstraction in the Pilbara is expected to increase from 350 GL in 2013 to 491 GL in 2020.

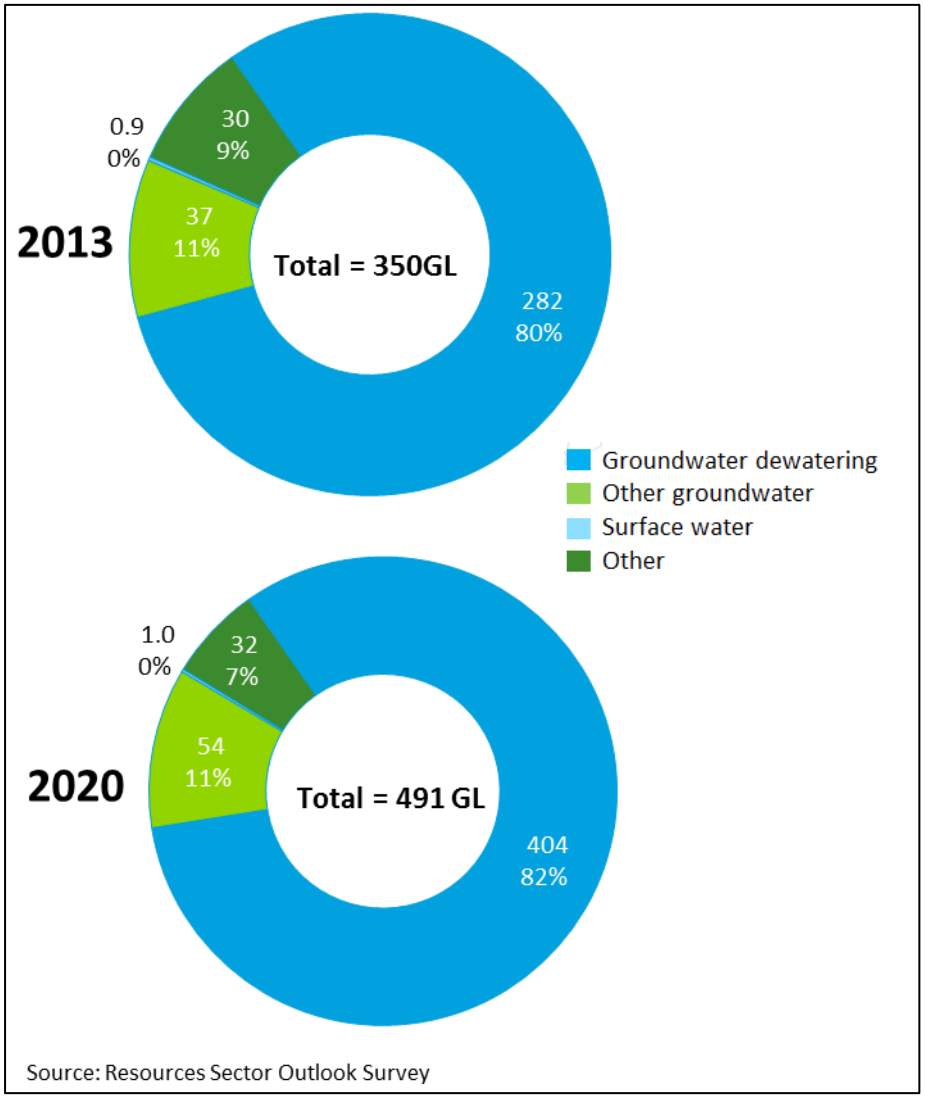
The Pilbara accounts for the majority of the increase in water abstraction expected in the Western Australian resources sector over the medium term.

The two main drivers for the increase in water abstraction are demand for water for mine operations and an increase in dewatering – most commonly to safely access the mineral resource located below the water table. A large portion of this is expected to be reinjected.

In line with the forecast for the broader resources sector, water abstraction in the Pilbara is expected to be highly volatile over the period to 2020.

5.4.2 Pilbara – Sources of abstraction

Pilbara resources sector sources of abstraction (GL, %)[69]



Source: Resources Sector Outlook Survey

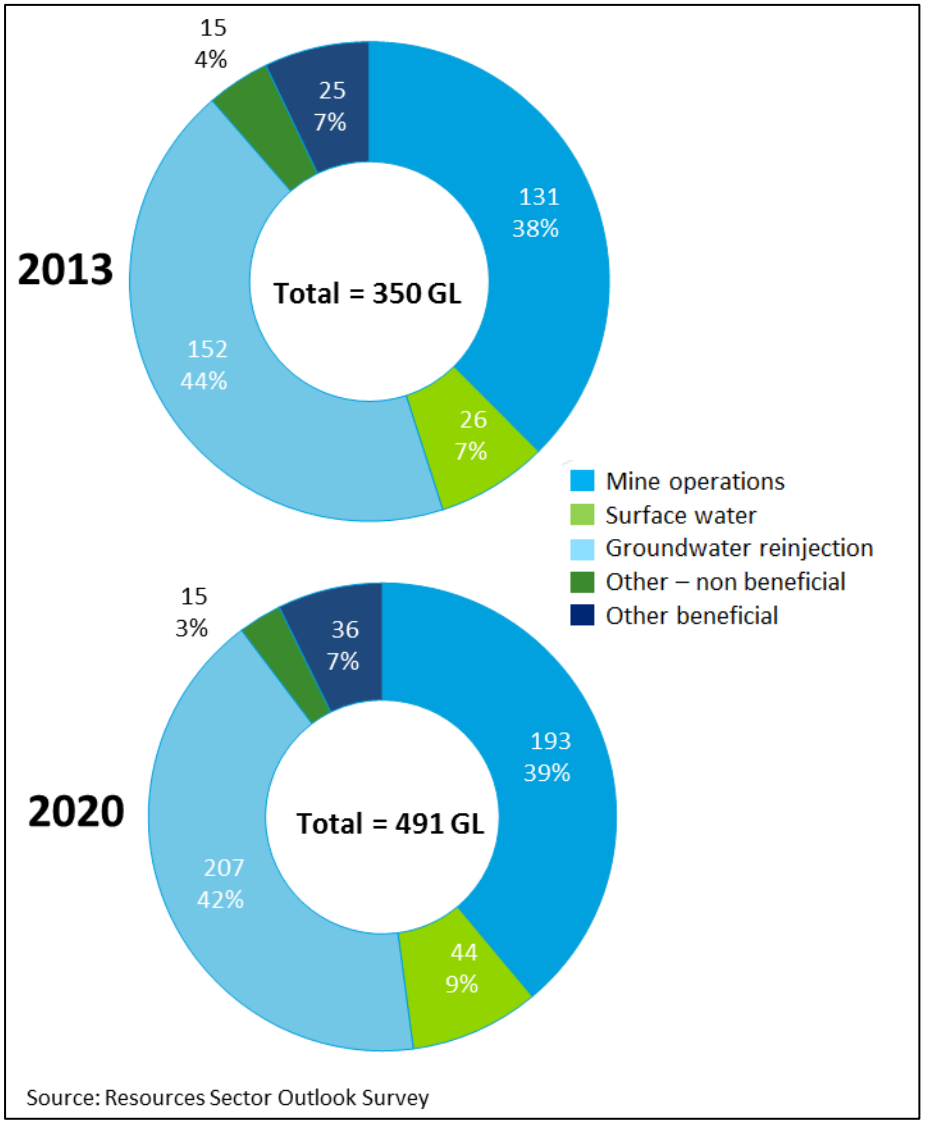
In the Pilbara region, 91% of the resources sector's water needs are sourced from groundwater resources, with 80% for the purpose of dewatering. This proportion is significantly greater than across the rest of the State.

Dewatering in the Pilbara is expected to moderately increase as a share of total abstraction by 2020 to 82%. The region's second largest source of water abstraction, 'Other Groundwater' (primarily for above water table operations), makes up 11% of total water abstraction. This proportion is not expected to change over the forecast period.

[69] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown

5.4.3 Pilbara – Destinations

Pilbara resources sector water destinations (GL, %)[70]



Source: Resources Sector Outlook Survey

Mine operations in the Pilbara use 38% of the water abstracted. This proportion is in line with use across the broader resources sector in Western Australia.

The proportion of water used for mine operations is expected to stay steady over the medium term, increasing slightly to 39% by 2020. Likewise, the proportion of water returned to the environment via surface water discharge or reinjection is expected to remain the same at 51%.

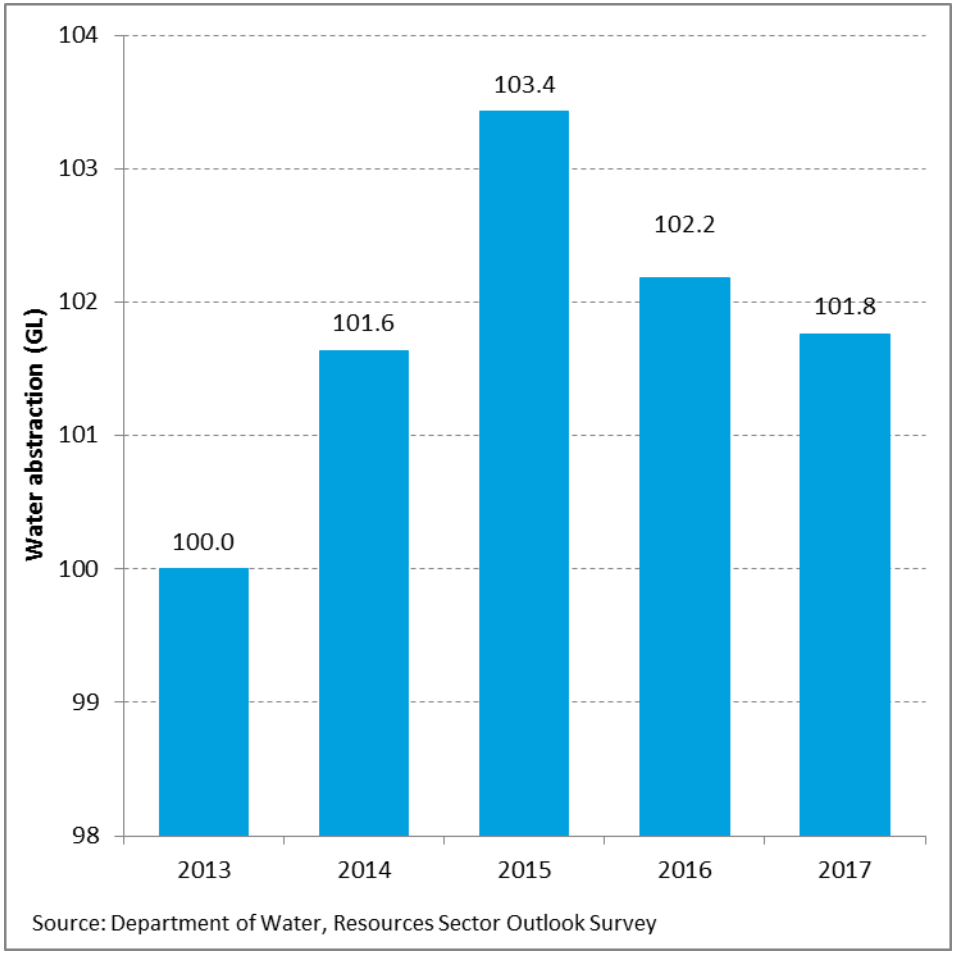
The share of groundwater reinjection as a water destination is expected to fall from 44% to 42% by 2020, although the quantum of reinjection is forecast to increase, in line with the significant rise in abstraction for dewatering purposes.

Other water destinations are expected to remain broadly steady and relatively small in terms of the overall proportion of water abstraction.

[70] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown

5.4.4 Goldfields-Esperance – Water abstraction

Goldfields-Esperance resources sector water abstraction, increment from 2013[71]



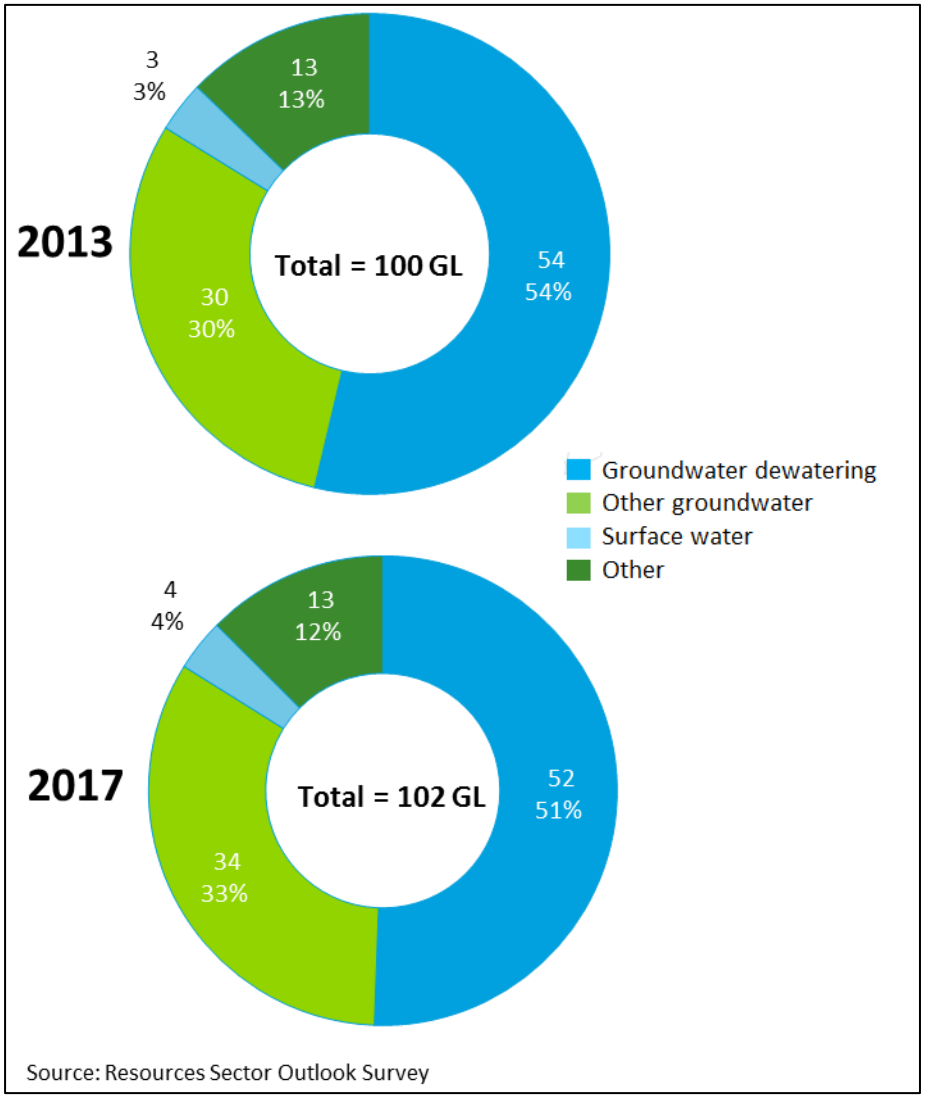
Water abstraction is not expected to change significantly in the Goldfields-Esperance.

After increasing from 100 GL in 2013 to a peak above 103 GL in 2015, water abstraction in the Goldfields-Esperance is expected to fall to 102 GL by 2017. The forecast decline in water abstraction in this region may be due to the nature of projects within the Goldfields-Esperance region, whereby expected demand profiles are not often prepared over long time horizons, and tend to be updated periodically as the life of mine is extended over time.

[71] Forecast data in the figure above are expressed as an 'increment from 2013', which show changes each year from a constant base year of 2013

5.4.5 Goldfields-Esperance – Sources of abstraction

Goldfields-Esperance resources sector sources of abstraction (GL, %)



Source: Resources Sector Outlook Survey

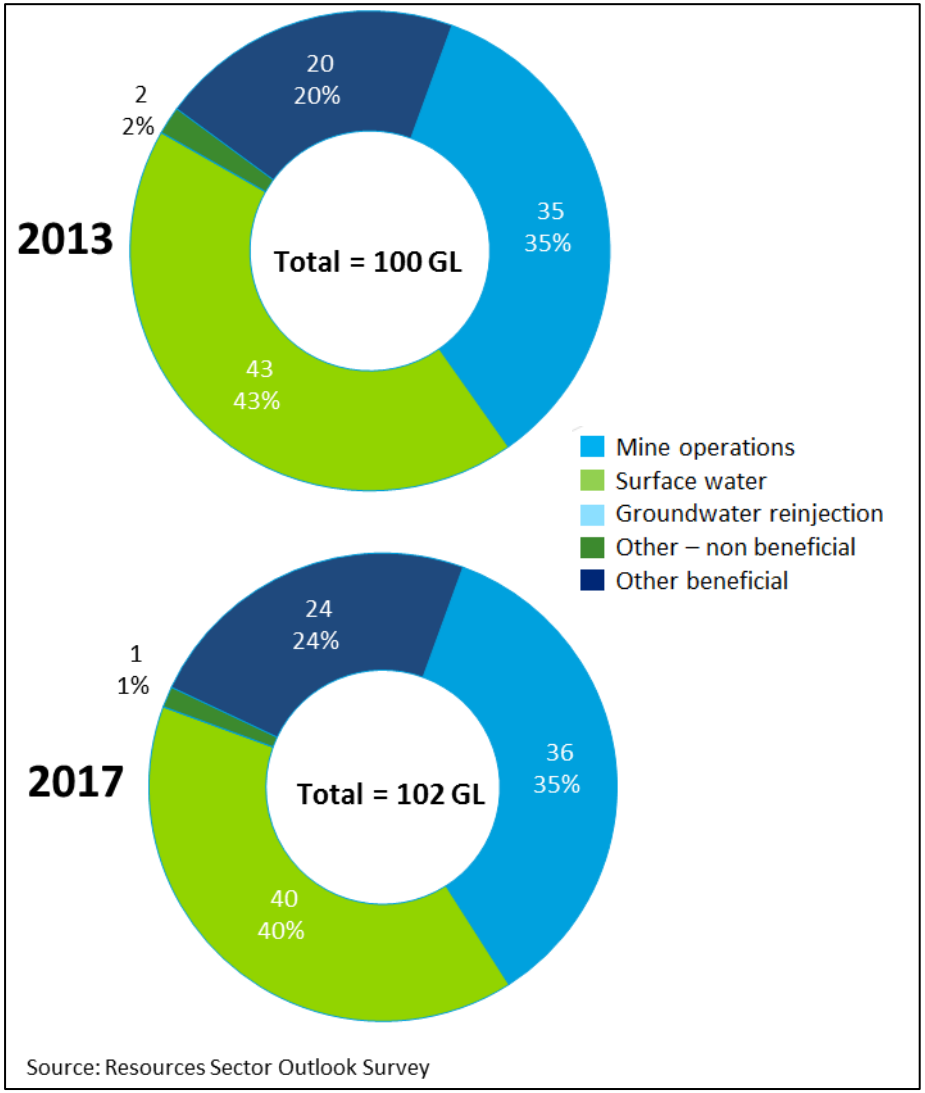
In the Goldfields-Esperance region, 84% of the resources sector's water needs are sourced from groundwater resources, with 54% for the purposes of dewatering.

In 2013, other groundwater sources (including bore field abstraction and ore entrainment) contributed 30% of water abstraction in the region. This proportion is expected to rise to 33% by 2017.

Overall, groundwater abstraction for dewatering purposes accounts for 54% of all water abstraction. This share is projected to decline to 51% by 2017, however, mining below the water table will still be significant.

5.4.6 Goldfields-Esperance – Destinations

Goldfields-Esperance resources sector water destinations (GL, %)[72]



Source: Resources Sector Outlook Survey

The breakdown of water destinations in the Goldfields-Esperance region is not forecast to change significantly between 2013 and 2017.

Dewatering is a key source of water in the Goldfields-Esperance region. While a small amount is returned to the environment via aquifer reinjection, discharge to surface water is the most substantial destination for abstracted water in the region, comprising 43%.

The discharge of surface water is not expected to change significantly by 2017. Water for mine operations will remain constant at 35%. Use of abstracted water for beneficial purposes will increase slightly to 24%.

[72] The percentages shown are rounded up. Therefore, multiplying the percentages shown by the individual totals and summing the individual totals may not add to the grand total shown

5.4.7 Other regions

Kimberley

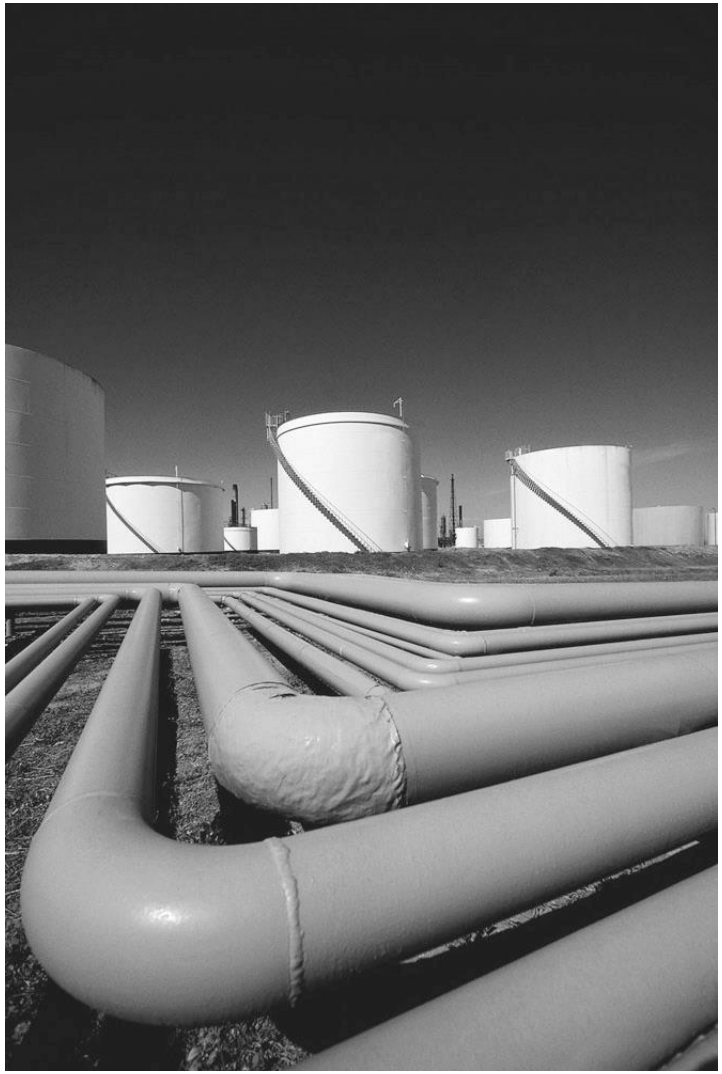
Water abstraction in the Kimberley is forecast to increase by 23 GL to 2020. The majority of this increase will be sourced from sea water and returned to the environment with no use in operations or other beneficial use.

Mid West

The Mid West is expected to see a slight increase in resources sector water abstraction, by 2 GL between 2013 and 2020.

Other

Other regions, including the Gascoyne, Great Southern, Peel/Perth, South West and Wheatbelt regions, are not expected to experience any material change in resources sector water abstraction over the forecast period.



5.5 Policy implications and opportunities

Four key policy implications and opportunities have been identified from the above analysis:

1. ***Water scarcity requires market mechanisms to efficiently allocate supply, where markets are possible.***

The majority of water abstracted by the resources sector is located in isolated parts of the State and is accessed from fractured rock aquifers. These are therefore remote from drinking and commercial water sources in most regions. However, there is potential in some regions for water scarcity to emerge where residential, mining and other commercial interests intersect.

While cases of this are limited, the State Government and industry should work together to refine how market mechanisms can be used as a means to resolving conflicts and issues of scarcity by encouraging an efficient allocation of water among competing users.

The State Government's intentions to introduce new water resources management legislation – which seeks to enable market mechanisms alongside other tools for water allocation and management – is supported and encouraged.

2. ***The volume of dewatering water surplus to mine needs may provide a supply for beneficial purposes, but volatility of supply and water quality are key constraints which will impact the viability of options.***

The State Government has identified mine dewatering as a potential source of water than can enable other economic activity, such as irrigated agriculture, industrial use or to meet the recreational and social needs of the community.

However, the sharp variability in the forecast dewatering profile needs to be considered against the reliability of supply required by users. Some beneficial uses may require constant, predictable volumes of supply throughout the year.

While the amount of surplus dewater is significant, it can be highly volatile over the short term and long term, a function of variability in both life of mine dewatering profiles and the spatial and temporal aspects of specific below water table projects. Availability of water after mine closure also needs to be considered.

These hurdles are recognised by the State Government in the Department of Water's *Strategic policy 2.09: Use of mine dewatering surplus* document.

It is possible these barriers may be overcome with the development of suitable commercial models to reflect supply variability and appropriate priority of use. Specifically, beneficial use projects need to be able to accept and adequately price the risks related to security of supply arising from supply driven water sources, without compromising the source mine plan.

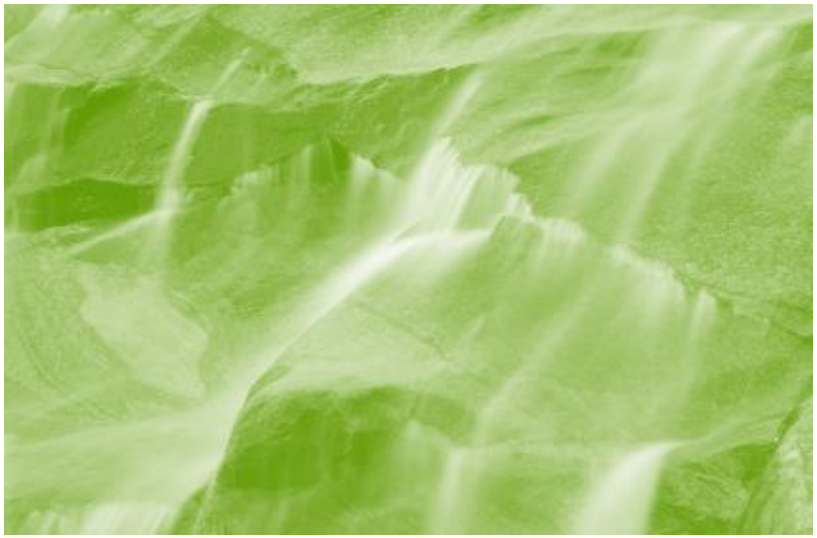
Additionally, water quality is an important factor for consideration when identifying the potential for use, both for the mining proponent and relevant third parties.

Although the volume of dewatering may be significant, this does not mean surplus water is suitable for beneficial use. Some mine operations abstract highly saline water unfit for use with appropriate treatment. Water surplus to mine needs may also contain traces of mineral resources or introduced chemicals, which may add costs to third party use.

3. Cumulative effects remain a priority issue, but further work is needed to ensure an appropriate management framework is developed.

While there is forecast to be an increasing volume of abstraction in the mining sector, high level data capture cannot identify potential areas of adverse cumulative effects. This requires a deeper granularity of analysis on a catchment-by-catchment basis.

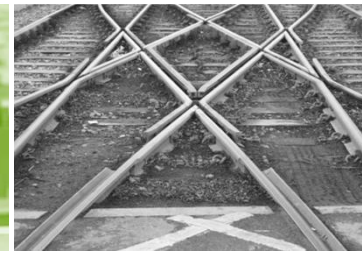
Timely, effective and risk-based identification and management of cumulative effects requires government leadership paired with collaboration within the sector. Existing regulatory arrangements are unclear on how to identify values at risk, manage cumulative effects across multiple contributors, and how management responses should be developed collaboratively.



6 Infrastructure

Chapter contents



6.1 Chapter summary

Key trends

Investment

- Investment in infrastructure has been a key driver of economic growth in Western Australia over the past decade. From 2004 to 2014, the average annual value of infrastructure construction has risen from $0.8 billion to $4.3 billion.
- Western Australia has a significant pipeline of major infrastructure projects, worth $247 billion as at September 2014. Nearly 60% of this value relates to projects currently under construction.

Aviation

- Perth Airport and several regional airports servicing the resources sector experienced significant growth in passenger volumes over the last decade, before contracting slightly in recent years. After increasing from 324 in 2009-10 to 415 in 2012-13, average daily aircraft movements at Perth Airport fell to 410 in 2013-14.
- Despite a projected smaller resources sector workforce by 2020, resources sector passengers utilising Perth Airport are forecast to be 313,000 above 2014 levels in 2020. This reflects shorter shift patterns at operational phase, which generates higher passenger movements.
- Demand for Perth Airport outbound timeslots from the resources sector is expected to remain unchanged over the medium term, with a preference for mid-week slots, between 6:00 and 9:00 am.

Ports

- A decade of buoyant commodity prices has driven an increase in the total volume and value of the State's international seaborne trade. From 2003-04 to 2012-13, the volume of sea freight has increased from 278 Mtpa to 645 Mtpa, while in value terms, trade has increased from $34 billion to $127 billion.
- By 2020, resources exported from Western Australian ports are expected to increase by 534 Mtpa above 2013 levels.

Road and rail

- Over the period 1972-73 to 2012-13, Western Australia recorded the highest annual growth rate of any State in terms of road freight movements (7% per year).
- According to the Department of Transport, Western Australia's regional road freight task is projected to almost double over the next two decades, from 24 billion tkm in 2012 to 40 billion tkm by 2030.
- Privately owned and operated rail lines in the Pilbara transport the majority of iron ore to ports for export. In total, rail transported 168 billion tkm of iron ore in Western Australia in 2011-12.

Summary of policy implications and opportunities

1. **A sound business case for determining future investment is required as forecast resources sector passengers at Perth Airport increase over the medium term due to shorter operational rosters.**

   To justify new investment, including the development of an additional runway, any business case process should be consultative and examine how existing infrastructure and processes can be optimised.

2. **Investment in regional airport infrastructure must keep pace with investment at Perth Airport to avoid creating bottlenecks in the regions.**

   For safety, fatigue and roster cycle management purposes, the resources sector requires stable departure and arrival slots. To the extent that current investment allows Perth Airport to continue to meet growing demand by the resources sector for existing slots, then there is a risk bottlenecks could be created at regional airports without adequate investment.

   The draft State Aviation Strategy also identifies infrastructure at a number of regional airports as being inadequate to meet current levels of demand.

3. **Some regional airports in Western Australia hold national significance and may benefit from being operated by the private sector.**

   There are financial constraints facing many local government-run regional airports, including their limited ability to invest in the required level of new infrastructure to support increasing air traffic and larger aircraft using these destinations.

   Private sector funding of regional airports should be considered as part of broader airport management, as identified in the draft State Aviation Strategy, through long term lease arrangements and/or changes to the *Local Government Act 1995*, where required. Additionally, given the operation of airports is not core to the functioning of local governments, greater efficiencies may be generated from allowing the private sector to manage these facilities.

4. **Additional port capacity will be required in the Pilbara in the medium term.**

   Growth in resources exported from Western Australian ports, underpinned by the Pilbara, may ultimately exceed available capacity at established ports – with a number already experiencing capacity issues. Additional investment in these facilities and in new port capacity should be considered a priority in the medium term.

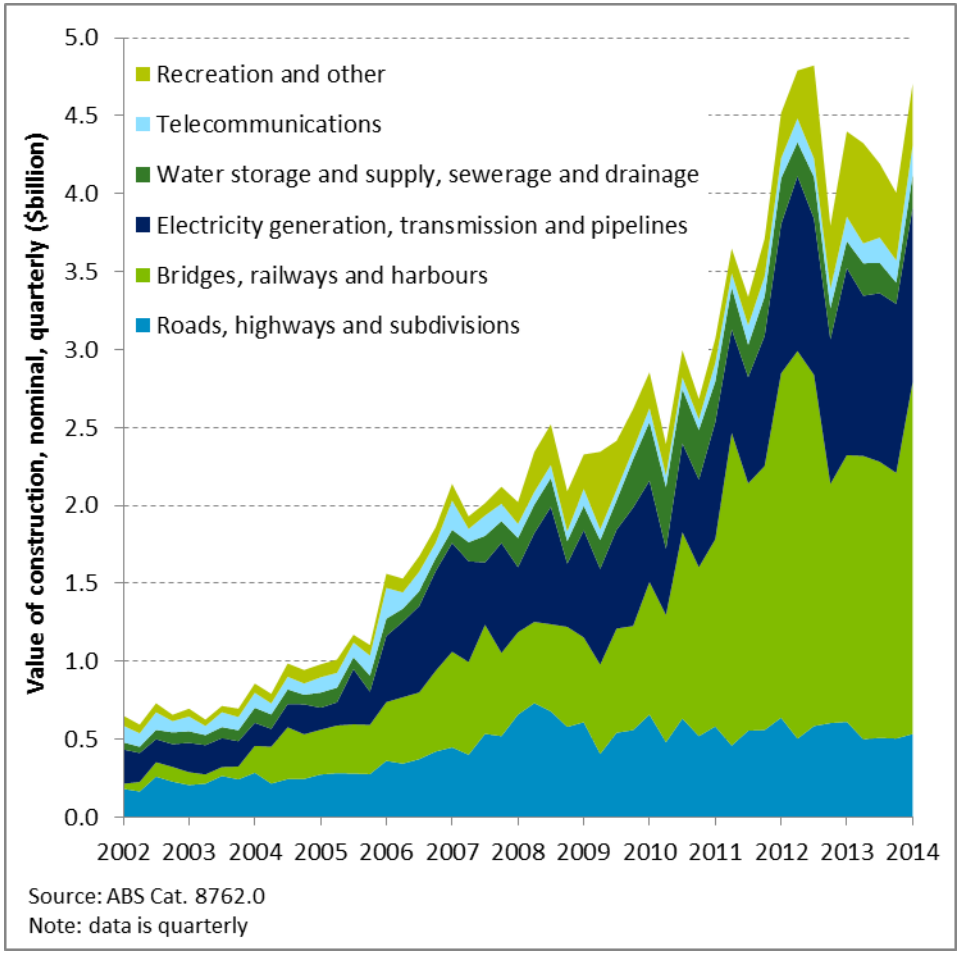
5. **There is room for improvement in infrastructure planning in Western Australia, while fiscal constraints also require new ways of funding infrastructure.**

   The current State framework for infrastructure planning does not optimise collaboration between the public and private sectors in the delivery of crucial infrastructure projects. Consideration should be given to an independent government body responsible for infrastructure prioritisation and coordination in Western Australia.

6.2 Investment trends

6.2.1 Infrastructure investment

Infrastructure related engineering construction, Western Australia



Investment in infrastructure has been a key driver of economic growth in Western Australia over the past decade, with investment in bridges, railways and harbours making up more than half of this investment.

The value of infrastructure construction has risen from $0.9 billion as at the June quarter of 2004 to $4.5 billion during the June quarter of 2014, representing an annualised growth rate of 18%[73].

Investment in bridges, railways and harbours were the largest areas of investment in infrastructure. Over the last 10 years, investment in these assets has grown from $0.2 billion as at the June quarter 2004 to $2.3 billion as at the June quarter 2014.

Electricity, roads and telecommunications also represent significant areas of investment as at the June 2014 quarter (1.1 billion, $0.5 billion and $0.2 billion, respectively).

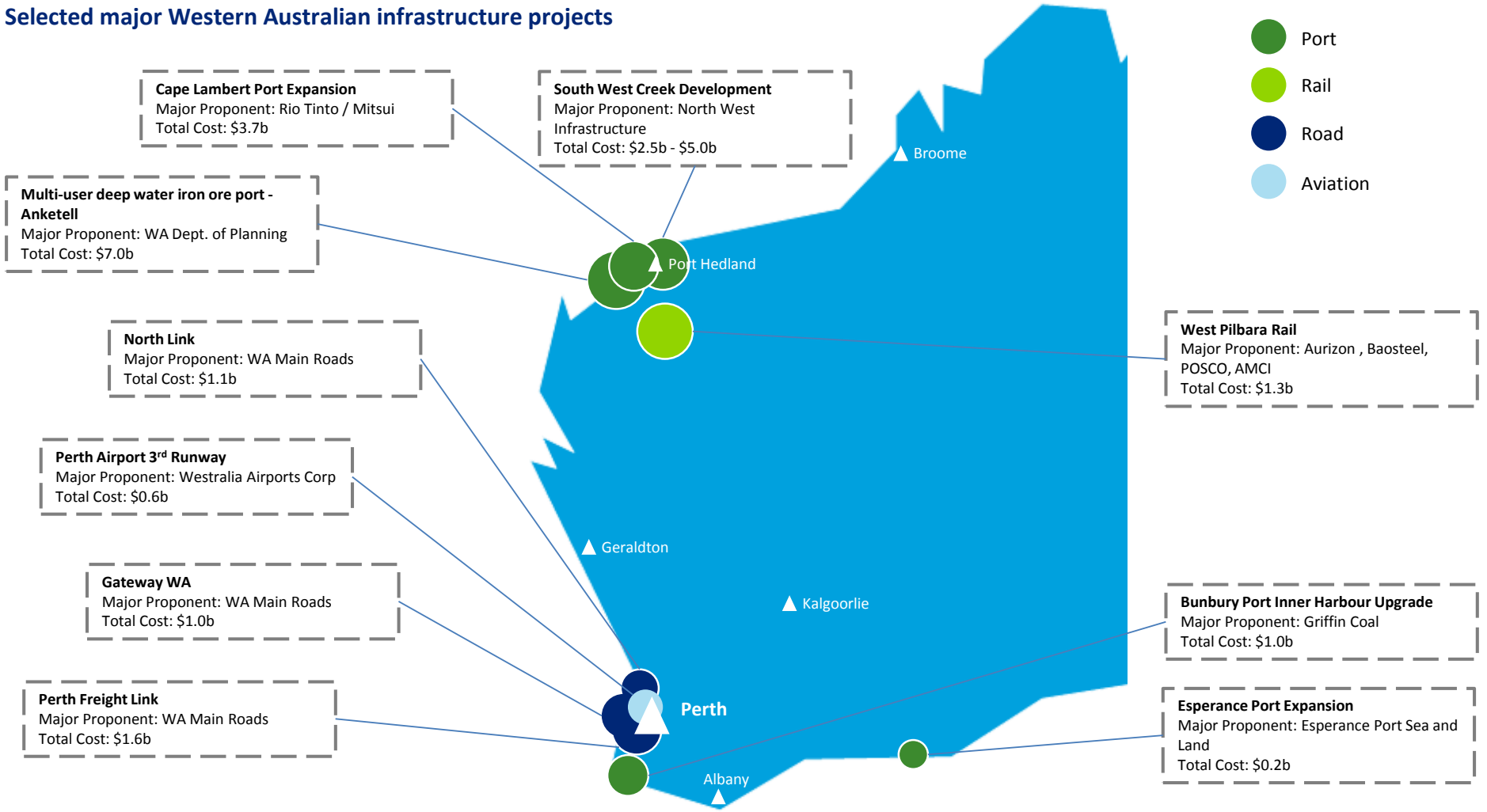
However, the value of infrastructure investment has likely peaked with the resources sector transitioning from the construction to the operational phase.

[73] ABS catalogue 8762.0

6.2.2 Western Australia's infrastructure investment pipeline

The State's pipeline of major infrastructure projects was worth $36.7 billion in September 2014, 29% of which consists of projects under construction, with the remainder either committed, under consideration or possible.

Selected major Western Australian infrastructure projects



Source: Deloitte Access Economics Investment Monitor, BREE Major Projects

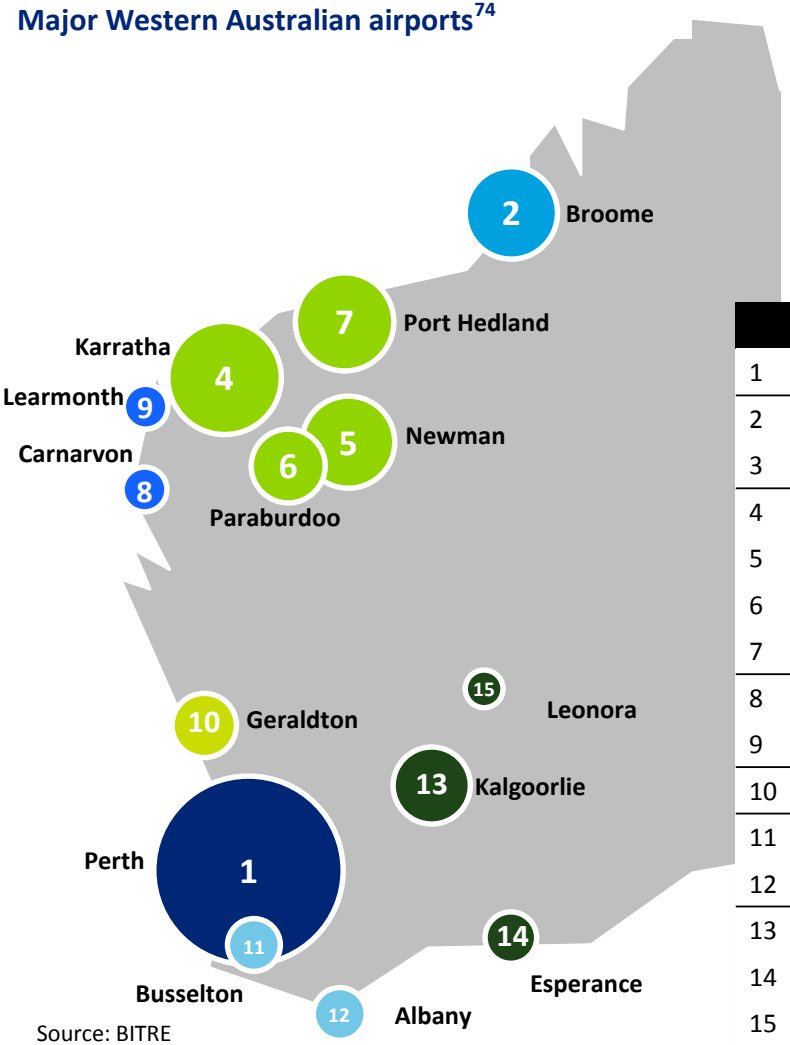
6.3 Aviation trends

6.3.1 Aviation infrastructure

Western Australia has 15 key airports, which together serviced almost 16 million passengers in 2013-14.

Ten regional airports in Western Australia are owned and operated by Local Government Authorities. These include Albany, Derby-Curtin, Esperance, Geraldton, Kalgoorlie, Karratha, Kununurra, Learmonth, Newman and Port Hedland. The other regional airports listed in the table below are owned by the State Government with the exception of the privately owned Broome Airport.

Major Western Australian airports[74]



	Airport	Region
1	Perth	Perth & Peel
2	Broome	Kimberley
3	Kununurra	
4	Karratha	Pilbara
5	Newman	
6	Paraburdoo	
7	Port Hedland	
8	Carnarvon	Gascoyne
9	Learmonth	
10	Geraldton	Mid West
11	Busselton	Great Southern / South West
12	Albany	
13	Kalgoorlie	Goldfields - Esperance
14	Esperance	
15	Leonora	

Source: BITRE

[74] Bubble sized based on relative 2013-14 total passenger movements (PAX) – Perth not drawn to scale

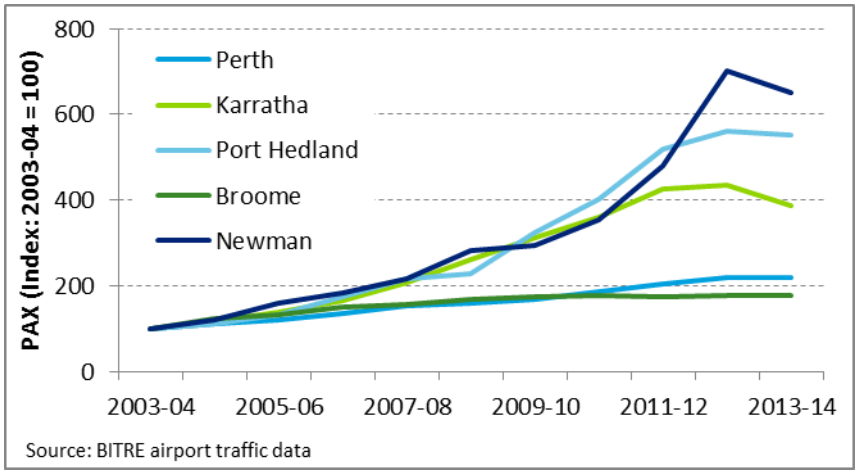
6.3.2 Passenger volumes

Top 10 Western Australian airports by passenger numbers

Airport	2003-04	2013-14	CAGR
Perth	5,888,799	12,936,490	8.2%
Karratha	187,401	727,798	14.5%
Port Hedland	91,371	512,630	18.6%
Broome	230,924	410,618	5.9%
Newman	62,670	408,332	20.6%
Kalgoorlie	160,352	237,396	4.0%
Paraburdoo	61,717	209,087	13.0%
Geraldton	56,707	129,980	8.7%
Learmonth	25,374	90,452	13.6%
Kununurra	40,239	86,279	7.9%

Source: BITRE airport traffic data

Historical Western Australian PAX growth, by airport



Perth airport and several regional airports servicing major resources sector regions have recorded significant growth in passenger (PAX) volumes over the last decade.

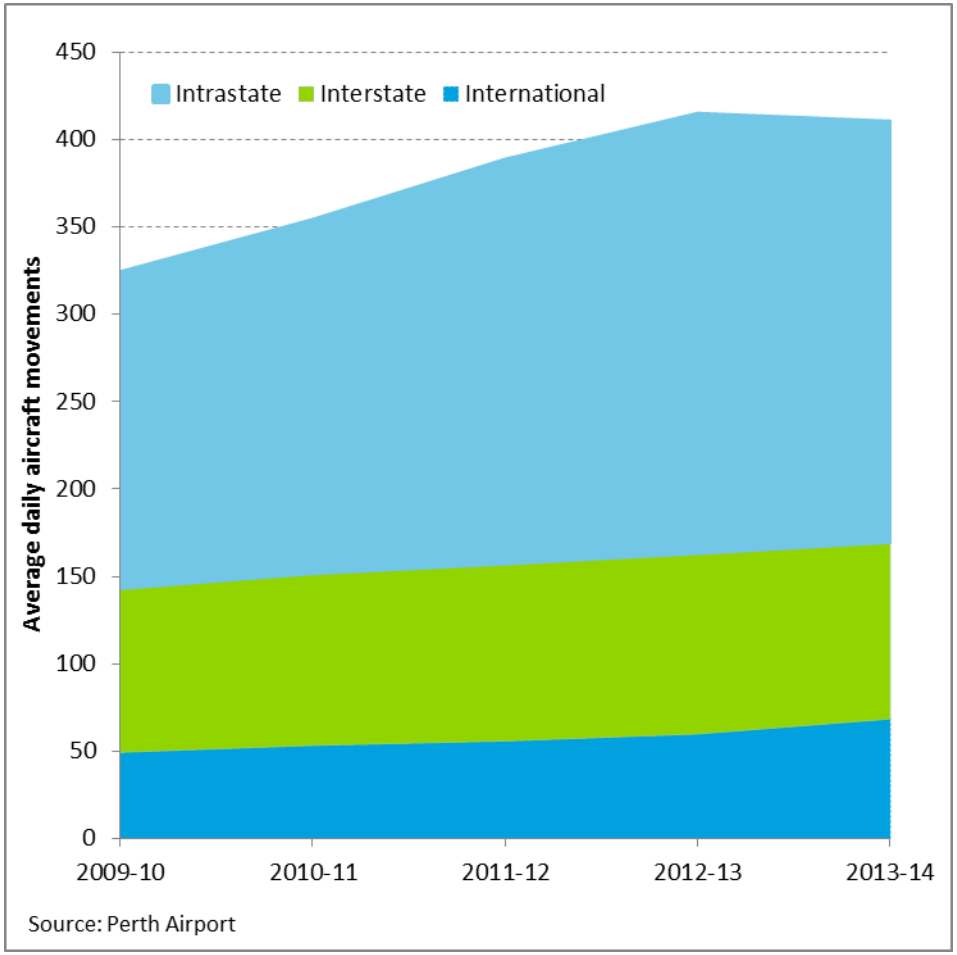
Regional airports located near resources sector operations, such as Port Hedland, Newman and Karratha, have seen the largest growth in PAX since 2003-04. A large construction workforce has driven this growth. Newman airport has recorded the largest growth in PAX, growing at 20% over the last decade.

In 2013-14, declines in PAX volumes have been recorded at most regional airports as several expansion projects reduce their construction workforce and are yet to fully transition into the operational phase.

Perth Airport caters to the largest number of PAX of all airports in Western Australia, accounting for approximately 80% of all passenger movements in the State's airports.

6.3.3 Perth Airport aircraft movements

Perth Airport average daily aircraft movements, inbound and outbound



Fewer intrastate flights meant Perth Airport recorded a decline in aircraft movements in 2013-14 after a period of strong growth.

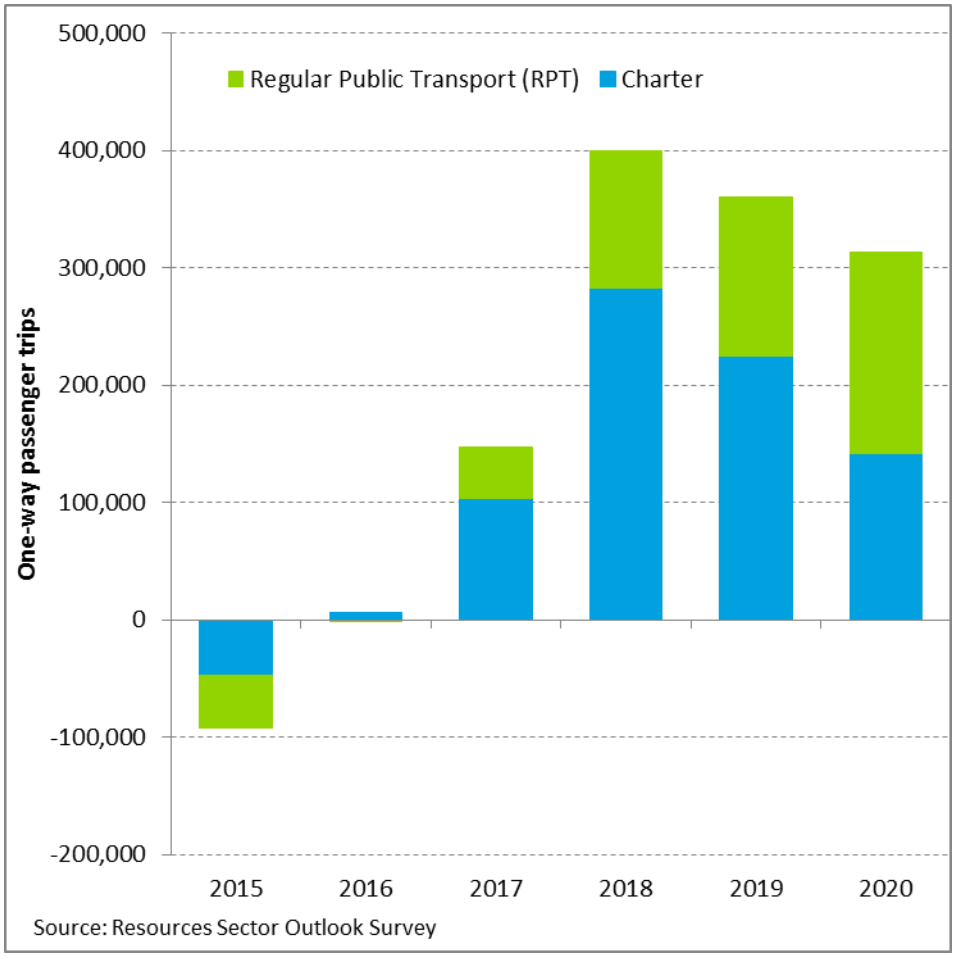
Intrastate flights make up more than 50% of daily aircraft movements at Perth Airport. The resources sector accounts for a significant proportion of these flights as a result of trips between Perth, regional airports and mine site airstrips.

After increasing from 180 average daily aircraft movements in 2009-10 to 251 average movements in 2012-13, intrastate movements declined to 240 in 2013-14.

Despite the softening in demand, capacity remains an issue at Perth Airport due to the time-specific departure and arrival needs of the resources sector.

6.3.4 Perth Airport forecast PAX movements

Perth Airport resources sector PAX, increment from 2014[75]



Recent declines in resources sector PAX volumes at Perth Airport are expected to continue in the short term before recovering.

By 2020, resources sector PAX utilising Perth airport are forecast to be 313,000 above 2014 levels. One-way passenger trips in 2020 associated with regular public transport (RPT) and charter flights are projected to be 172,000 and 141,000 above 2014 levels, respectively.

Despite the forecast decline in the size of the resources sector workforce between 2013 and 2020, PAX movements are expected to increase due to shorter operational roster cycles. A construction workforce roster is typically four weeks on, one week off, or three weeks on, one week off – whereas an operational roster is more likely to be two weeks on, one week off or nine days on, five days off.

A range of operational efficiencies have been pursued at Perth Airport to address capacity constraints such as the introduction of the schedule coordination system. A sound business case should be undertaken to assess the demand for a third runway.

[75] Forecast data in the figure above are expressed as an 'increment from 2014', which show changes each year from a constant base year of 2014. Charter passenger numbers have also been estimated employing estimates of airplane capacity derived from the 2013 CME Airports Study

6.3.5 Perth Airport forecast timeslot demand

Expected distribution of resources sector flight slots (outbound from Perth)[76]

	M	Tu	W	Th	F
Before 6am	0%	7%	9%	4%	1%
Between 6am and 9am	9%	11%	21%	9%	7%
Between 9am and 3pm	3%	3%	4%	7%	1%
After 3pm	0%	3%	0%	1%	1%

Source: Resources Sector Outlook Survey

Expected distribution of resources sector flight slots (inbound to Perth)[76]

	M	Tu	W	Th	F
Before 6am	0%	3%	0%	0%	0%
Between 6am and 9am	0%	8%	10%	0%	0%
Between 9am and 3pm	4%	6%	11%	4%	0%
After 3pm	0%	13%	18%	18%	4%

Source: Resources Sector Outlook Survey

[76] M = Monday, Tu = Tuesday, W = Wednesday, Th = Thursday, F = Friday. Percentages indicate proportion of respondents

Demand from the resources sector for specific departure and arrival slots at Perth Airport is not expected to change significantly over time.

Wednesday between 6:00 am and 9:00 am is expected to remain the most popular timeslot for outbound traffic from Perth Airport out to 2020. In addition, there is also strong demand for outbound slots between 6:00 am and 9:00 am on Tuesday and Thursday.

Flights from mine sites and regional airports to Perth are more heavily concentrated in the mid and latter part of the week and generally in the afternoon and evening periods, after 3:00 pm from Tuesday to Thursday.

6.3.6 Key regional airport infrastructure issues

Five year regional airport infrastructure requirements

Airport	Estimated Cost ($m)	Runway	Taxiway	Apron	Terminal	Hangers	Services
Albany	15.0	✓			✓		✓
Broome	n/a	✓			✓		
Derby-Curtin	1.7	✓			✓	✓	
Esperance	2.6				✓		
Geraldton	109.2	✓	✓	✓	✓		✓
Kalgoorlie	n/a	✓	✓				
Karratha	46.0			✓	✓		
Kununurra	27.0	✓	✓	✓			
Learmonth	7.0	✓	✓		✓	✓	✓
Newman	60.0	✓		✓	✓		✓
Paraburdoo	n/a	✓					
Port Hedland	70.5	✓		✓	✓	✓	✓
Total	**339.0**						

Source: WA Department of Transport, draft State Aviation Strategy 2013

The State Government's draft State Aviation Strategy identifies runway capacity and terminal infrastructure as key investment priorities over the next five years.

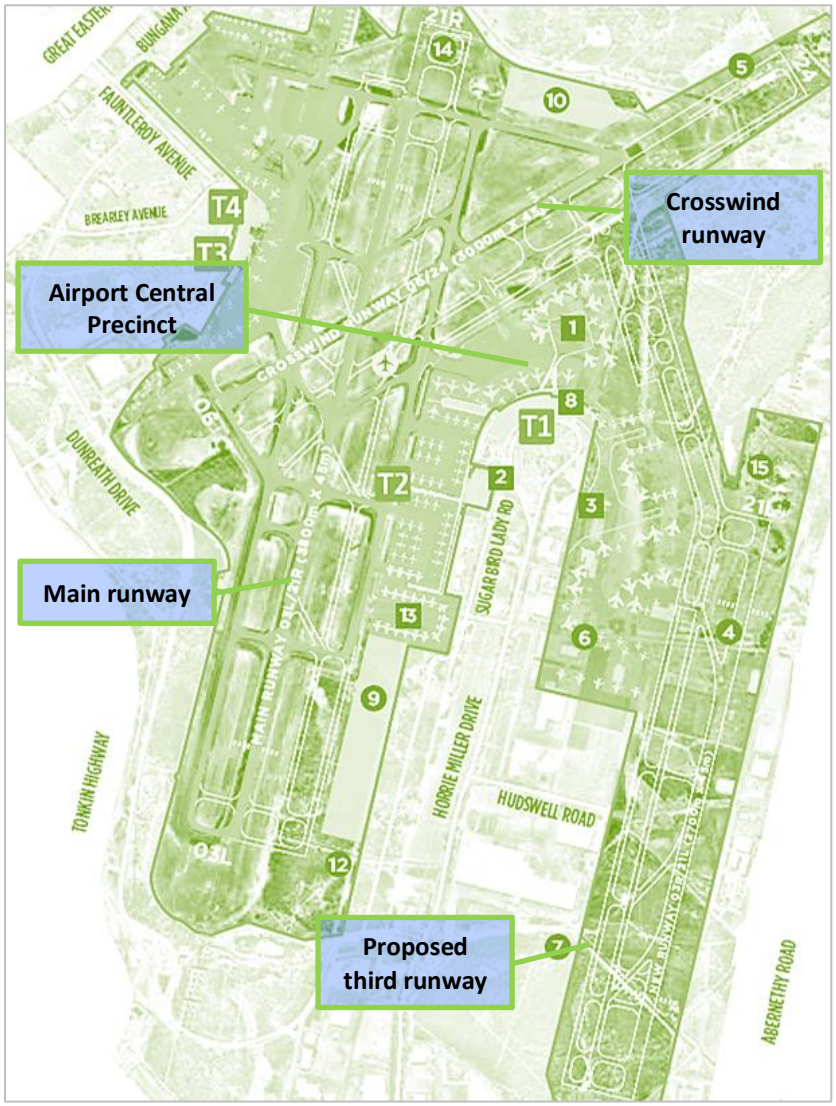
To overcome existing capacity constraints Geraldton, Port Hedland and Karratha Airports are all expected to require significant investment across a range of infrastructure, including runways, taxiways, aprons and terminal facilities. Required upgrades to each of these airports are expected to cost over $50 million[77].

For smaller airports, investment in security infrastructure is required, although this is expected to place a disproportionate cost burden on passengers relative to other airports.

[77] WA Department of Transport, draft State Aviation Strategy 2013

6.3.7 Perth airport development initiatives

Perth Airport 2034 Development Plan



Source: Perth Airport Preliminary Draft Master Plan 2014, Perth Airport Pty Ltd

Perth Airport is undertaking and planning a number of development initiatives to improve the operational efficiency of the airport.

The Perth Airport Preliminary Draft Master Plan 2014 identifies the need for a third runway at Perth Airport. The runway is proposed to cater for the airport's projected increase in demand over the coming 20 year period. Due to the nature of the resources sector's FIFO workforce and the need for many international flights to connect to other services at hub airports, Perth Airport experiences significant peak periods. The 2,700 m third runway is planned for a site east of the airport running parallel to the existing main runway.

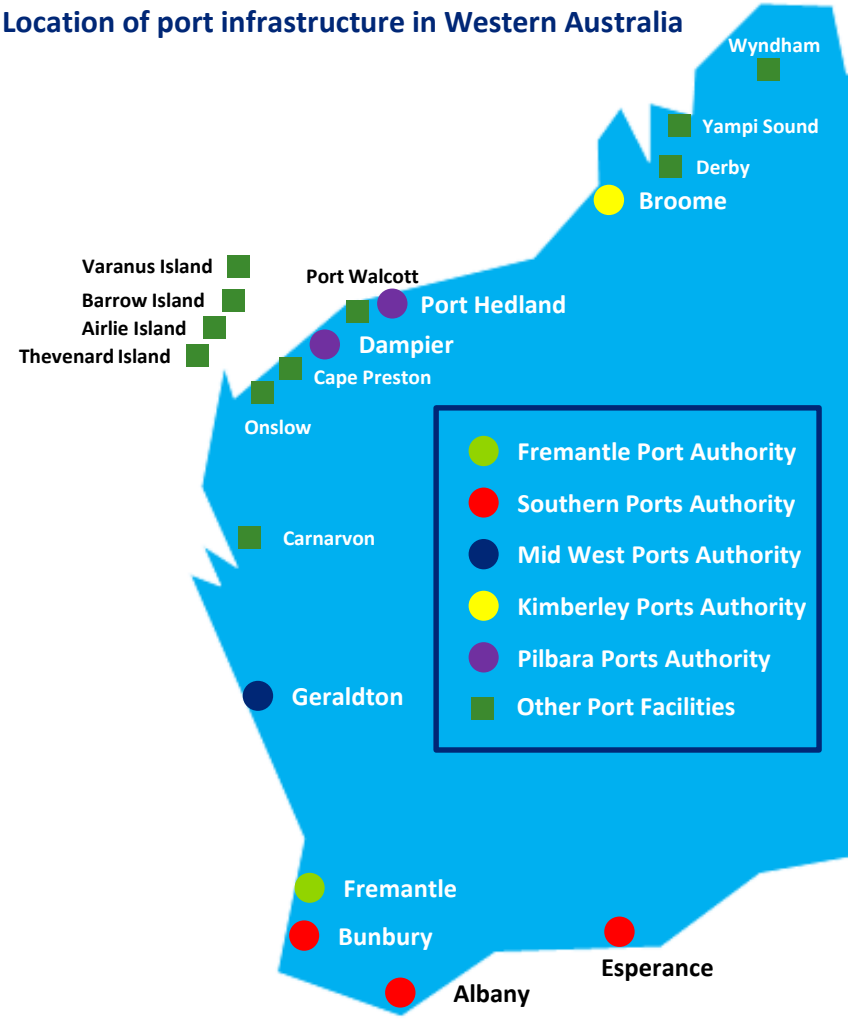
In addition, the Preliminary Draft Master Plan proposes consolidation of terminal activity into the Airport Central Precinct. The Airport Central Precinct (previously referred to as Perth Airport International Terminal) now caters for both domestic and international aviation operations. Perth Airport has developed a plan to consolidate all commercial air services into the Airport Central Precinct by the early 2020s.

As a national infrastructure priority, the Gateway WA project is underway and aims to improve the road network into and around Perth Airport prior to the consolidation of the domestic and international terminals.

6.4 Port trends

6.4.1 Port infrastructure

Location of port infrastructure in Western Australia



Source: WA Department of Transport, WA Ports Handbook

Demand for Western Australia's exports remains strong, driving further demand for port infrastructure and services.

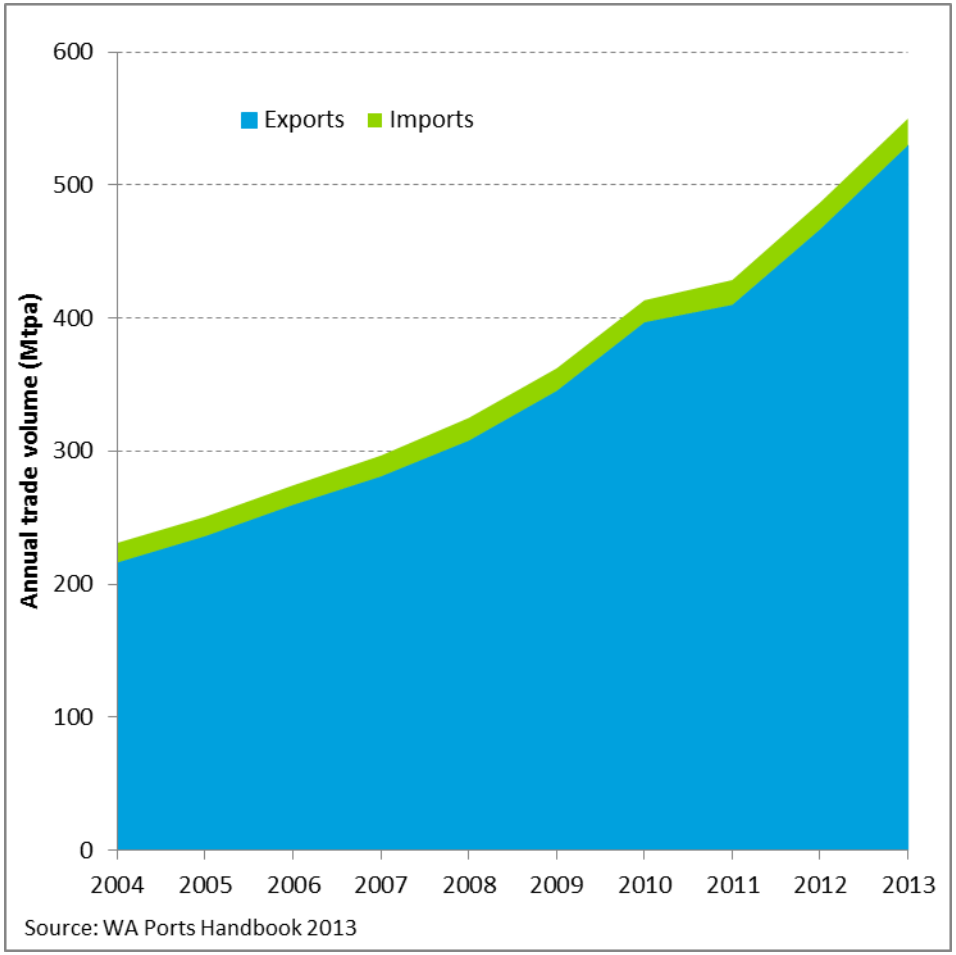
The State Government consolidated Western Australia's Port Authorities in 2014. Eight port authorities were amalgamated into four regional port authorities, while Fremantle Port Authority remains a standalone authority. The four regional port authorities are now Southern Ports Authority (Albany, Bunbury and Esperance), Mid West Ports Authority (Geraldton), Kimberley Ports Authority (Broome), and Pilbara Ports Authority (Dampier and Port Hedland).

There are 13 other non-port authority ports in Western Australia. These ports are generally operated by resources sector companies, and handle bulk commodity exports such as iron ore, crude oil and salt. The government intends for these ports to be amalgamated under the new port authority structure, with legislation to enable this scheduled to be introduced into Parliament within 12 months (Tranche 2).

In addition to the second tranche of port amalgamation, and the development of a Port Improvement Rate policy, the Department of Transport will develop a State Ports Strategy in consultation with industry.

6.4.2 Port authority ports

Aggregate port authority ports trade volume



The total volume of trade through port authority ports has more than tripled since 2004.

Trade volume (imports and exports) at all ports has risen from 231 million tonnes (Mt) to 550 Mt during the period 2004 to 2013.

Port Hedland and Dampier Ports represent the majority of throughput, with almost 500 Mt exported. Port Hedland is the world's largest bulk export port, with almost its entire throughput coming from the iron ore industry. Dampier Port exports both iron ore (83% of trade in 2013-14) and LNG (11%).

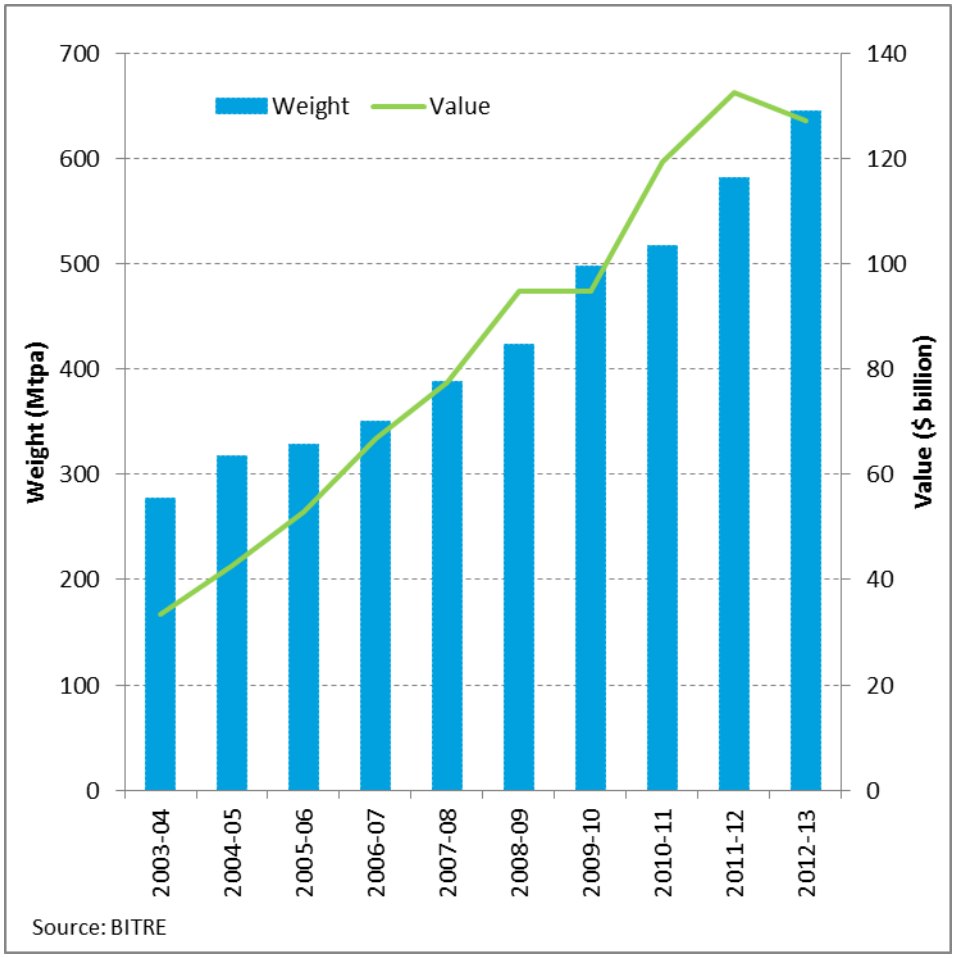
Fremantle Port is the State's largest import port, with throughput of 14 Mt in 2013.

Overall, Western Australia's significant port infrastructure positions it at the centre of Australia's export industry, with the State accounting for almost half of all exports earnings nationally in August 2014[78].

[78] ABS catalogue 5368.0

6.4.3 International trade

Western Australia's international seaborne freight, weight and value



International seaborne trade across all ports in Western Australia – both port authority ports and non-port authority ports – has increased significantly over the past 10 years.

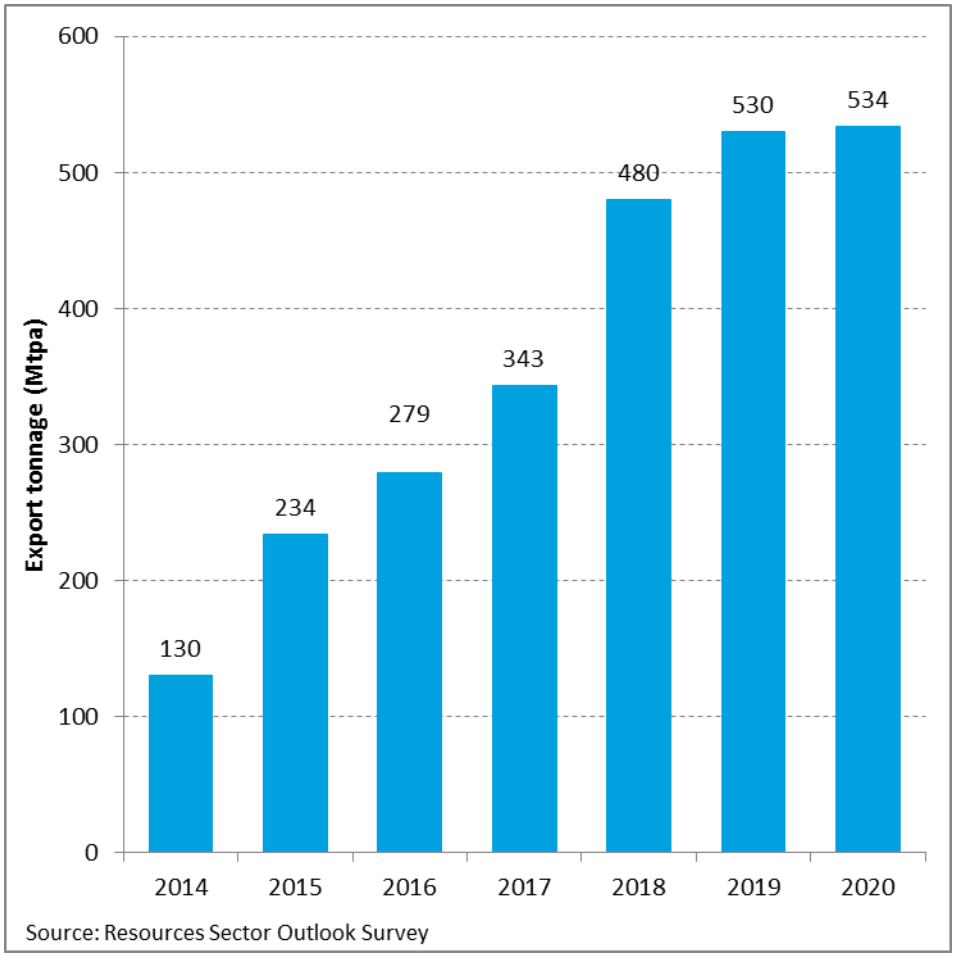
A decade of buoyant commodity prices has driven an increase in the total volume and value of the State's international seaborne trade.

The volume of international seaborne freight has increased at an annual rate of 9% from 2003-04 to 2012-13, from 278 Mtpa to 645 Mpta. In value terms, trade has risen by 16% annually from $34 billion to $127 billion in 2012-13.

After nine years of uninterrupted growth, the value of the State's seaborne trade fell by $5 billion in 2012-13 as commodity prices softened. Despite the drop in value, volumes continued to increase, as new production came online at a number of Pilbara iron ore projects.

6.4.4 Forecast port throughput

Resources sector export volume, increment from 2013



Export-driven throughput at Western Australian ports is forecast to increase significantly as new resources projects complete construction and commence operations.

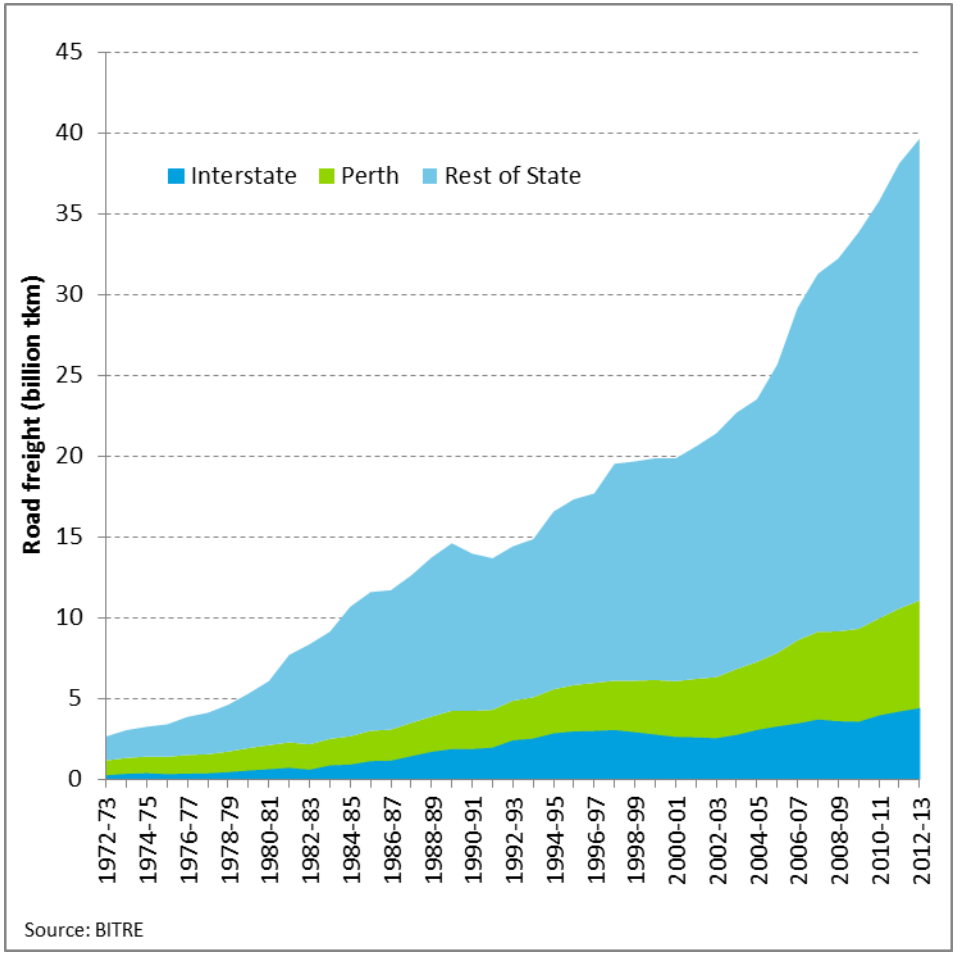
By 2020, resources exported from Western Australian ports are expected to increase by 534 Mtpa above 2013 levels. This represents an 80% increase from Western Australia's entire international seaborne freight volume in 2012-13.

Growth of this magnitude may constrain port and landside capacity at ports such as Port Hedland and Dampier, which are already experiencing some capacity issues.

6.5 Road trends

6.5.1 Historical road freight movements

Western Australian road freight movement



The resources sector is a major driver of intrastate road freight movements in Western Australia.

Over the period 1972-73 to 2012-13, Western Australia recorded the highest annual growth rate of any State in terms of road freight movements at 7% per year. Freight vehicles in Western Australia travelled a total of 39.6 billion tkm[79] in 2012-13.

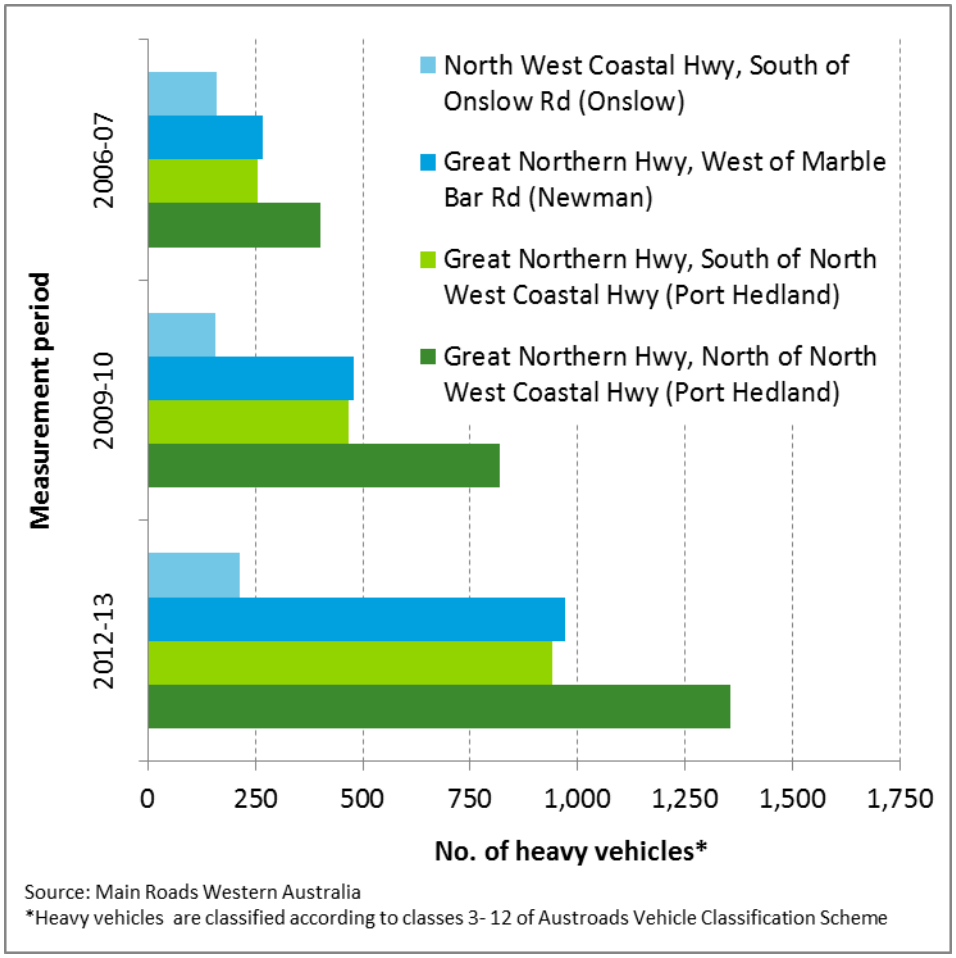
Around 70% of the State's total freight movements are accounted for by intrastate freight movements.

In 2012-13, Western Australia accounted for 35% of the nation's intrastate freight movements, but only 15% of all capital city movements. This highlights the significant freight task that is undertaken by the resources sector in the State.

[79] Billion tonne kilometre (tkm) is a measure of the freight payload distance travelled

6.5.2 Road freight movements in the Pilbara

Average daily heavy vehicle volumes at key locations in the Pilbara, both directions



Source: Main Roads Western Australia
*Heavy vehicles are classified according to classes 3- 12 of Austroads Vehicle Classification Scheme

The Pilbara is likely to be the main centre of activity for intrastate road freight movements in Western Australia.

The construction phase of the State's resources sector has resulted in significant growth on key regional road networks in the Pilbara. The Great Northern Highway is the most important road corridor for sites in the Pilbara, connecting Perth to major resources centres such as Newman, Karratha and Port Hedland.

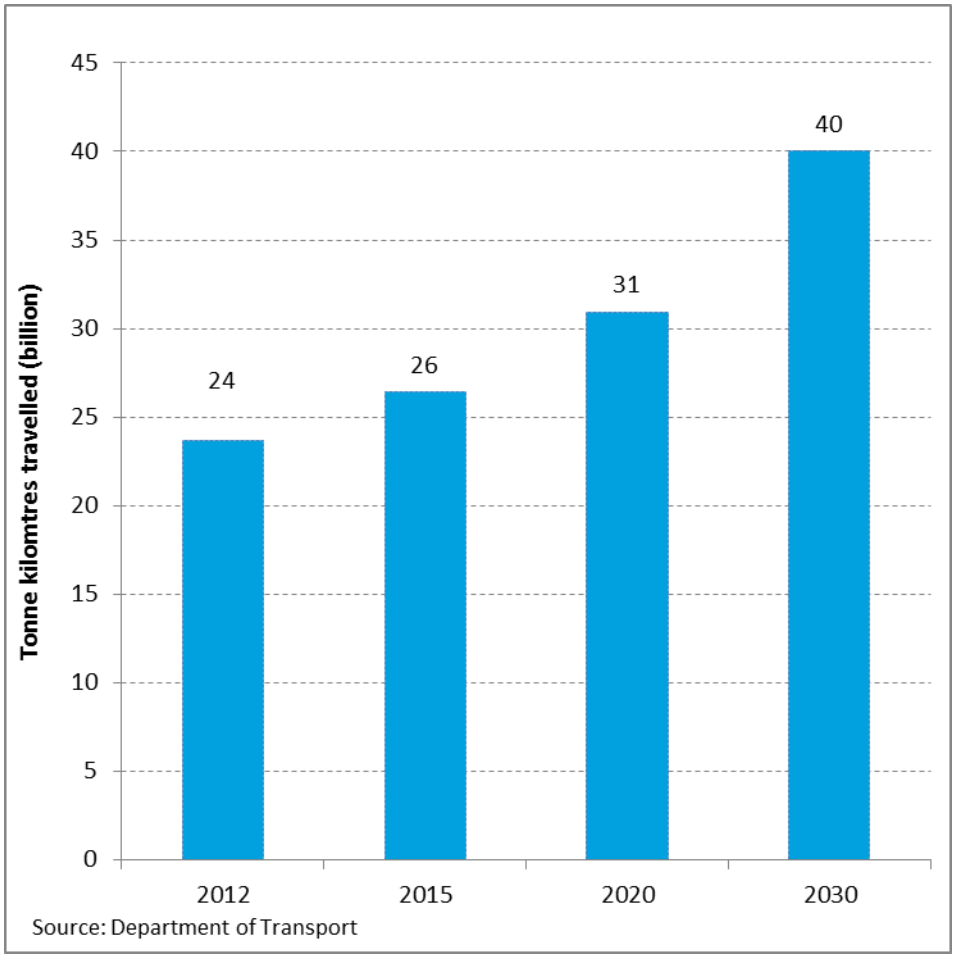
The average daily volume of heavy vehicles on the Great Northern Highway at key points in the Pilbara has increased by well over 200% over the past six years. Notably, most of the heavy vehicles on this corridor are Austroads Class 12 vehicles, or triple road trains – the heaviest vehicle class[80].

The North West Coastal Highway near Onslow is a particularly important corridor for oil and gas freight. It too has seen increases in road freight in recent years (by 34% over the six years to 2012-13), although not to the extent seen for the Great Northern Highway.

[80] Main Roads Western Australia, Annual Class Counts

6.5.3 Regional road freight forecast

Movement of registered freight vehicles in Western Australia, tonne kilometres travelled



Western Australia's regional road freight task is projected to almost double over the next two decades.

Freight moving into, within and out of the State's regions is projected to increase from 24 billion tkm per annum in 2012 to 40 billion tkm by 2030.

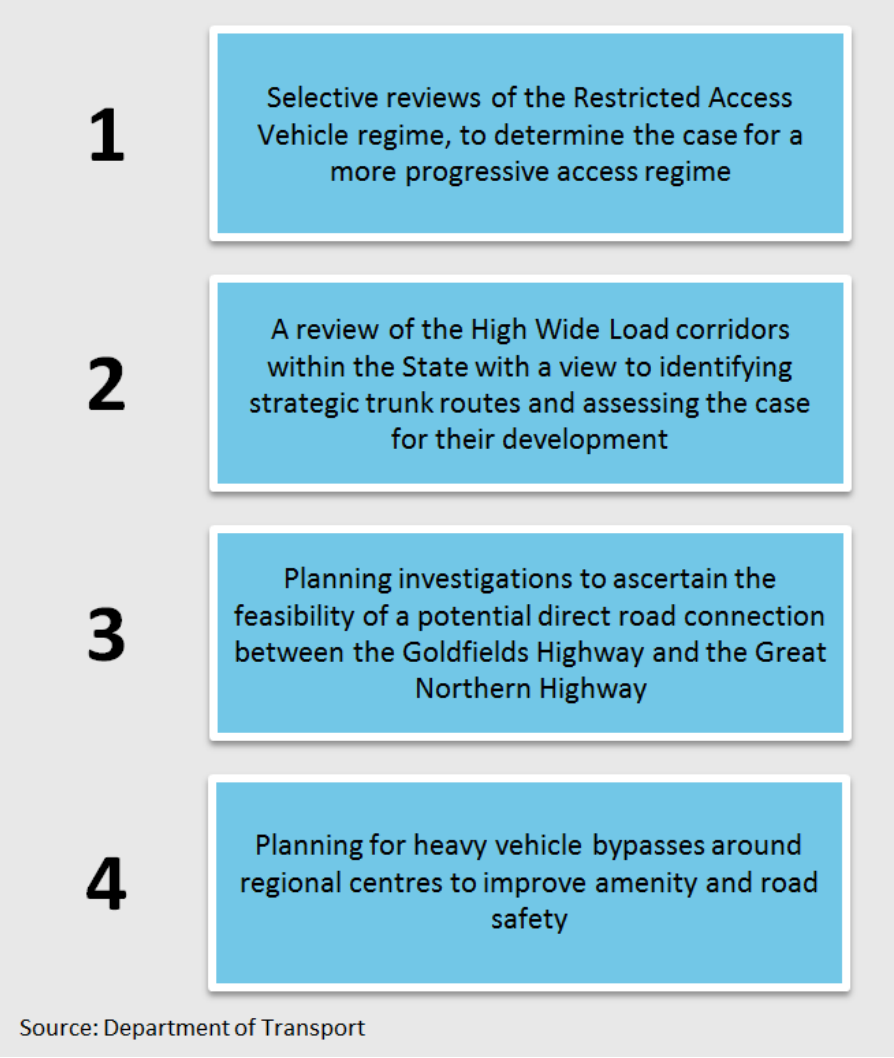
The Great Northern Highway will continue to act as an integral part of the State's northern supply chain, but the coastal strip is also expected to experience substantial road freight growth[81].

The expansion of inland mines and the expected development of processing plants and industrial estates along the coast (such as the Ashburton North Strategic Industrial Area) could place pressure on existing road networks. Road corridors will have to accommodate increased tonnages, trip frequencies and oversized loads. Coordination between State Government and local government to protect these corridors is therefore important.

[81] WA Department of Transport, Regional Freight Transport Network Plan

6.5.4 Road freight priorities

Western Australian Regional Freight Transport Network Plan – Road freight priorities



Source: Department of Transport

The State Government's Regional Freight Transport Network Plan recognises the need to invest in and expand the road network, to support user needs to 2031.

Western Australia's road network comprises around 54,000 sealed kilometres and 95,000 unsealed kilometres of road. While the network is extensive, only a relatively small number of roads move most of the State's road freight task[82].

The pipeline of the State Government's priority road investment projects include:

- construction of the Kununurra heavy vehicle bypass;
- upgrade of the North West Coastal Highway;
- construction of the Karratha bypass;
- upgrade of the Great Northern Highway (Muchea to Wubin);
- upgrade and seal the Goldfields Highway (Wiluna to Meekatharra); and
- completion of the Bunbury Outer Ring Road.

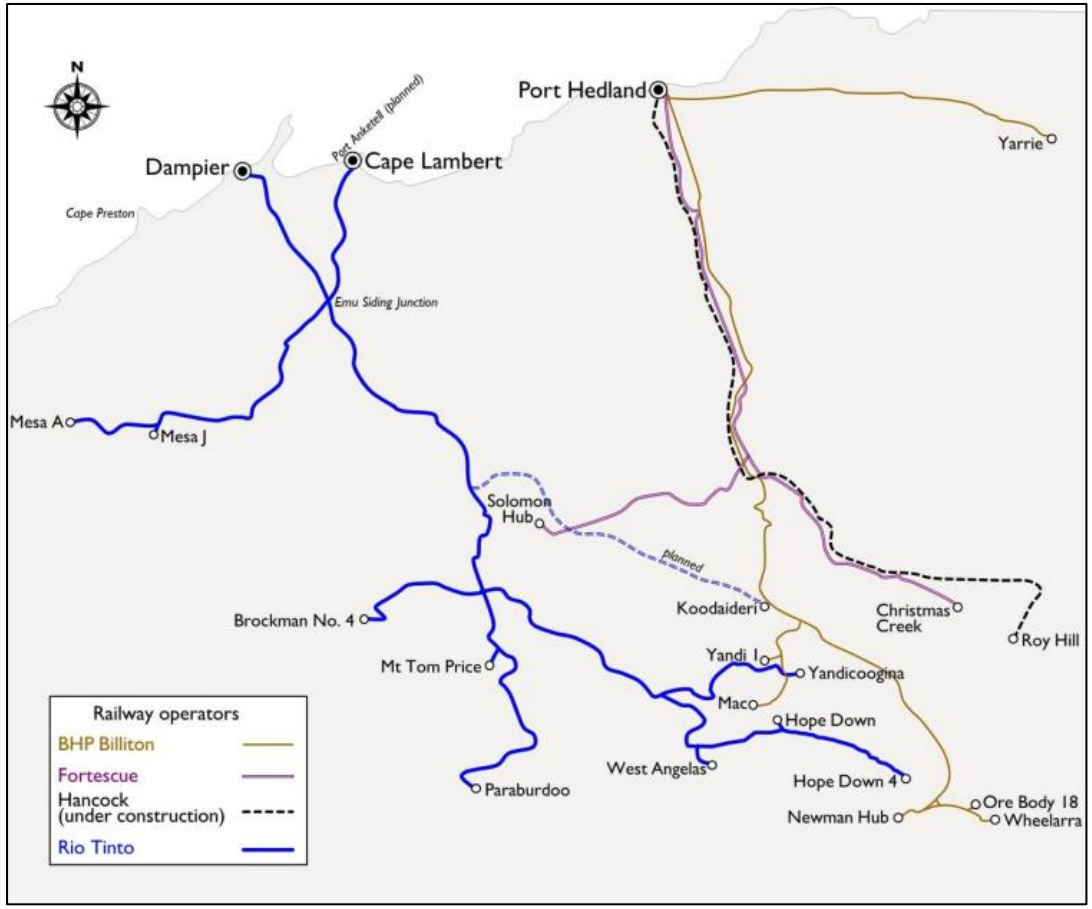
The Department of Transport is currently developing a Metropolitan Freight Strategy to complement the existing Regional Freight Transport Network Plan.

[82] WA Department of Transport, Regional Freight Transport Network Plan

6.6 Rail trends

6.6.1 Privately owned rail networks

Pilbara rail infrastructure map



Source: BITRE

Privately owned and operated rail lines in the Pilbara account for the majority of Western Australia's private rail infrastructure.

There are a number of private heavy haulage rail lines that transport iron ore to the ports of Port Hedland, Dampier and Port Walcott (Cape Lambert). These rail lines transport the majority of the iron ore exported from Western Australia.

The major railways are operated by BHP Billiton, Fortescue Metals Group and Rio Tinto. Another significant rail network is currently under construction by Hancock Prospecting related to the Roy Hill iron ore project.

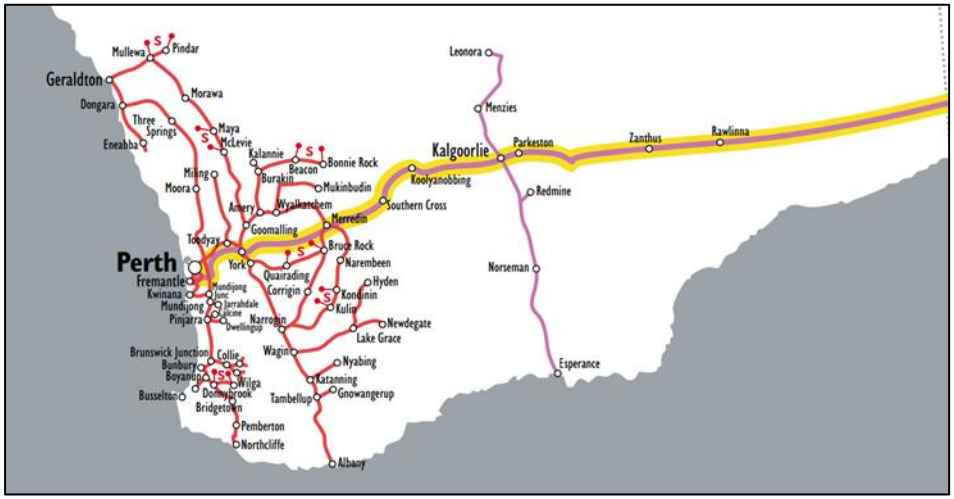
Also under consideration, in a joint venture between Baosteel, Aurizon, AMCI and POSCO, is the West Pilbara rail project, to connect a new deep-water port at Anketell to eight separate mining areas.

In total, rail transports 168 billion tkm of iron ore in Western Australia in 2011-12, with road movements representing 3 billion tkm[83].

[83] BITRE

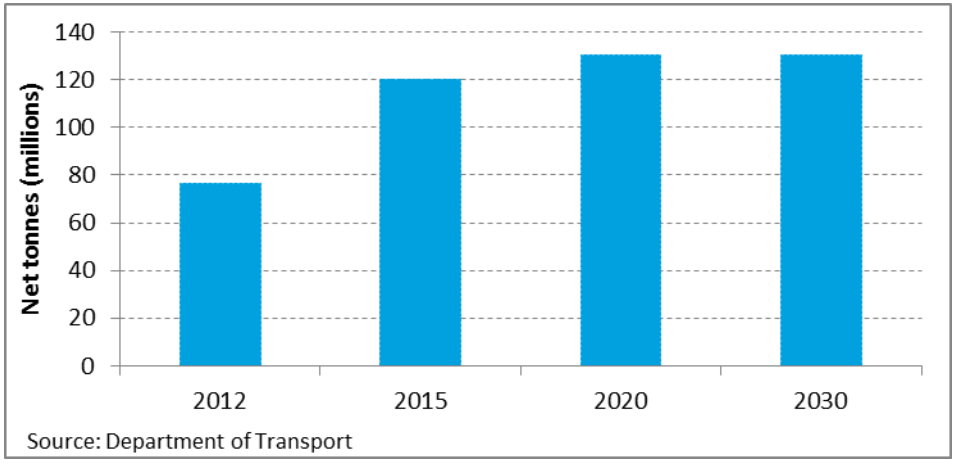
6.6.2 State owned rail network

State owned rail network



Source: Australasian Railway Network

Forecast tonnages on State owned rail network



[84] WA Department of Transport, Regional Freight Transport Network Plan

Western Australia's state owned rail network is managed by Brookfield Rail as an open-access multi user network.

Brookfield's rail network comprises 5,000 km of track and connects the major regional centres of Bunbury, Geraldton, Kalgoorlie and Esperance.

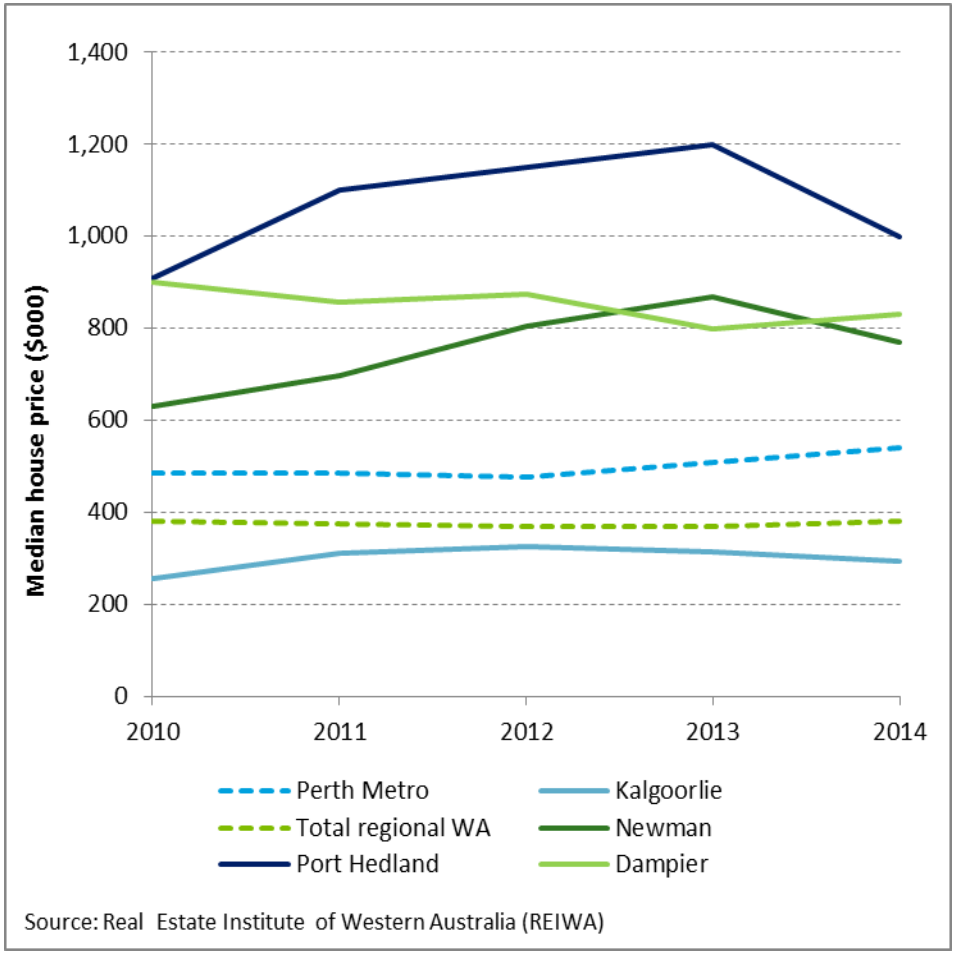
The regional freight task of this network is forecast to increase from 75 million net tonnes per annum in 2012, to more than 130 million net tonnes per annum by 2030[84].

Iron ore will be a significant source of the increased demand for this network. Iron ore rail movements on this network are forecast to rise from approximately 20% of all tonnages currently, to more than 40% of demand by 2030[84].

6.7 Social Infrastructure trends

6.7.1 House prices

Median house prices, key Western Australian locations



Source: Real Estate Institute of Western Australia (REIWA)

House prices have begun to soften in regional areas, including the key resources sector centres of Port Hedland and Newman.

Housing affordability is often a key determinant of the availability of local personnel and supporting services for resources sector projects. House prices in Port Hedland experienced a period of strong growth over the past five years. In 2013, the median house price in Port Hedland reached $1.2 million – more than double the median price in the Perth metropolitan area. The median price in Newman had also risen significantly to reach $868,000 in 2013.

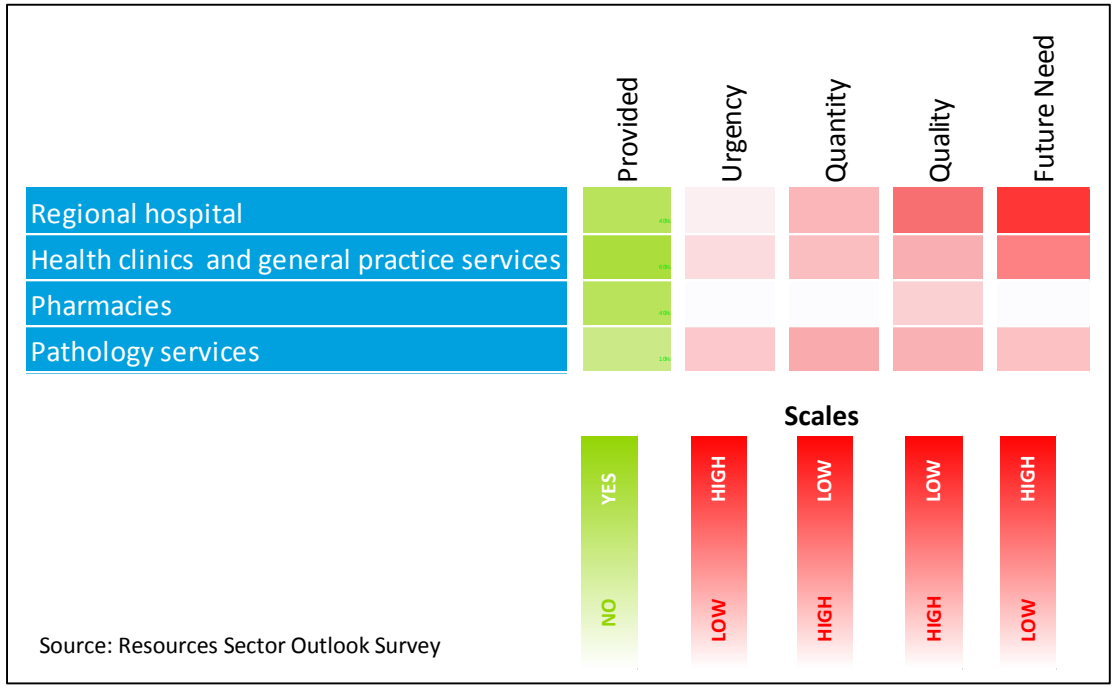
However, after this sustained period of growth, median house prices in these areas have begun to fall as demand related to the construction phase of major projects has eased. In the year to September 2014, median house prices in Port Hedland decreased by 17% to a median price of $1.0 million, while prices in Newman fell by 11% to a median price of $770,000.

House prices in Dampier have bucked this trend, falling by almost 8% over the past five years to $830,000 in 2014. Prices in both Dampier and nearby Karratha have softened earlier than in Port Hedland and Newman as a result of additional supply entering these markets[85].

[85] The cost of doing business in the Pilbara, Pilbara Development Commission, May 2013. Note: Karratha commentary is based on average prices, not median prices

6.7.2 Health services

Provision of health services[86]



Source: Resources Sector Outlook Survey

Health services are generally well provided in resources sector project regions, but in some areas they are lacking.

Regional hospitals were perceived to be in need of some improvement and will need to continue to grow in the future in resources sector project regions, particularly in the Pilbara and Kimberley.

These findings were similar to perceptions of the provision of health clinics and general practice services, which will also need to expand to meet expected greater demand in the future.

Social infrastructure survey questions

Provided: Are these services provided nearby the project in question?

Urgency: If not currently provided, what is the urgency for their provision?

Quantity: If they are provided, is the size of the provision adequate?

Quality: If they are provided, how would you rate the delivery of these services?

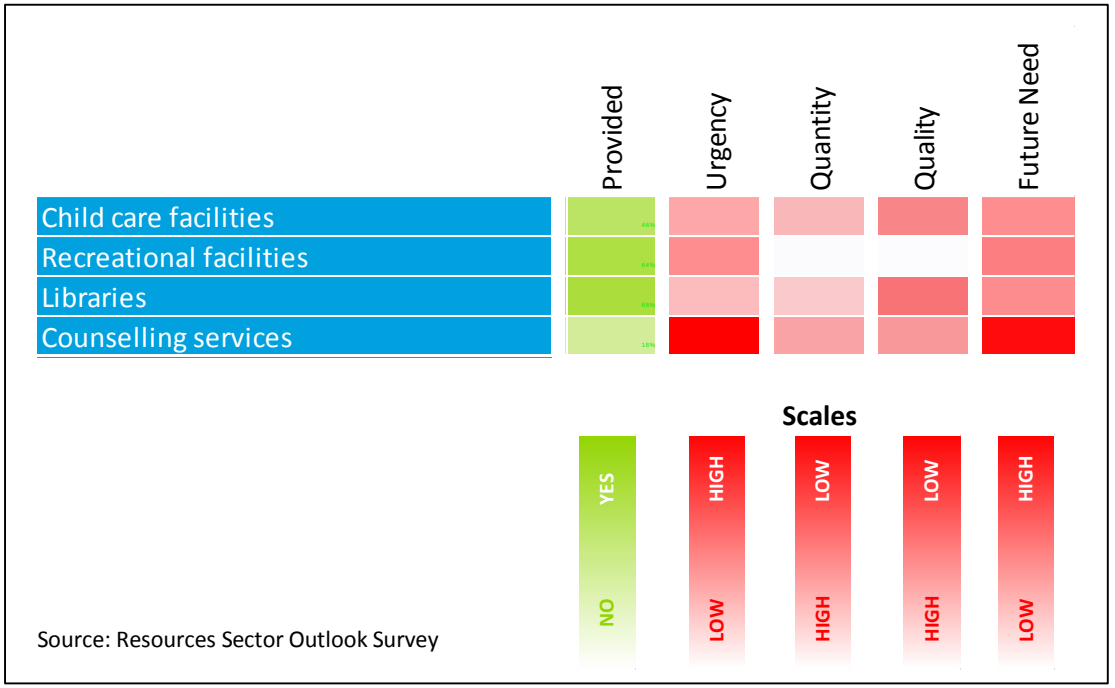
Future Need: If they are provided, will there be a need to increase provision over the next ten years?

The Outlook sought views from the resources sector in terms of the provision of non-company social infrastructure in areas nearby to projects. The responses are a qualitative perception of the resources sector.

[86] Survey questions were asked specifically relating to non-company, government funded social infrastructure

6.7.3 Community infrastructure

Provision of community infrastructure[87]



Source: Resources Sector Outlook Survey

Counselling services are identified as an area of high priority to the resources sector and in many areas these services are not adequately provided.

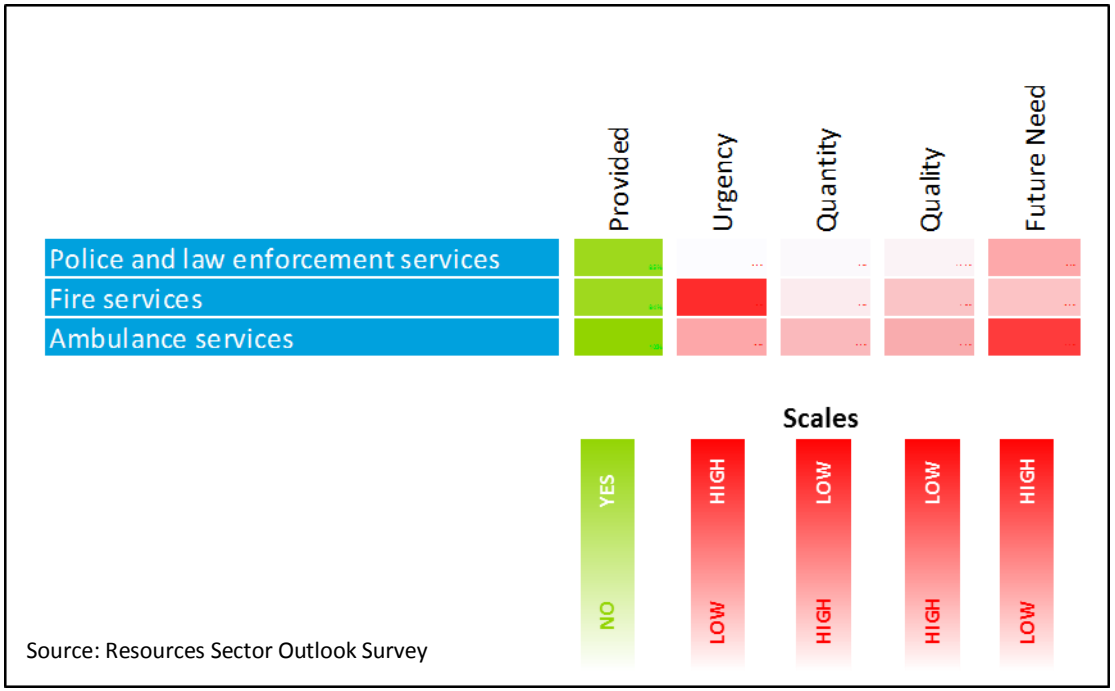
Resources sector companies provide their own employee assistance and counselling support programs, including family and workplace counselling and mental health services. However, improvement in the provision of non-company counselling services was perceived to be an urgent need, particularly in the Pilbara.

Child care facilities and libraries were also perceived to be in need of improvement now and into the future.

[87] Survey questions were asked specifically relating to non-company, government funded social infrastructure. The Outlook sought views from the resources sector in terms of the provision of non-company social infrastructure in areas nearby to projects. The responses are a qualitative perception of the resources sector.

6.7.4 Emergency services

Provision of Emergency services[88]



Source: Resources Sector Outlook Survey

Emergency services are adequately provided in most regions, although some outliers exist.

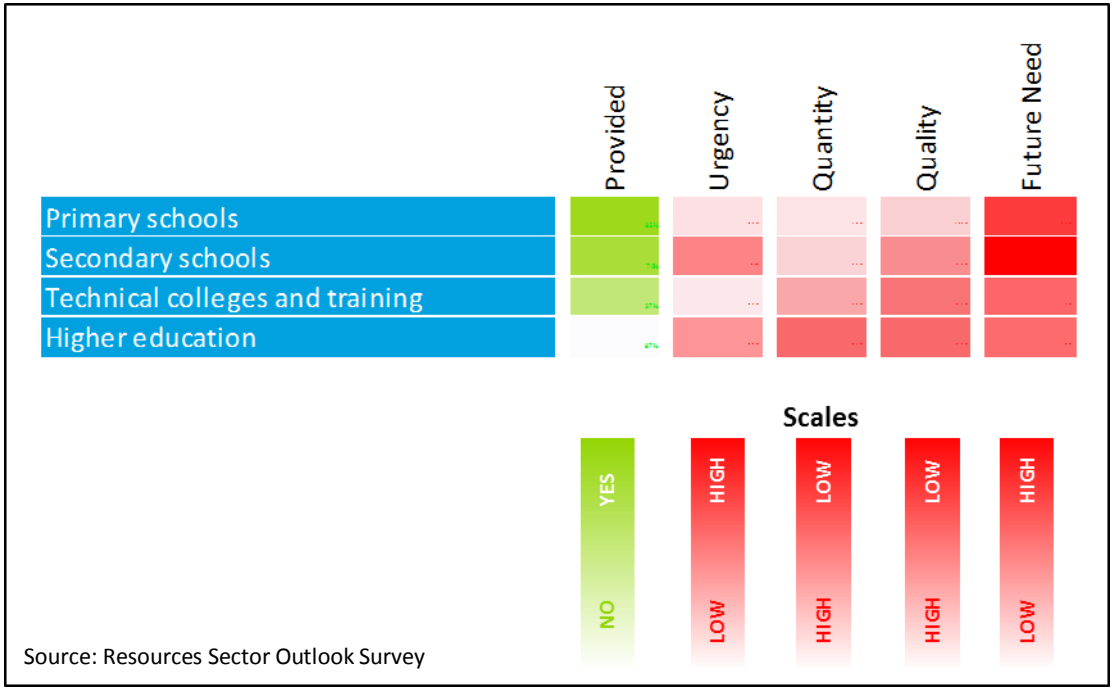
While fire services are provided in most regions, there are a number of areas within the Pilbara where these services were perceived to be urgently required.

Ambulance services were identified as the area that would require the greatest increase in provision over the next 10 years, particularly in the Goldfields-Esperance region.

[88] Survey questions were asked specifically relating to non-company, government funded social infrastructure. The Outlook sought views from the resources sector in terms of the provision of non-company social infrastructure in areas nearby to projects. The responses are a qualitative perception of the resources sector.

6.7.5 Education and Training

Provision of Education and Training[89]



Source: Resources Sector Outlook Survey

Although most regions have access to primary and secondary education, a greater level of provision will be required in the future.

Across all categories of education there is a future need to increase the provision of these services. Secondary schools were identified as likely to see the greatest increase in demand, particularly in the Goldfields-Esperance and Mid West regions. A requirement for technical colleges and training was also identified in the Pilbara.

Higher education is generally not provided, but nor has it been identified as an urgent area to address.

[89] Survey questions were asked specifically relating to non-company, government funded social infrastructure. The Outlook sought views from the resources sector in terms of the provision of non-company social infrastructure in areas nearby to projects. The responses are a qualitative perception of the resources sector.

6.8 Policy implications and opportunities

Five key policy implications and opportunities have been identified from the above analysis:

1. ***A sound business case for determining investment at Perth Airport is required as resources sector passengers are forecast to increase over the medium term due to shorter operational rosters.***

While there will be a decline in the overall workforce, passenger volumes are expected to increase over the medium term as the resources sector transitions from the construction to the operational phase. On average, construction rosters operate a four weeks on, one week off, or three weeks on, one week off cycle, while operational rosters are likely to be shorter at two weeks on, one week off, or nine days on, five days off.

A sound business case needs to be developed in a consultative process to justify the development of an additional runway, and should examine how existing infrastructure and processes can be optimised. This includes quantitatively demonstrating how the outcomes of the Airport Capacity and Enhancement program will improve efficiency and optimise airport performance.

2. ***Investment in regional airport infrastructure must keep pace with investment at Perth Airport to avoid creating bottlenecks at regional airports.***

Perth Airport is currently planning further development that will allow it to better meet the aviation needs of the State in the future. However, as these demands are met, it is critical investment in infrastructure at regional airports keeps pace.

For safety and roster cycle management purposes the resources sector requires stable departure and arrival slots. To the extent that investment allows Perth Airport to continue to meet growing demand by the resources sector for existing slots, then there is a risk bottlenecks could be created at regional airports without adequate investment.

The draft State Aviation Strategy identifies infrastructure at a number of large, fast-growing regional airports is inadequate to meet current levels of demand and significant upgrades are required to meet forecast growth in air traffic.

Failure to make the upgrades may impose significant costs and limitations on the State's economic development, particularly in the Pilbara.

3. Some regional airports in Western Australia hold national significance and may benefit from being operated by the private sector.

There are financial capacity constraints facing many local government-run regional airports, including their limited ability to invest in the required level of new infrastructure to support increasing air traffic and larger aircraft.

Investment sources are mainly limited to airport funds, with nearly 80% of funds invested in regional airports over the past five years coming from airport reserves or operating surpluses[90].

Private sector funding of regional airports should be considered as part of broader airport management, as identified in the draft State Aviation Strategy, through long term lease arrangements and/or changes to the *Local Government Act 1995*, where required.

Additionally, given the operation of airports is not core to the functioning of local governments, greater efficiencies may be generated from allowing the private sector to manage these facilities.

Any such arrangements should be accompanied by suitable contractual or legislative frameworks to prevent abuse of any monopolistic position with timely access for all users at reasonable commercial rates.

[90] WA Department of Transport, draft State Aviation Strategy

4. Additional port capacity will be required in the Pilbara in the medium term.

By 2020, resources exported from Western Australian ports are forecast to increase by 534 Mtpa above 2013 levels – an 80% increase from the State's entire international seaborne freight volume in 2012-13.

This growth, underpinned by exports from the Pilbara, may ultimately exceed available capacity at the existing Pilbara ports, with a number already experiencing capacity issues. Additional investment in these facilities will be required, including the protection of landside corridors and buffers.

Additional investment in new port capacity in the Pilbara should be considered a priority in the medium term, with continued support by the State Government for Anketell Port.

5. *There is room for improvement in infrastructure planning in Western Australia, while fiscal constraints also require new ways of funding infrastructure.*

The current State framework for infrastructure planning does not optimise collaboration between the public and private sectors in the delivery of crucial infrastructure projects.

Coordination sits mainly with the Western Australian Planning Commission, with support from the Department of Planning and a number of specialised planning committees, including the Infrastructure Coordinating Committee.

Infrastructure planning processes would benefit from the establishment of an independent body responsible for infrastructure prioritisation and coordination in Western Australia.

Given the current pressure on State and Australian Government finances (and as part of the review of public ownership of assets underway in Western Australia), public private partnerships should be considered to facilitate greater private sector participation in the delivery of infrastructure projects.

Capital recycling should also be utilised as a tool to ease government financial pressures and make funds available for investment in critical infrastructure. However, greater breadth in the purchasable portfolio of assets in Western Australia is required in order to release sufficient funds for re-investment in major income generating assets, and to retire debt.

7 Appendix

Chapter contents




7.1 Methodology

The objectives of this Outlook were to:

- Provide an integrated supply and demand outlook across Western Australia and at the regional level on the key enablers.
- Examine changes to the structure and composition of the workforce and productivity.
- Examine energy requirements in relation to electricity and natural gas.
- Examine water abstraction and changes in sources and destination.
- Examine infrastructure requirements and bottlenecks.
- Analyse the policy implications with a particular emphasis on the opportunities and challenges.
- Provide input into government planning to improve regulatory and policy regimes.

The approach adopted incorporated a four stage process:

1. designing a comprehensive demand survey and conducting a test process with selected minerals and energy companies to refine the survey approach;
2. collecting direct survey data and publicly available information from minerals and energy companies on operating and development projects;
3. consulting with key government and other agencies on the supply issues for each of the growth enablers; and
4. validating survey results and identifying potential implications and opportunities with various reference groups.

Demand for the growth enablers of people, energy, water and infrastructure were derived from operating and planned projects in the minerals and energy sector in Western Australia

The demand side data were sourced directly from participating companies via the demand survey, which sought annual demand data between 2013 and 2025.

To minimise impact on companies participating in the survey, a targeted approach was adopted whereby only data for individual projects – both operating and planned – were sought.

Operating projects were prioritised and selected according to their importance to overall output and employment in the resources sector using estimates of production value and employment, by site, from the Department of Mines and Petroleum.

Planned projects were prioritised and selected using Deloitte Access Economics' Investment Monitor, according to the size of the planned capital expenditure (including projects under construction).

To ensure completeness, the demand survey data were supplemented with benchmark data to estimate the aggregate contribution to the demand outlook from operating projects not covered by direct survey responses.

Methodology continued…

Additionally, publicly available information and benchmark data on major planned projects not surveyed were also included in the demand forecast. However, there is potential for new projects which are not recognised in this study to enter construction by 2025.

Overall, projects included in the Outlook represent approximately 82% of the total value of production in the resources sector in 2013, and over 75% of the value of upcoming project investment in the industry.

The value of the pipeline of upcoming capital spending in Western Australia is defined according to Deloitte Access Economics' Investment Monitor and includes projects under construction, committed or under consideration as at the June quarter 2014.

Further details on the model itself are provided in the subsequent section.

The supply outlook was developed in consultation with numerous government agencies and organisations, which provided useful advice and data, where available. The following agencies were involved through reference group and / or one-on-one discussions:

- Bunbury Port Authority
- Department of Training and Workforce Development
- Department of Finance - Public Utilities Office
- Department of Water
- Department of Transport
- Department of State Development
- Department of Premier and Cabinet
- Department of Housing
- Main Roads WA
- LandCorp
- Independent Market Operator
- Australian Bureau of Statistics (WA)
- Department of Infrastructure and Transport
- Department of Mines and Petroleum
- Department of Planning
- Department of Lands
- Department of Regional Development
- BITRE
- BREE
- Department of Industry

A process of validating the project approach, examining the survey results and identifying potential implications and opportunities was undertaken with four industry reference groups (people, energy, water and infrastructure) and a government reference group. Each reference group was convened on three separate occasions throughout the course of the project.

7.2 Model design

An Excel model was developed to aggregate raw data from survey respondents to determine regional and State wide demand for each enabler.

Other than a probability weighting applied to some responses (see 4 below), no adjustments were made to survey responses under the assumption that companies had responded with a 'base-case' scenario: macroeconomic and price assumptions where not provided to survey respondents.

Rather, respondents were asked to reply according to their own internal base case assumptions of future economic conditions.

The model analysed incremental changes to demand, rather than absolute values, to avoid errors associated with establishing a baseline. Four key steps were employed in building the full demand forecast from the raw data:

1. Gap analysis and data cleansing
2. Operating projects residual estimation
3. Planned projects estimation
4. Risk adjustment

(1) Gap analysis and data cleansing

A review of the raw survey data was undertaken to identify key gaps in responses or potentially incorrect data. Where this was the case, project staff returned to respondents to seek clarification and apply adjustments on the advice of respondents.

A round of workshops was also held with the project reference groups to present the aggregated raw survey responses and seek advice on any inconsistent or potentially incorrect results.

Again, where this was the case, project staff returned to relevant respondents to seek clarification and apply adjustments on the advice of respondents.

(2) Operating projects residual estimation

Survey responses spanned projects in operation, under construction and planned. In total, the operating projects captured by the demand survey represented approximately 82% of the total value of production in the resources sector in 2013. Demand from the residual of operating projects was estimated by deriving commodity specific (per unit production) benchmarks for each enabler.

These demand benchmarks were applied on a regional basis to determine the residual of production not initially captured by the survey. This residual estimate for the base year (2013) was carried forward through the forecast period (to 2025) without applying any increase or indexation.

(3) Planned projects estimation

In total, the projects included in the demand outlook represented over 75% of the value of planned project investment in the industry. Survey responses covered some key planned projects. Expected demand was estimated for other planned projects where a survey response was not received.

However, not all planned projects were estimated. Only demand for a selection of major planned projects was estimated.

Model design continued…

These projects were selected based on their proposed quantum of investment to ensure a large proportion of the planned pipeline of investment was included in the demand outlook.

These projects were identified using Deloitte Access Economics' Investment Monitor. The Investment Monitor and other publicly available sources were employed to estimate production start dates and maximum production capacities for these projects. Each pipeline project was assigned a probability weighting (see below). An estimate of demand for each enabler for each project was calculated by employing the commodity specific benchmarks.

(4) Risk adjustment

A risk adjustment was applied against planned projects (i.e. projects not in operation or under construction) to account for the fact that not all planned projects in the data set will eventuate.

Individual probability weightings were assigned to these projects based on historic project realisation rates. Weightings were derived from a study of historic project realisation rates[91] (projects under construction or in operation were applied a probability weighting of 1 given their certainty).

[91] Realisation rates were based on estimates outlined in the study, *The investment project pipeline: cost escalation, lead time, success, failure and speed*, Kenneth W Clements and Jiawei Si, Business School, The University of Western Australia, Crawley, Australia

7.3 Limitation of our work

General use restriction

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