WA State Growth Outlook 2013

Chamber of Minerals and Energy of Western Australia

November 2012

pwc

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Section One

Study Background

The Chamber of Minerals and Energy of Western Australia (CME) is the peak resources sector representative body in WA. The role of CME is to champion the WA resources sector and assist it in achieving its vision to lead the world in sustainable practice through innovation and to underpin Australia's position in the global economy.

CME commissioned PwC Consulting to complete the State Growth Outlook study in 2009 and again in 2011, to provide an integrated outlook of industry and government development plans in the minerals and energy sector. Both studies focused on the key growth enablers of people, energy and water to aid policy development.

The objectives of the 2009 and 2011 studies were to:

- Develop a demand outlook for the three key growth enablers: people; energy; and water and identify potential demand/supply gaps;
- Provide a basis for identifying potential implications arising from current growth plans; and
- Provide valuable input into industry and government planning and to better position industry and government to capture opportunities from WA's growth.

The 2013 State Growth Outlook seeks to update the outlook for the resources industry and refine the implications discussion after a period of change for the WA, Australian and international economies.

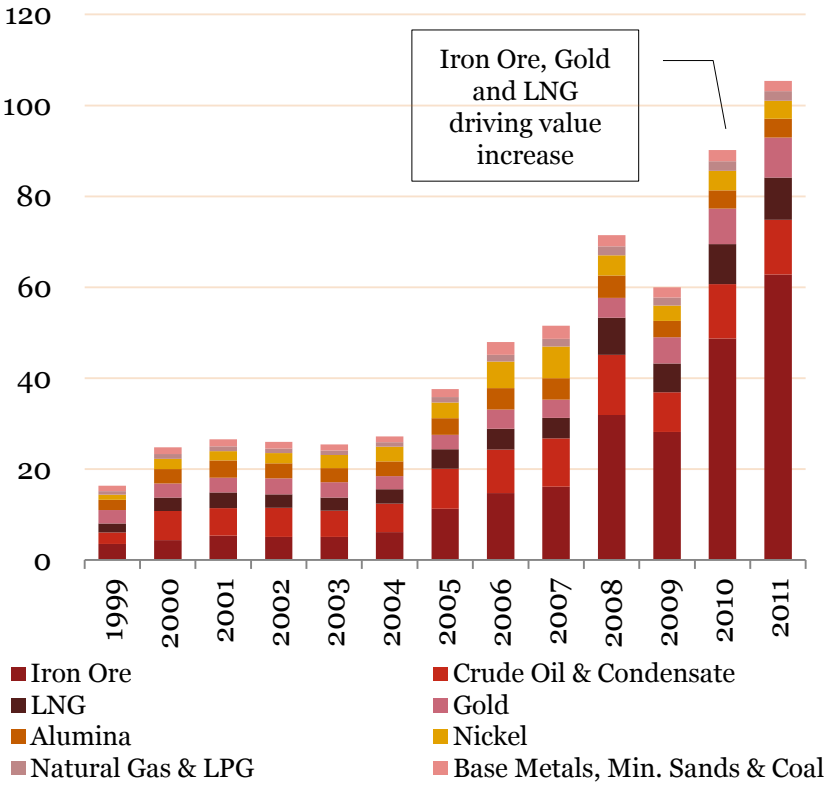
The current study considers two additional key growth enablers: social infrastructure and hard infrastructure capacity.

The body of the report comprises six sections:

- ***Section One: Study Background*** provides context on the minerals and energy sector, along with the approach taken in the study.
- ***Section Two: Executive Summary*** outlines State-wide survey outcomes and key regional trends along with the relevant potential implications and opportunities for each growth enabler.
- ***Sections Three through Six*** are sections on each growth enabler. Each section commences with a State view, providing historical context and survey outcomes and trends. Survey outcomes on a regional basis follow. Each section closes with a discussion on potential implications and opportunities arising from the growth.
- ***Section Seven: Appendix*** contains supporting information.

Historic Value of the WA minerals and energy sector

Value of WA Minerals and Energy Industry
($b)



The value of the minerals and energy sector quadrupled between 2000 ($26.2b) and 2011 ($107b), as measured by the value of total annual sales.

The outlook for WA's minerals and energy sector remains positive, despite recent fluctuations in commodity prices. Preceding 2008-09, proposed investment in minerals and energy projects stood at ~$100b and has now climbed to over $190b of committed and proposed projects in 2012. The State Growth Outlook aims to provide valuable information to enable government and industry to effectively capture these opportunities.

Iron ore continues as the highest value sector, followed by the petroleum sector.

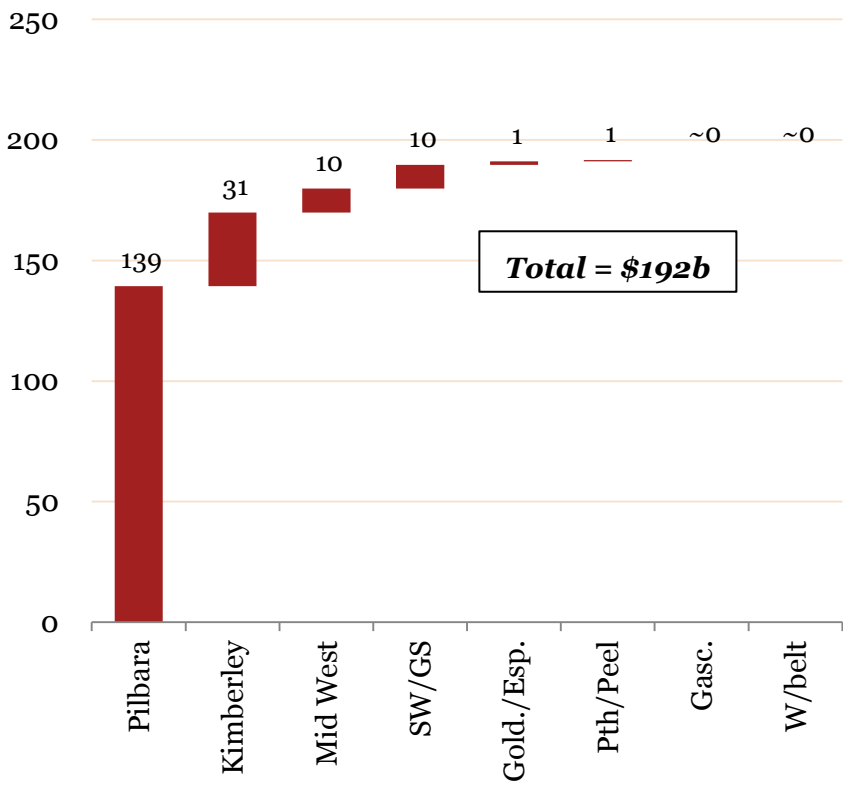
As an integral driver of the WA economy, the minerals and energy sector provides thousands of direct and indirect employment positions and generates a significant revenue stream, supporting growth across WA and the country.

Source: DMP, *Resource Statistics*, 2012

Upcoming Projects in the WA minerals and energy sector

Upcoming Project Capital Expenditure

($b)



The immediate outlook for the sector in WA is one of growth, with over $190b of planned minerals and energy sector (and relevant infrastructure) projects across the State.

Over $190b worth of projects are currently under consideration or further advanced in WA across bulk commodities, oil and gas and precious metals.

Over 64% of this spend is related to oil, gas and condensate projects. Approximately 28% of the spend is related to iron ore and associated infrastructure.

The majority of the capital expenditure is related to projects in the Pilbara, Kimberley and the Mid West.

Balanced against the short term investment, industry participants report growing concern with the increasing costs of doing business in Australia.

With a solid pipeline of upcoming projects, WA remains an investment destination, continuing to develop economic benefits for WA as well as the national economy.

Note: Publicly available information only, including projects under construction, under consideration and less advanced in feasibility status. Does not include capital expenditure estimates not publicly disclosed or for projects not far enough advanced.

Source: DMP and DSD, *Prospect, September – November 2012*, 2012

Approach Followed in This Study

The approach was similar to that developed in the previous State Growth Outlook studies, incorporating a three stage process:

1. Collecting direct survey data and publicly available information from minerals and energy companies with upcoming projects;
2. Consulting with key government and other agencies on the supply outlook for each of the growth enablers; and
3. Validating results and identifying potential implications and opportunities with various reference groups.

The demand outlook was derived from a comprehensive survey of contributing CME members and selected non-members representing approximately 70% of the upcoming capital spend in the industry. The survey covered projected demand for people, energy, water and hard infrastructure capacity, and accompanying project information such as annual production rates and capital expenditure where available. To ensure completeness, the direct survey data was supplemented with publicly available data on upcoming projects not surveyed.

The survey-based approach included only projects that had reached preliminary feasibility stage. There is the potential for new projects, which are not recognised in this study, to enter construction by 2025.

To account for the fact that not all proposed projects eventuate, probabilities were assigned to each project, based on: time to construction; outlook for the commodity; greenfields vs. brownfields; and the company's operations profile. The aggregate probability for all projects was adjusted to align with historic project realisation rates.[1]

The demand outlook was developed under unconstrained supply of all resources.

The supply outlook was developed in consultation with numerous government and private agencies, providing data where available (list of contributing agencies outlined in *Section 7.2 Methodology*).

Five reference groups (CME People Strategies Committee, CME Energy Reference Group, CME Water Issues Group, CME Infrastructure Committee and a Project Reference Group) were consulted throughout the project to: validate data quality; identify implications and opportunities; and to ensure alignment with objectives.

1. Historic realisation over 4 year period to 2008 was ~ 80% based on retrospective analysis of "Historical Projects List", CCI, 2008 and "Prospect Magazine", DOIR 2004-2008 (DOIR now DMP)

Section Two

Executive Summary

Key findings relating to People

State Overview

- The workforce required for growth plans in the minerals and energy sector in WA is projected to peak at 125,000 people in 2014, approximately 9,000 above the 2012 workforce of 116,000.
- After the peak in 2014, employment in the minerals and energy sector will slowly reduce as the current wave of construction activity gives way to operations. From 2018, the workforce will reduce to below 2012 levels.
- The construction workforce will peak in 2014, with 300 workers above 2012 levels, before commencing a decline to 24,000 below 2012 levels by 2018. The completion of construction of a number of major minerals and energy projects, particularly in the Pilbara, drives this decline in construction workers.
- As these major projects commence operation, the operating workforce will increase strongly to 2018, with an additional 19,000 operational staff required.

High Growth Regions

- The area of highest labour growth to 2018 is the Mid West, followed by the Kimberley. A decline in the minerals and energy sector workforce is forecast for the Pilbara.
- The minerals and energy sector in the Pilbara is forecast to require 9,300 fewer workers in 2018. This fall comprises a reduction of 22,900 construction workers, partially offset by 13,600 additional operations workers.
- The Mid West will require an additional 4,800 workers by 2014, 3,600 of which will be new construction workers. The additional workforce requirement will decline to 3,300 above 2012 levels by 2018.
- The minerals and energy workforce in the Kimberley is forecast to increase from 3,400 workers in 2012 to 6,200 in 2015 before declining to 4,200 in 2018.
- The Perth/Peel region supplies significant numbers of FIFO workers. An additional 5,500 FIFO workers will be required from Perth/Peel in 2014, before a decline to 5,600 less than 2012 levels by 2018.
- While population projections and labour force participation rates indicate sufficient aggregate labour availability, the changing composition of workforce requirements from construction to operations will shift the skills required for minerals and energy projects.

Growth and Competitiveness

- The ability to respond to the demand for skilled labour will be a determining factor in the on-time delivery of minerals and energy projects. The changing nature of demand from construction to operations highlights the importance of appropriate skills rather than aggregate labour numbers.
- Demographic and economic factors are likely to increase the challenges faced by the resource sector in attracting and maintaining appropriately skilled staff.
- The mineral and energy sector's investment in education and training needs to be focussed on ensuring the workforce is ready for the operational phase of major projects.
- There is a need to continue to promote increased interstate labour agility as a means of meeting skilled labour demand. However, barriers to interstate mobility reduce the attractiveness of relocating to the State.
- The ability to draw on international workers with the required skills will be important in maintaining growth in the sector.
- Continued opportunities to increase workforce participation in the sector should be pursued, focusing on under-represented groups such as indigenous and women, to supplement FIFO and migration programs.
- The reduced construction workforce requirements in the minerals and energy sector will increase the availability of workers with construction skills for other sectors.

Environment and Liveability

- Population increase will place increasing demands on social and hard infrastructure in Perth and regional towns, requiring advanced planning and investment.
- To attract and retain skilled and highly mobile resource sector workers, it is important that efforts continue to improve the liveability and vibrancy of Perth and regional towns.

Key Findings Relating to Electricity

State Overview

- The estimated total State electricity consumption growth rate over the period to 2023 is 5.6% per year; substantially higher than the long term electricity growth forecast from BREE[1] (1.9% per year to 2035).
- Electricity consumption in WA could increase by approximately 52% by 2018, largely driven by projects in the minerals and energy sector.
- Across all industries, in the area serviced by the SWIS, 12% of new electricity generation demand to 2018 is projected to be purchased. Outside the SWIS and across all industries, 14% is projected to be purchased from third party generators.
- Minerals and energy sector electricity demand to 2018 is projected to increase by the equivalent of 2.7 GW[2] of generation capacity. The majority of minerals and energy sector demand is projected to be met through self generation (95%) and fuelled by natural gas (94%), a far higher proportion of self-generation than for other industries.

High Growth Regions

- The majority of new electricity generation required by the sector in 2018 is for projects in the Pilbara (70%) and the Mid West (15%).
- Incremental electricity demand in the Pilbara from minerals and energy projects is forecast to reach 9,700 GWh per year or the equivalent of 1.9 GW[2] of generation capacity by 2018, predominantly self generated and gas fired.
- Minerals and energy projects in the Mid West are projected to require 2,100 GWh above 2012 levels, or 0.4 GW[2] additional generation capacity by 2018, around 23% of which would be purchased.

Network Outlook

- Project proponents propose to use self generated electricity supply for minerals and energy projects in the Pilbara rather than the NWIS.
- Completion of the Mid West Energy Project *(see section 4.3.1)* would increase capacity to meet the demands of minerals and energy projects in the Mid West.
- The SWIS will require 1,000 MW additional generation capacity over the next decade; 95 MW of additional capacity is forecast to be required for minerals and energy projects by 2018, which is within existing generation capacity.

1. The Bureau of Resources and Energy Economics
2. Equivalent GW estimated at 0.6 load factor

Key Findings Relating to Domestic Gas

State Overview

- Natural gas demand in WA is projected to increase 65% from an estimated 430 PJ in 2012 to 700 PJ in 2023 (excluding gas used in gas production and processing).
- Activity in the minerals and energy sector over the period to 2023 will drive much of the gas demand. However new gas fired electricity generation (not specific to minerals and energy projects) will drive high levels of demand related to other industries.
- Minerals and energy project demand for gas is expected to increase to 81 PJ above 2012 levels by 2018 – a 47% increase on 2012 estimated consumption.
- The incremental natural gas demand is predominantly for electricity generation.

High Growth Regions

- The incremental natural gas demand from minerals and energy projects will predominantly be consumed in the Pilbara (incremental 60 PJ by 2018).
- The Mid West will also exhibit significant incremental demand of 11 PJ per year by 2018. Electricity generation is the primary driver of domestic gas demand.

Supply Outlook

- Projections by the Department of Mines and Petroleum suggests that domestic gas supply (that is, natural gas supplied to third parties) will, at a minimum, increase by around 220 PJ per year by 2016.
- Using the Department of Mines and Petroleum supply forecasts, it appears that the supply will be tight. The Department's low supply case is not sufficient to meet forecast demand.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Growth and Competitiveness

- Self generation will remain the predominant source of additional electricity supply for minerals and energy projects in the Pilbara.
- Potential future projects in the Mid West provide an opportunity for coordinated development of energy infrastructure.
- Delivery on the energy infrastructure needs of WA will require facilitation by the WA and Federal Governments, including streamlining regulatory frameworks.
- There is a need to match the regulatory framework and decision making timeframes that apply to access requests and investment in transmission and generation infrastructure with other project approval processes in order to encourage the optimal balance between self-generation and networked power supply, and to avoid delays to projects.
- The WA Government's framework for the WA energy market should focus on achieving competitive markets, security and reliability of supply, and sustainability .
- There is increasing demand for domestic gas (natural gas supplied to third parties) and indications are that the balance between supply and demand will be tight.
- Increasing gas prices and the potential for higher electricity costs will increase energy costs for business.

Environment and Liveability

- An increase in electricity prices to achieve cost reflective pricing would affect all business sectors and residential electricity users.
- Technical and commercial hurdles to the introduction of widespread networked generation makes the introduction of renewables challenging.

Key Findings Relating to Water

State Overview

- The agriculture (including irrigation) and mining sectors are the major water users in WA, comprising 32% and 24% of use in WA respectively. Residential domestic use also comprises a significant portion of water use, with 19% of use in this category.
- Total water use in WA is forecast to increase by 39% to 2023, from 1,900 GL in 2012 to 2,640 GL in 2023.
- Incremental minerals and energy water use is projected to reach 400 GL above 2012 levels by 2018, totalling an annual 980 GL.
- Dewatering will be a significant activity in minerals and energy projects: around 180 GL per year above 2012 levels by 2018.[1]
- Survey responses indicate that almost 20% of 'new' minerals and energy dewatering in 2018 would be re-injected into aquifers, and 14% supplied to third parties.

High Growth Regions

- The majority of the new minerals and energy water use in WA will be located in the Pilbara, with an average annual growth rate in the Pilbara to 2018 of 13%.
- The Mid West region is also projected to experience significant growth in minerals and energy sector water use (growth of 10% per year).

Water Availability

- Increasing volumes of water abstraction may place pressure on allocation limits and affect the likelihood of approvals.
- While groundwater allocation limits suggest room for growth in many regions, localised water constraints may restrain water abstraction and/or consumption.
- Most water abstraction for minerals and energy abstraction is from 'fractured rock' areas where allocation limits are not used. The unreliability of these types of aquifers and the cumulative effect of high levels of abstraction require careful management and can constrain project approvals.
- Water Corporation forecasts suggest a potential demand-supply imbalance in Perth beyond 2020, with an annual supply shortfall of 140 GL by 2040.

1. Dewatering levels may be higher as some water use reported by survey respondents was not categorised by source.

Growth and Competitiveness

- Further work is needed to understand the cumulative and downstream impact of abstraction from fractured rock aquifers, including dewatering, aquifer re-injection, and discharge to rivers and creeks.
- In some areas, competition between players in the minerals and energy sector and other water intensive industries will increase as water becomes relatively more scarce.
- Logistical and commercial barriers limit better beneficial use of water from mine dewatering.
- Increasing water scarcity in some locations will stimulate calls for the creation of a water market. Water trading is possible under current laws but legislative changes are required for a more efficient water market in WA.
- Technology improvements and innovation in the water supply industry will assist in meeting future water demands. However, additional investigation of new sources will be required to meet the majority of supply needs.
- While the Mid West has sufficient groundwater availability in the aggregate, the distribution and salinity of water can lead to challenges in securing supply for specific projects.
- Recent investments in water supply for Pilbara communities are expected to meet demand from population growth in the medium term.

Environment and Liveability

- Reduction in sustainable groundwater yields due to declining rainfall in the Perth/Peel and Great Southern/South West regions will require contingency planning and increased cooperation between the public and private sector to ensure water use demands continue to be met.
- As the scarcity of water increases, price may be used to allocate scheme water or reflect an increased cost of abstraction and production, potentially further increasing the cost of living in WA.

Key Findings Relating to Infrastructure

Aviation

- WA's airports have experienced significant growth in demand over the last decade.
- Passenger volumes at Perth Airport grew from 4.9m in 2001 to 11.3m in 2011, a growth rate of 9% p.a. Growth rates at Port Hedland, Newman, Paraburdoo and Karratha have averaged over 16% p.a., meaning that passenger volumes have more than quadrupled since 2001.
- Perth Airport reaches capacity on weekday mornings, reflecting demand from FIFO traffic.

Ports

- Total trade volume through Port Authority ports has more than doubled from 200 Mt in 2002 to 428 Mt in 2011. This growth was driven almost entirely by export volumes.
- Port Hedland and Dampier are the dominant export ports, while Fremantle accounts for around 70% of WA imports (by volume).

Road

- Interviews for the State Growth Outlook indicated that transport of heavy equipment and construction materials by road is a challenging issue for mining and energy companies, Main Roads and the Department of Transport.

Rail

- The majority of WA's mineral exports are carried to ports by privately owned railways in the Pilbara.
- The majority of WA's public freight rail network is managed by Brookfield Rail. The Australian Rail Track Corporation manages the East-West main line into Kalgoorlie.

Social Infrastructure

- Growth in WA's mining and energy industries has been supported by significant levels of international migration.
- Career factors are a major motivator to ensuring a city is an attractive place to live in or move to. Safety, culture, education and public infrastructure also play a role.
- Perth is consistently rated as being amongst the world's most liveable cities.
- The cost of living in the Pilbara is far higher than in Perth. A mismatch between supply and demand has seen rapid growth in housing and land prices.
- The Pilbara lacks a full range of high quality community infrastructure to support liveability.

Aviation

- There is a bottleneck at Perth Airport during peak hours. Current traffic patterns reflect shift patterns designed around best practices in safety, fatigue management and operational efficiency. For this reason, flying outside of current peak hours is expensive for resource companies.
- Dealing with the peak capacity problem at Perth Airport requires shifting some traffic outside of the peak, or capacity expansion through improving efficiency of existing infrastructure or through an additional runway.

Ports

- Bulk mineral export facilities are operating at capacity. There is not yet a clear pathway to delivering new port facilities at Anketell, Oakajee and Esperance. These developments are required to facilitate resource developments in the Pilbara, Yilgarn and Mid West.
- Production growth plans rely on successfully executing infrastructure plans.

Road

- The Regional Freight Transport Network Plan will evaluate investments in key corridors to address the increasing number of oversize loads. Improved port facilities in the Pilbara are essential to facilitate a move from road transport to coastal shipping for some loads.

Rail

- Continued growth in exports will require additional rail capacity, and the protection of rail corridors for future growth.

Social Infrastructure

- Perth is competing for internationally mobile, highly skilled minerals and energy workers. These workers are able to choose from a wide range of international resource hubs.
- While Perth scores well on many liveability factors, culture and the incidence of crime are areas for potential improvement.
- Housing affordability and town amenity are critical enablers to maintaining a residential operational workforce. Housing costs in mining communities continue to be significantly higher than Perth.

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Section Three
People

3.1 Summary

Key findings relating to People

State Overview

- The workforce required for growth plans in the minerals and energy sector in WA is projected to peak at 125,000 people in 2014, approximately 9,000 above the 2012 workforce of 116,000. [1]
- After the peak in 2014, employment in the minerals and energy sector will slowly reduce as the current wave of construction activity gives way to operations. From 2018, the workforce will reduce to below 2012 levels.
- The construction workforce will peak in 2014, with 300 workers above 2012 levels, before commencing a decline to 24,000 below 2012 levels by 2018. The completion of construction of a number of major minerals and energy projects, particularly in the Pilbara, drives this decline in construction workers.
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High Growth Regions

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- The minerals and energy workforce in the Kimberley is forecast to increase from 3,400 workers in 2012 to 6,200 in 2015 before declining to 4,200 in 2018.
- The Perth/Peel region supplies significant numbers of FIFO workers. An additional 5,500 FIFO workers will be required from Perth/Peel in 2014, before a decline to 5,600 less than 2012 levels by 2018.
- While population projections and labour force participation rates indicate sufficient aggregate labour availability, the changing composition of workforce requirements from construction to operations will shift the skills required for minerals and energy projects.

1. Latest DMP employment data available is for 2011, where average employment was 100,641. Based on previous Growth Outlook studies and forthcoming PwC work, employment growth for 2012 has been estimated at 15,000 workers.

- The 2011 State Growth Outlook forecast rapid growth in the workforce from 2009 and a peak of 120,000 workers in 2012. This profile is consistent with the results from the current State Growth Outlook. However, the peak in workforce size of 125,000 in 2014 is higher and later than that forecast in the 2011 State Growth Outlook.
- On a regional basis, a slightly lower peak is expected in the Pilbara, with a peak of 65,500 workers in 2014 compared to the forecast peak of 67,000 workers in 2012 in the 2011 Outlook.
- Much of the growth in employment projected to occur by 2012 for the Mid West in the 2011 Outlook has not materialised, and is now forecast to occur in 2013 and 2014 as construction of iron ore and associated infrastructure projects in the region commence. A similar peak in 2014 of 13,000 workers, 4,800 above current levels, is forecast in the current State Growth Outlook.
- The 2011 Outlook under-predicted employment growth in the Goldfields/Esperance region, with current estimated employment of 22,000 being 5,200 higher than the forecast peak. The current survey forecasts a roughly flat profile of employment growth from 2012.
- Compared with the last survey, the current survey suggests a lower use of local resident workers for the operational workforce. Nonetheless, the shift from construction to operations for many minerals and energy projects is expected to increase the proportion of local residents in the workforce.
- The source of FIFO workers was mostly consistent in both surveys. A forecast of 81% from Perth/Peel and 11% from interstate was made in the 2011 Outlook, compared with 79% Perth/Peel and 11% interstate in the current Outlook.

Growth and Competitiveness

- The ability to respond to the demand for skilled labour will be a determining factor in the on-time delivery of minerals and energy projects. The changing nature of demand from construction to operations highlights the importance of appropriate skills rather than aggregate labour numbers.
- Demographic and economic factors are likely to increase the challenges faced by the resource sector in attracting and maintaining appropriately skilled staff.
- The mineral and energy sector's investment in education and training needs to be focussed on ensuring the workforce is ready for the operational phase of major projects.
- There is a need to continue to promote increased interstate labour agility as a means of meeting skilled labour demand. However, barriers to interstate mobility reduce the attractiveness of relocating to the State.
- The ability to draw on international workers with the required skills will be important in maintaining growth in the sector.
- Continued opportunities to increase workforce participation in the sector should be pursued, focusing on under-represented groups such as indigenous and women, to supplement FIFO and migration programs.
- The reduced construction workforce requirements in the minerals and energy sector will increase the availability of workers with construction skills for other sectors.

Environment and Liveability

- Population increase will place increasing demands on social and hard infrastructure in Perth and regional towns, requiring advanced planning and investment.
- To attract and retain skilled and highly mobile resource sector workers, it is important that efforts continue to improve the liveability and vibrancy of Perth and regional towns.

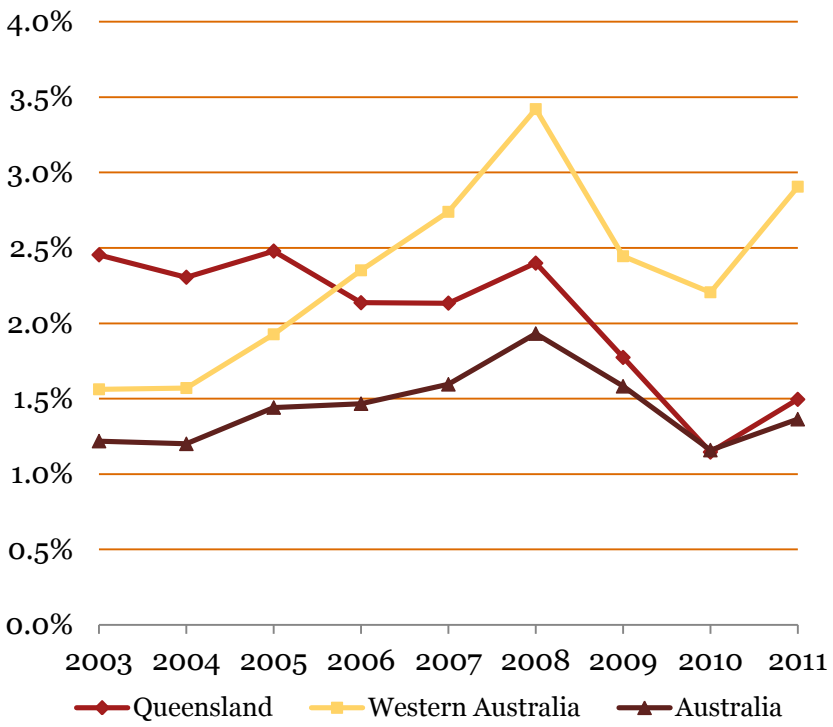
3.2 State Overview

3.2.1 Historic Population and Labour Trends

3.2.2 Forecast Demand and Trends

Historic Population Growth in Australia

Australian Population Growth
(% Year on Year)



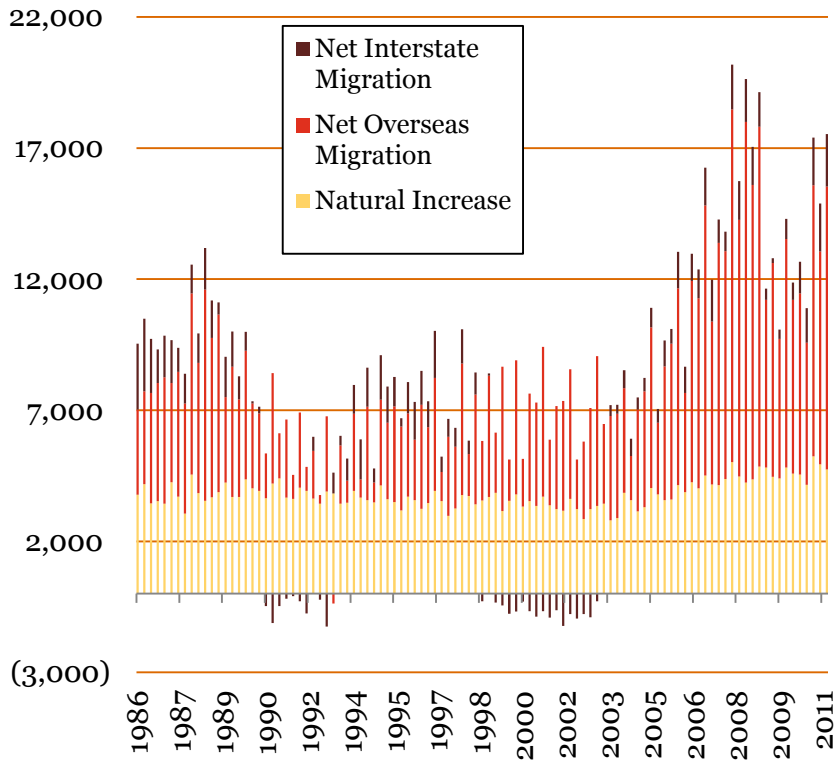
Since 2006, WA's population has been the fastest growing in Australia.

From March 2000 to December 2011, Australia's population has increased by almost 3.4 million to approximately 22.5 million. The population of WA is approximately 2.4 million. While WA constitutes 11% of the national population, 15% of the national net population increase since March 2000 has occurred within the State.

Source: ABS, *3101.0 - Australian Demographic Statistics, Dec 2011*, 2012

Sources of WA Population Growth

WA Population Change Components
(Quarterly)



Population increase in WA has primarily been driven by net overseas migration, and secondly by natural increase.

Since 2004, the population in WA has increased by 414,000, comprising: 59% net international migration; 33% natural increase; and 8% net interstate migration.

The recent high level of net migration to WA coincides with strong demand for labour by the minerals and energy sector and other State development. Skilled migration comprised 58% of migration to WA in 2010-11.

Of 16,290 subclass 457 visas granted in WA for 2011-12 3,630 were sponsored by the mining and energy sector. A further 4,100 were granted for the construction sector.

While interstate migration is a smaller contributor to population growth than overseas migration and natural increase, the current levels of net interstate migration have not been seen since the mid 1990s.

Source: ABS, *3103.0 - Australian Demographic Statistics, Dec 11*, Table 2, 2012
Department of Immigration & Citizenship, *Population Flows: Immigration Aspects 2010-11 Edition*, 2012
Department of Immigration & Citizenship, *Subclass 457 State/Territory summary report 2011-12,* 2012

WA Population Outlook – Population Change Components

WAPC Population Change Components 2006-2026	Average Annual Natural Increase	Average Annual Interstate Migration	Average Annual Overseas Migration
Band A	17,695	1,440	24,200
Band B	18,300	1,410	27,000
Band C	18,780	1,400	28,800
Band D	19,240	7,025	30,700
Band E	19,920	7,125	33,500

ABS Population Change Components 2009-2020	Average Annual Natural Increase	Average Annual Interstate Migration	Average Annual Overseas Migration
Series A	22,300	5,550	35,900
Series B	18,500	2,550	26,000
Series C	15,500	-500	20,500

The Western Australian Planning Commission (WAPC) projects interstate and overseas migration to WA over the period 2006 to 2026 of between 511,900 and 699,100 people.

The WAPC prepared 10,000 simulations of population growth, each with slightly varying parameters. The simulation results were grouped into five bands of varying population levels, labelled Band A for the lowest 20% of outcomes through to Band E for the highest 20%. In all scenarios, overseas migration is the dominant source of population growth, followed by natural increase.

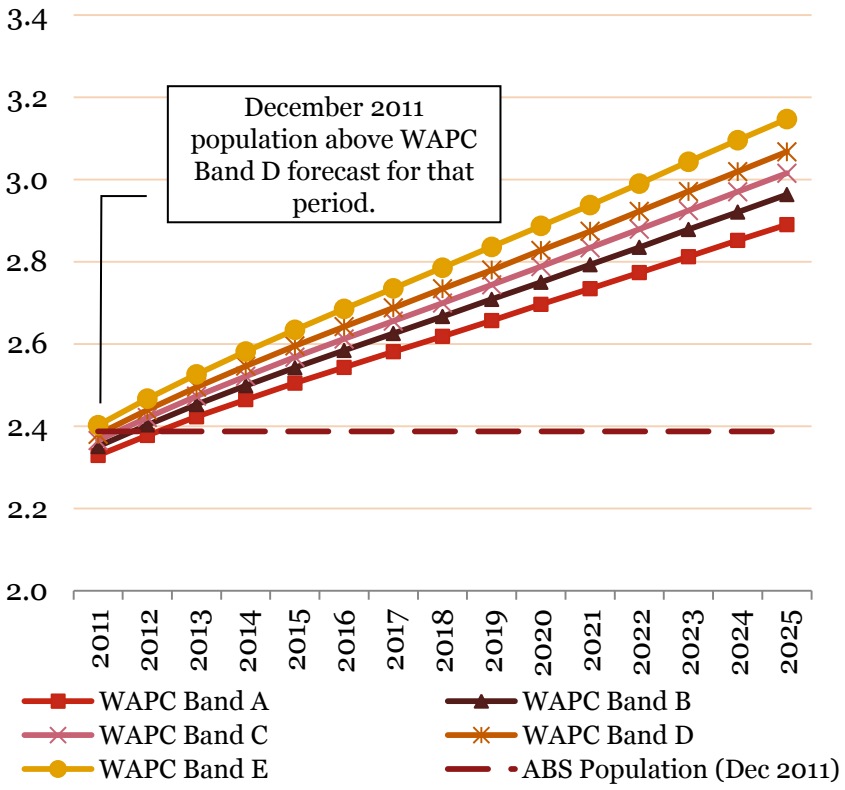
These projections contrast with the assumptions of the ABS in developing its demographic projections for WA. The ABS projections contain a broader range of outcomes than those from the WAPC, but retain the dominant role for migration and natural increase as drivers of population growth.

These ABS projections are now relatively dated, as they were released in 2008, and thus significantly pre-date the 2011 census.

Source: Western Australian Planning Commission, *WA Tomorrow*, 2012
ABS, *3222.0 – Population Projections, Australia, 2006 to 2101*, 2008

WA Population Outlook

WA Population Outlook - WAPC
(Millions)



WAPC population projections for WA forecast a 2026 population of between 2.93 and 3.20 million (representing a compound annual growth rate of between 1.6 and 2.0%).

There is no consensus population outlook for WA although the outlooks developed by the WAPC and the ABS are widely endorsed.

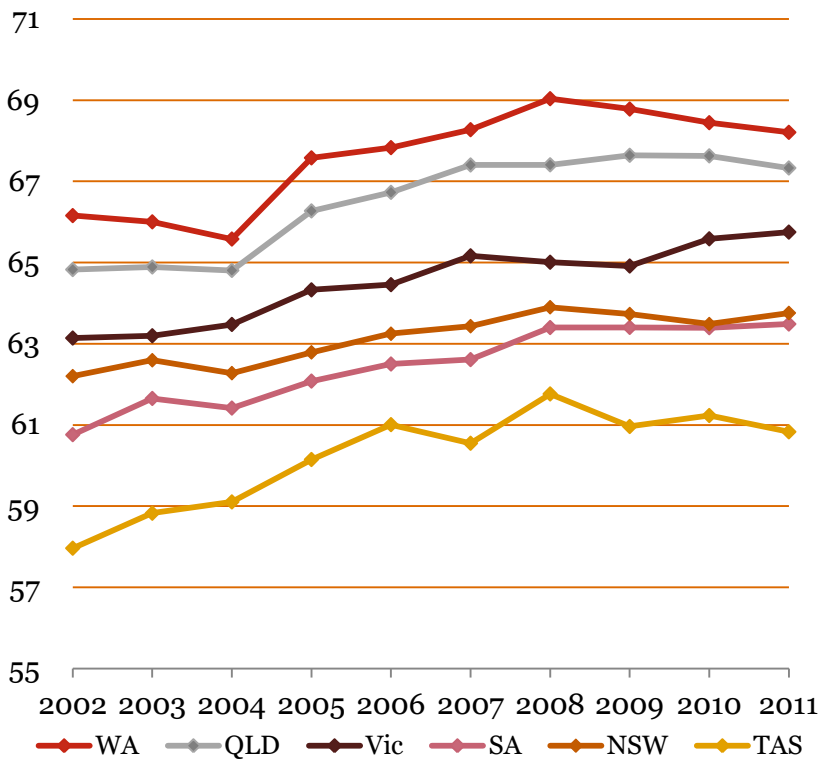
The WAPC "Bands" and ABS "Series" demonstrate the range of potential population growth for WA, though both have underestimated the short term growth experienced in 2010 and 2011.

The WAPC forecasts for WA's population in 2025 range from 2.8m (Band A) to 3.1m (Band E). The ABS projections for 2025 produce a wider range, from 2.7m (Series C) to 3.2m (Series A).

Source: Western Australian Planning Commission, *WA Tomorrow*, 2012
ABS, *3101.0 - Australian Demographic Statistics*, Dec 2011
ABS, *3222.0 – Population Projections, Australia, 2006 to 2101*, 2008

Comparative Workforce Participation Rates

Workplace Participation Rates
(%, annual average)



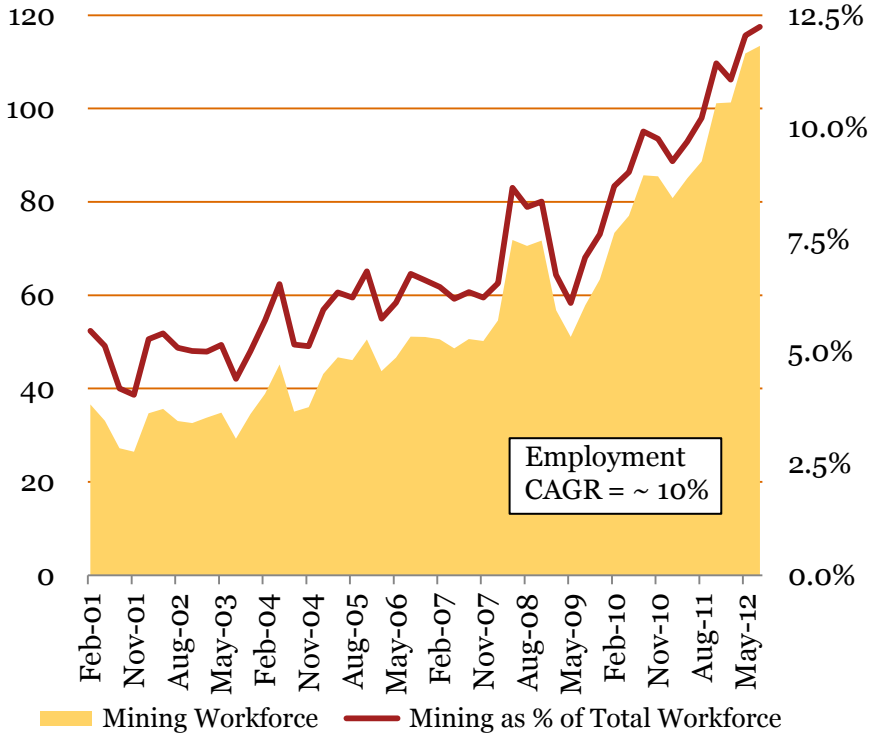
WA has the highest workforce participation rate of any state in Australia and therefore may have limited scope for increase in the future.

Workforce participation is an important driver of workforce availability. Recent economic growth in WA, underpinned by strong growth in the minerals and energy sector, has stimulated an increase in the participation rate. The workforce participation rate in WA increased from 66.5% in 2001 to 68.2% in 2011, remaining above all other states.

Source: ABS, *6202.0 - Labour Force, Australia, Aug 2012*, Table 12, 2012

Growth in Mining Employment

Historic Mining (including Oil and Gas)* Employment in WA
(000's Employed LHS, % Total Workforce RHS)



Over the past 10 years the mining workforce has grown significantly – both in absolute terms and relative to other industries. It now accounts for over 12% of the workforce in WA.

Analysis of mining employment over time demonstrates the strong growth in the industry. In 2001, mining accounted for only 5.4% of the workforce in WA, and in November 2011 accounted for 11.4%.

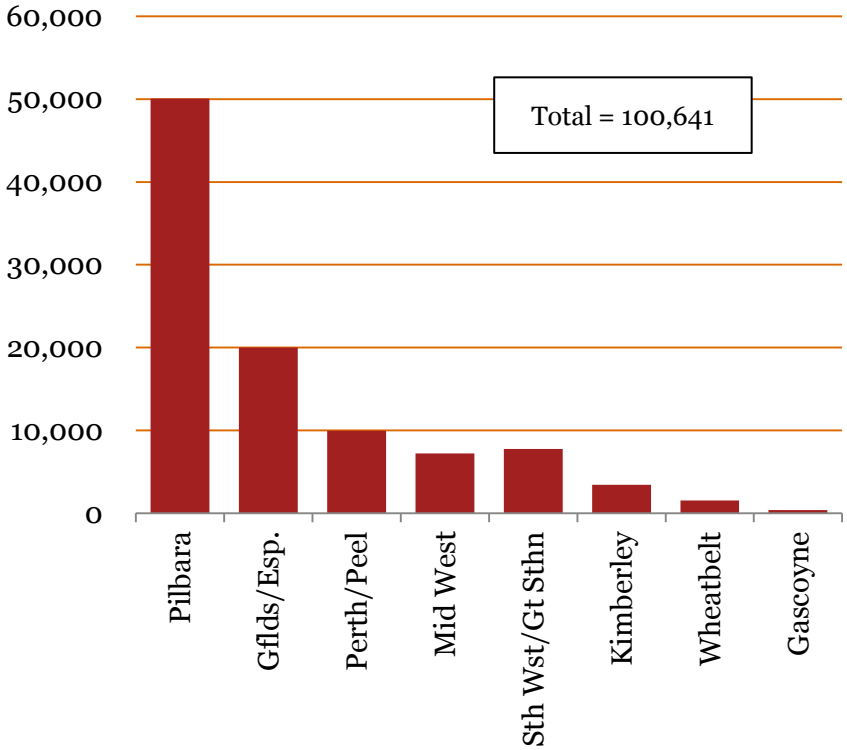
The mining workforce was affected during the Global Financial Crisis, with a significant drop in employment in the months after November 2008. The decrease in mining as a proportion of the workforce shows the sector was hit harder than other sectors in WA. However, mining industry employment recovered quickly, now reaching levels above those before the Global Financial Crisis.

Note: *ABS categorisation of Mining includes Oil and Gas exploration and extraction, but not processing. Some mining industry segments are not captured, for example site preparation and removing overburden at a mine site on a contract or fee basis sits within Site Preparation Services, and ore processing and liquefying natural gas can be included in Manufacturing.
CAGR = Compound average growth rate

Source: ABS, *6291.0.55.003 - Labour Force, Australia, Detailed, Quarterly, Aug 2012*, 2012

Minerals and Energy Workforce – Regional Breakdown

WA Minerals and Energy Workforce
(12 month average, 2011)



Half of the minerals and energy workforce in WA is employed in the Pilbara, with approximately 50,000 working in the region in 2011 according to the Department of Mines and Petroleum.

The Department of Mines and Petroleum tracks site-based employment in the resource sector. These numbers reflect the number of employees on a site, and are not directly comparable to ABS statistics.

The second largest workforce is located in the Goldfields/Esperance region, with 20,000 employed in 2011.

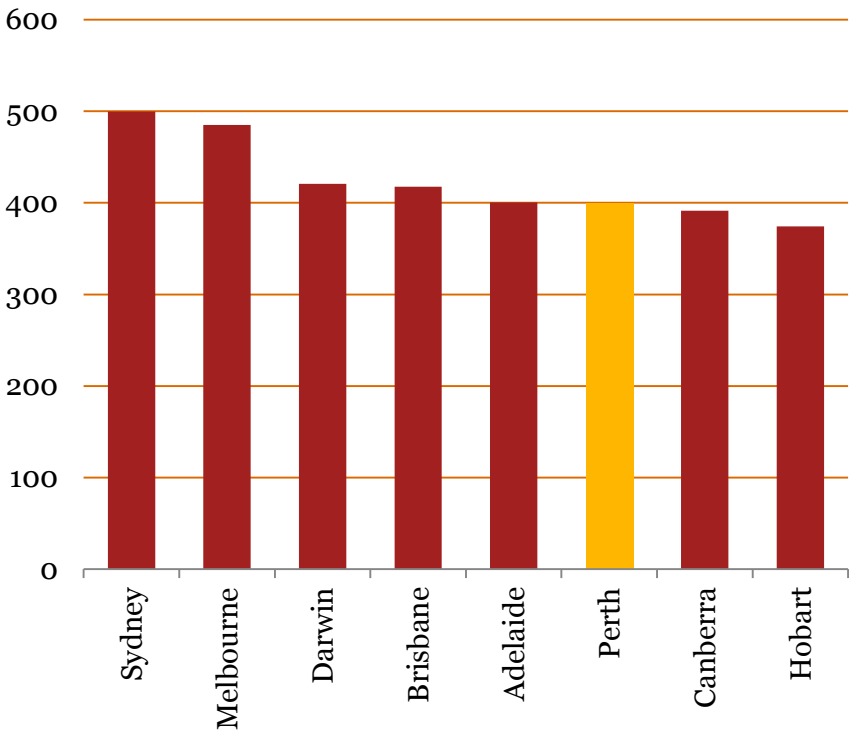
The total minerals and energy workforce comprises 92,300 people employed in minerals projects, and 8,300 involved in petroleum projects, including LNG processing.

The 92,300 engaged in minerals projects is a significant increase on the estimated 76,900 employed in minerals projects in 2010.

Note: DMP measure of site-based employees. 358 workers could not be allocated to regions.
Source: DMP, *Resource Statistics*, 2012

Comparative Housing Affordability in Australia

Housing Affordability, Australia
(Ratio of Median House Price to Average Weekly Earnings, 2012)



House prices in Perth, relative to weekly earnings, are the third most affordable of Australian capital cities.

House prices in Perth are fifth highest of the capital cities (behind Canberra, Sydney, Darwin and Melbourne) and Perth residents have the second highest average weekly earnings (behind Canberra). The high weekly earnings is a significant contributor to the housing affordability.

Perth houses were second least affordable by this measure in the 2011 State Growth Outlook, but declines in housing values since that survey with continuing income growth has resulted in an affordability improvement. Nonetheless, housing affordability remains an issue for sections of the community.

The Pilbara remains the most expensive region to rent a house in Australia.

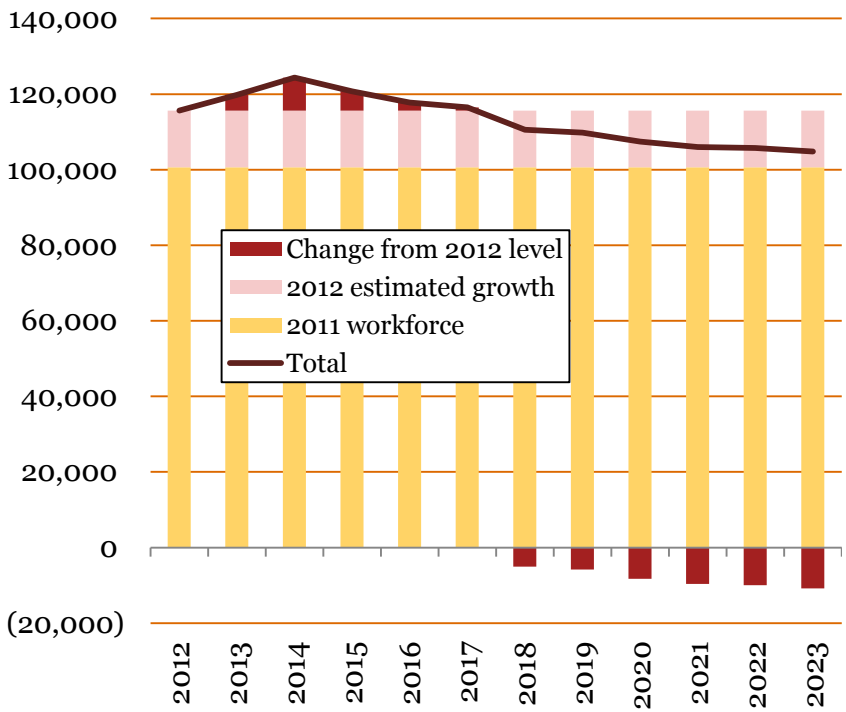
RP Data's June 2011 quarterly analysis of the rental market suggested Pilbara median rents were four times more expensive than Perth median rents and had increased 18% in the previous year.

This affects the ability of the minerals and energy sector to draw permanent interstate and international workers into the Pilbara.

Source: ABS, *6416.0 - House Price Indexes: Eight Capital Cities*, Table 7 and 8, Jun 2012
ABS, *6302.0 - Average Weekly Earnings May 2012*, Aug 2012
RP Data, *Rental Review*, June 2011.

Minerals and Energy Workforce Outlook – WA

Minerals and Energy Workforce Outlook
(Headcount)



The workforce required for growth plans in the minerals and energy sector in WA is projected to peak at 125,000 people in 2014, approximately 9,000 above the 2012 workforce of 116,000.

After the peak in 2014, employment in the minerals and energy sector will reduce as the current wave of construction activity gives way to operations. After 2018, the workforce is projected to reduce to below 2012 levels.

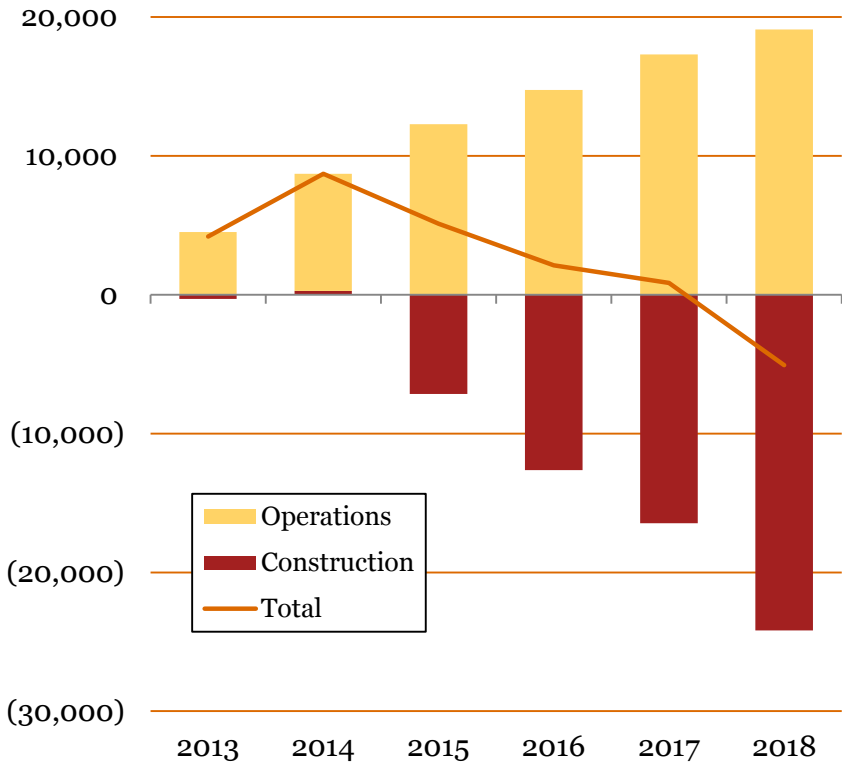
The peak in workforce size is slightly higher and later than that forecast in the 2011 State Growth Outlook, where a peak of 120,000 was projected for 2012. The shift in the peak is due to project delays, particularly in the Mid West.

Note: Latest DMP employment data available is for 2011, where average employment was 100,641. Based on previous Growth Outlook studies and forthcoming PwC work, employment growth for 2012 has been estimated at 15,000 workers.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012; DMP, *Resource Statistics*, 2012

Minerals and Energy Workforce Outlook – Construction vs. Operations Workforce

New Workforce Breakdown
(Headcount, Increment above 2012 level)



The minerals and energy sector construction workforce will peak in 2014 with 300 workers above 2012 levels. The construction workforce will then commence a decline to 24,000 below 2012 levels by 2018.

The completion of construction of a number of major minerals and energy projects, particularly in the Pilbara, drives this decline in construction workers. However, the completion of these projects results in a corresponding increase in the operational workforce.

The operating workforce will increase strongly through to 2018, with an additional 19,000 operational staff required for minerals and energy projects.

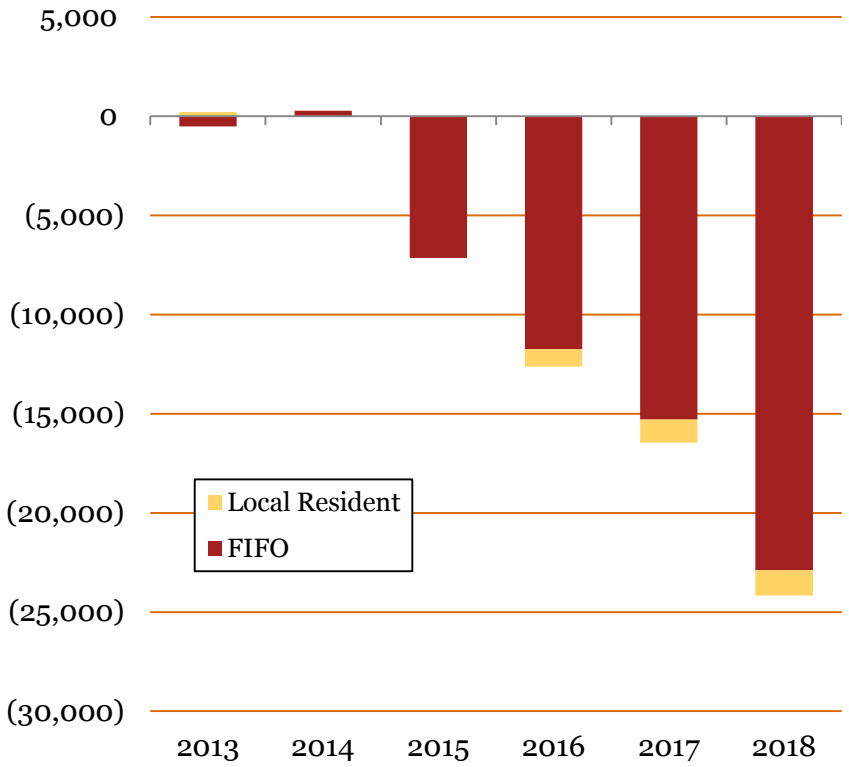
The skills required by the minerals and energy sectors will change with the shift from construction to operational workforces and a changing mix of minerals and energy projects.

The survey-based approach included only projects that had reached preliminary feasibility stage. There is the potential for new projects, which are not recognised in this study, to enter construction by 2018.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012

Minerals and Energy Construction Workforce – FIFO vs. Local Resident

Construction Workforce Breakdown
(Headcount, Increment above 2012 level)



Construction activity in the minerals and energy sector reduces sharply after 2013. This partially reflects the stage of many project lifecycles.

The construction workforce is forecast to decline by 24,000 by 2018 as current and near term activity winds down.

Projects that have currently not reached pre-feasibility study stage (and thus are not included in our study) may begin construction toward the end of this decade, potentially increasing construction activity above the forecast.

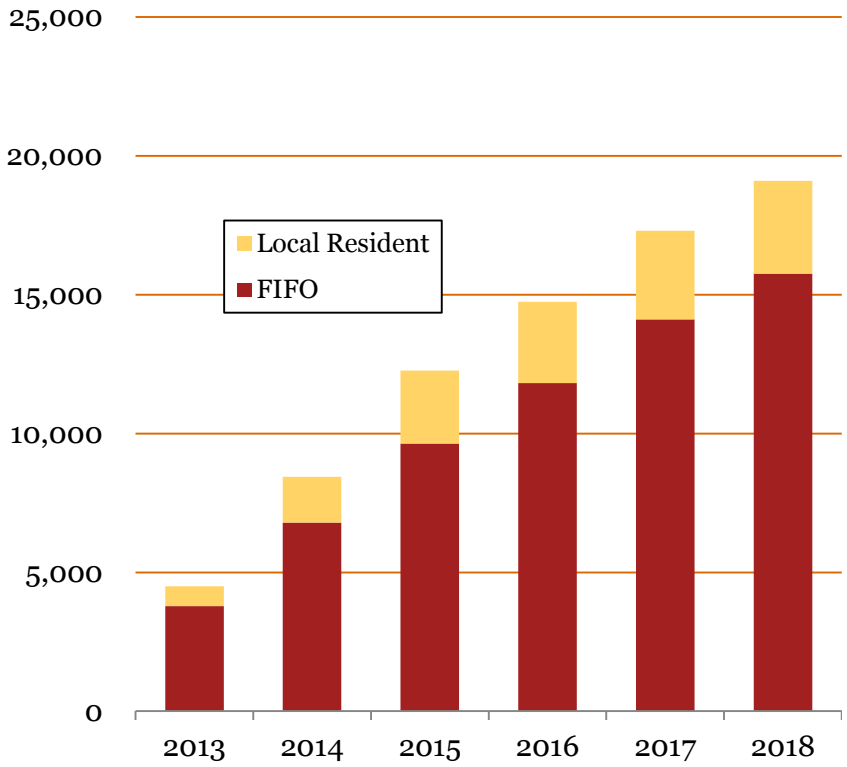
The construction workforce operates almost entirely on fly-in, fly-out rosters.

Consequently, there is a strong decline of 23,000 FIFO workers associated with the reduction in the construction workforce.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012

Minerals and Energy Operations Workforce – FIFO vs. Local Resident

Operations Workforce Breakdown
(Headcount, Increment above 2012 level)



The operations workforce is forecast to grow steadily as current and near-term construction projects begin production.

19,000 additional operations workers are required in the minerals and energy sector by 2018.

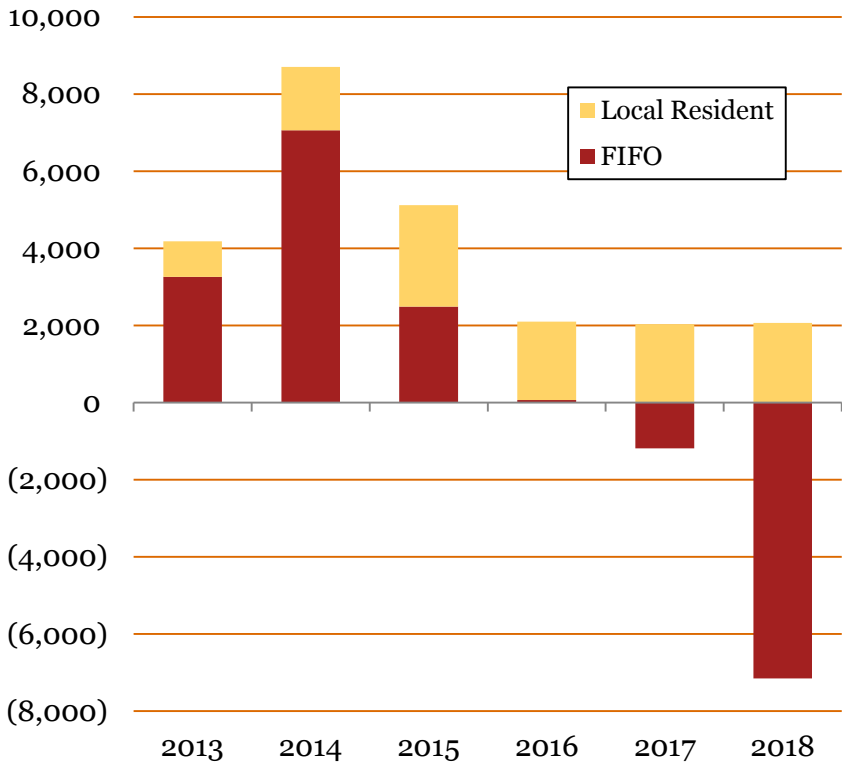
Incremental growth in the minerals and energy operations workforce is expected to be largely FIFO. Residents in the local area account for 17% of incremental growth to 2018.

The forecast level of local resident employees has decreased from the 2011 State Growth Outlook, when 23% of the incremental operations workforce was projected to be resident in the local area.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012

Incremental Minerals and Energy Workforce – FIFO vs. Local Resident

FIFO vs. Local Resident
(Headcount, Increment above 2012 level)



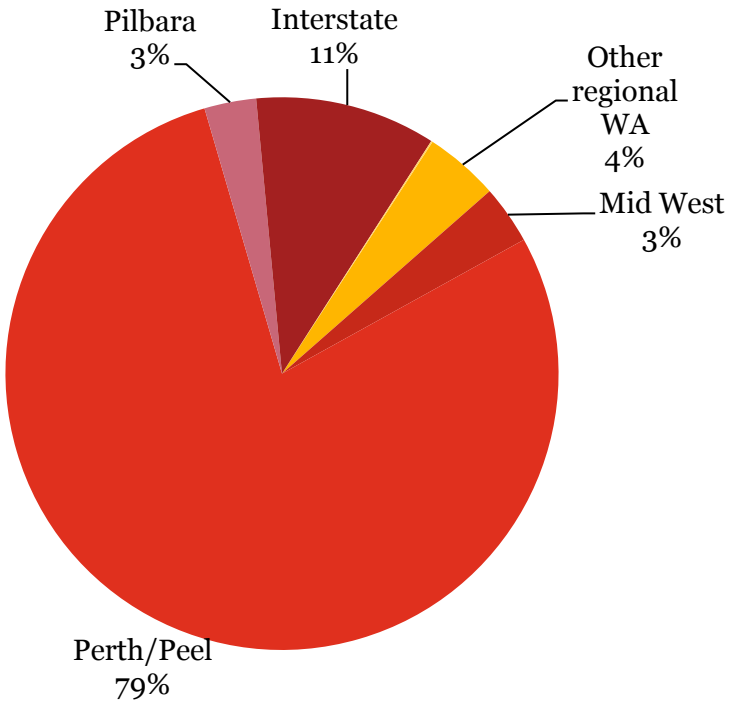
The expected decrease in construction activity drives a reduction in the minerals and energy FIFO workforce, with an incremental decrease of over 7,000 workers by 2018 despite the growing operational workforce.

There is a strong shift towards a local residential workforce over the period, with over 2,000 additional residential workers expected. These changes reflect a shift from construction to operations activity in the sector.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012

Total Minerals and Energy Workforce – Source of FIFO

Source of FIFO
(By place of residence, 2012)



Survey results indicate that 79% of the FIFO workforce is based in the Perth/Peel region.

Of the FIFO workforce, 3% is based in the Mid West, which predominantly constitutes workers who will FIFO (and drive-in-drive-out) from Geraldton. The 3% identified as coming from Pilbara locations were not identified in the previous survey.

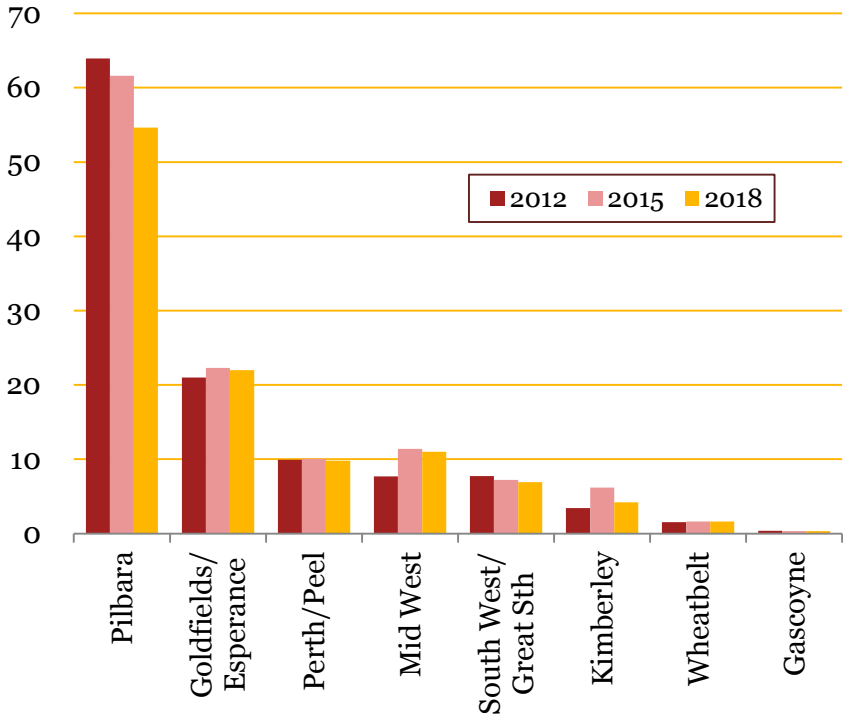
The survey highlighted a large number of interstate FIFO workers (11% of total).

This is the same result as the 11% interstate FIFO workers identified in the 2011 State Growth Outlook. Queensland, NSW and Victoria were identified as the main sources of interstate FIFO. There was no international FIFO identified in the 2012 survey.

Source: State Growth Outlook Survey

Minerals and Energy Workforce Growth by Project Region

Minerals and Energy Workforce Growth
(Thousands)



The major changes in the minerals and energy sector workforce to 2018 occur in the Pilbara, where the total workforce declines, and the Mid West, where the workforce increases.

Pilbara employment declines by 9,300 workers to 2018, from a 2012 base of 63,900. This is still a significantly higher level of employment than the 33,000 employed in the minerals and energy sector in the Pilbara in 2009 and comprises the majority of minerals and energy sector employment in WA.

The Mid West minerals and energy workforce is around 8,000 or 7% of the total WA minerals and energy workforce in 2012. With the rapid growth expected in the region, this is likely to grow to 10% of the total minerals and energy workforce by 2018, with 3,300 additional workers.

While employment growth in the Goldfields/Esperance region is relatively flat, this still represents a net increase in employment of 1,000 workers by 2018, from a base of 22,000.

The minerals and energy workforce in the Kimberley is forecast to increase from 3,400 workers in 2012 to 6,200 in 2015 before declining to 4,200 in 2018.

Limited additional growth is expected in the remaining regions.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012; DMP, *Resource Statistics*, 2012

3.3 Regional Overview

Overview of High Growth Regions

Growth in the Pilbara

Planned projects for the Pilbara suggest a decline of 2,300 minerals and energy workers below 2012 levels by 2015, declining to 9,300 workers below 2012 levels by 2018. This decline is driven by a decline in the construction workforce of 22,900 and an increase in the operations workforce of 13,600 by 2018.

In 2018, there is forecast to be an additional 2,100 local resident workers in the Pilbara. This increase is caused by the shift from construction to operations for many of the Pilbara's minerals and energy projects.

The minerals and energy projects driving growth in this region are: oil and gas; and iron ore and associated infrastructure.

Growth in the Mid West

Planned projects for the Mid West require an additional 4,800 workers in 2014 and 3,300 in 2018 above the 7,700 in the region in 2012.

The peak minerals and energy workforce in the Mid West is forecast to occur in 2014, with an additional 3,600 construction and 1,200 operations workers.

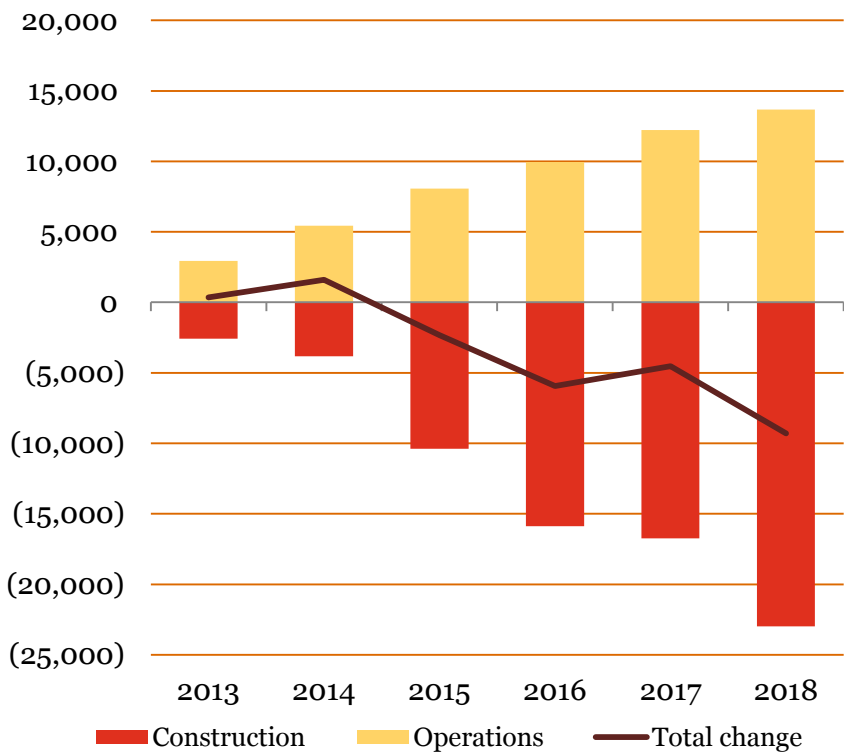
Major minerals and energy projects driving the labour demand within this area include: iron ore and relevant infrastructure; and uranium.

Growth in the Perth/Peel Region

The Perth/Peel region supplies significant numbers of FIFO workers. An additional 5,500 FIFO workers will be required from Perth/Peel in 2014, before a decline to 5,600 less than 2012 levels by 2018.

Pilbara – Incremental Minerals and Energy Workforce

Pilbara Minerals and Energy Workforce
(Headcount, Increment above 2012 level)



The composition of the minerals and energy workforce in the Pilbara will undergo a significant shift from construction to operations to 2018. Planned projects suggest 22,900 fewer construction workers will be required in 2018, whereas 13,600 additional operations workers will be required.

This net effect of these changes is a 14% decline in the minerals and energy workforce in the Pilbara by 2018, with 9,300 fewer minerals and energy workers.

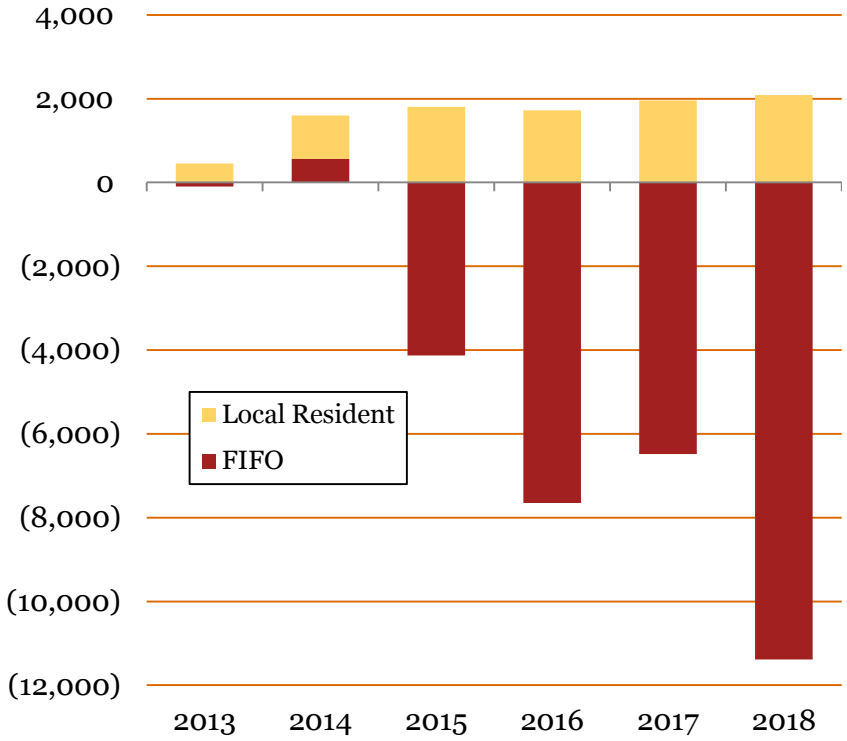
Employment plans for the Pilbara region were taken from the Pilbara Population and Employment Study, a detailed study of employment plans in the Pilbara region conducted in January 2012. This study achieved a more complete set of responses for the Pilbara, and thus was used to supplement the State Growth Outlook dataset.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012; DMP, *Resource Statistics*, 2012

Pilbara – FIFO and Local Resident Minerals and Energy Workforce

FIFO vs. Local Resident Over Time - Pilbara

(Headcount, Increment above 2012 level)



Over the period to 2018, the composition of the workforce is forecast to shift towards local resident workers and away from FIFO.

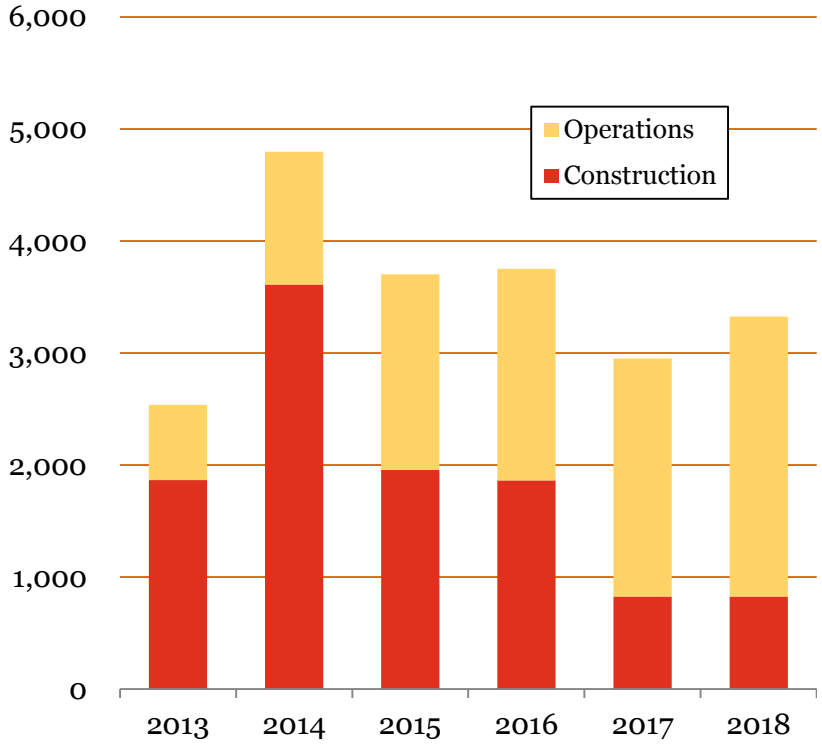
The change in workforce composition is largely the result of the shift from construction to operations at a number of minerals and energy projects. Whereas the construction workforce is comprised almost solely of FIFO workers, operations workforces tend to include a material proportion of local residents.

In 2018, there are expected to be 2,100 additional local resident workers and 11,400 fewer FIFO workers engaged in minerals and energy projects in the Pilbara.

Source: State Growth Outlook Survey; Pilbara Population and Employment Study 2012

Mid West – Incremental Minerals and Energy Workforce

Mid West Minerals and Energy Workforce
(Headcount, Increment above 2012 level)



Planned projects for the Mid West require an additional 4,800 workers in 2014 and 3,300 in 2018 above the 7,700 minerals and energy workers in the region in 2012.

The peak minerals and energy workforce in the Mid West is forecast to occur in 2014, with an additional 3,600 construction and 1,200 operations workers.

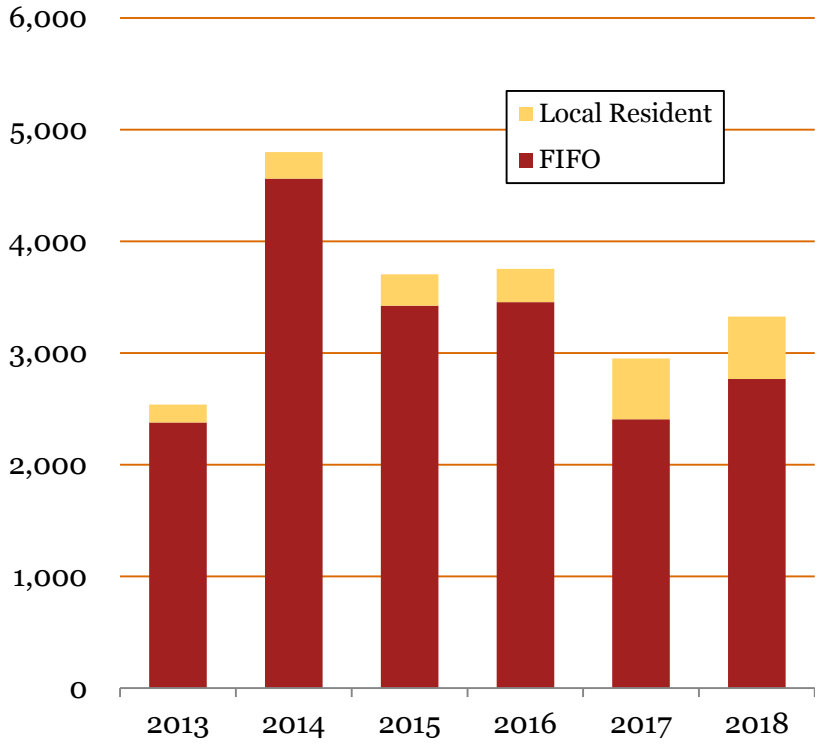
The peak in construction in the Mid West occurs in 2014, with construction activity then declining. By 2016, the 'new' minerals and energy workforce will consist mainly of operations workers as most of the planned projects have been commissioned.

Major projects driving the labour demand within this area include iron ore and uranium production as well as supporting infrastructure.

Source: State Growth Outlook Survey

Mid West – FIFO and Local Resident Minerals and Energy Workforce

FIFO vs. Local Resident Over Time – Mid West
(Headcount, increment above 2012 level)



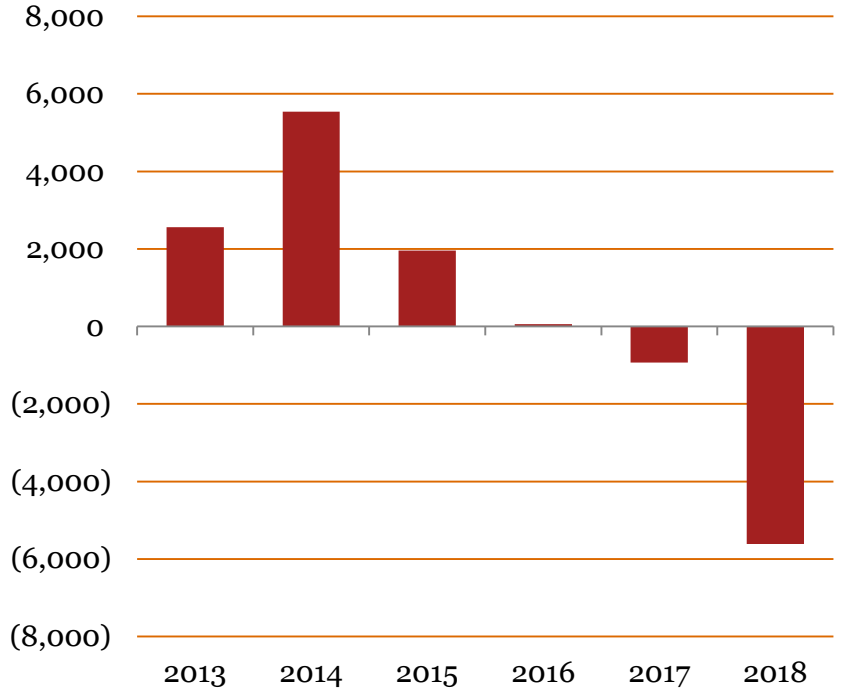
In 2018, 83% of the incremental workforce in the minerals and energy sector in the Mid West is forecast to be FIFO.

As the shift from construction to operations occurs in Mid West minerals and energy projects to 2018, it is forecast that the proportion of local resident workers will also increase.

Source: State Growth Outlook Survey

Perth/Peel –Minerals and Energy FIFO Minerals and Energy Workforce

Perth/Peel Minerals and Energy FIFO Employment
(Headcount, Increment above 2012 level)



The Perth/Peel region is a major source of FIFO workers for minerals and energy projects in other regions. An additional 5,500 FIFO workers will be required from Perth/Peel in 2014, before a significant decline to 5,600 fewer workers than 2012 levels in 2018.

The decrease in FIFO workers from Perth/Peel is due to the decline in construction activity associated with minerals and energy projects and the increasing proportion of local residents employed in operational activities. The shift in activity from the Pilbara to the Mid West, where a lower proportion of FIFO workers are used, is also contributing to the decline.

Source: State Growth Outlook Survey

Other Regions

Great Southern/South West

There is a small decrease in the minerals and energy workforce forecast for the region, peaking in 2013 with an additional 180 workers. From 2014 there is a transition from construction workforce to operations workforce. The construction workforce will reduce to below 2012 levels by 2014. The operations workforce is likely to increase by around 230 by 2015 and 360 by 2018.

Gascoyne

There is limited incremental minerals and energy demand in the Gascoyne to 2018.

Wheatbelt

There is projected to be a slight increase in the minerals and energy sector workforce of 70 people by 2018, all in operations.

Kimberley

The minerals and energy workforce in the Kimberley is forecast to increase from 3,400 workers in 2012 to 6,200 in 2015 before declining to 4,200 in 2018.

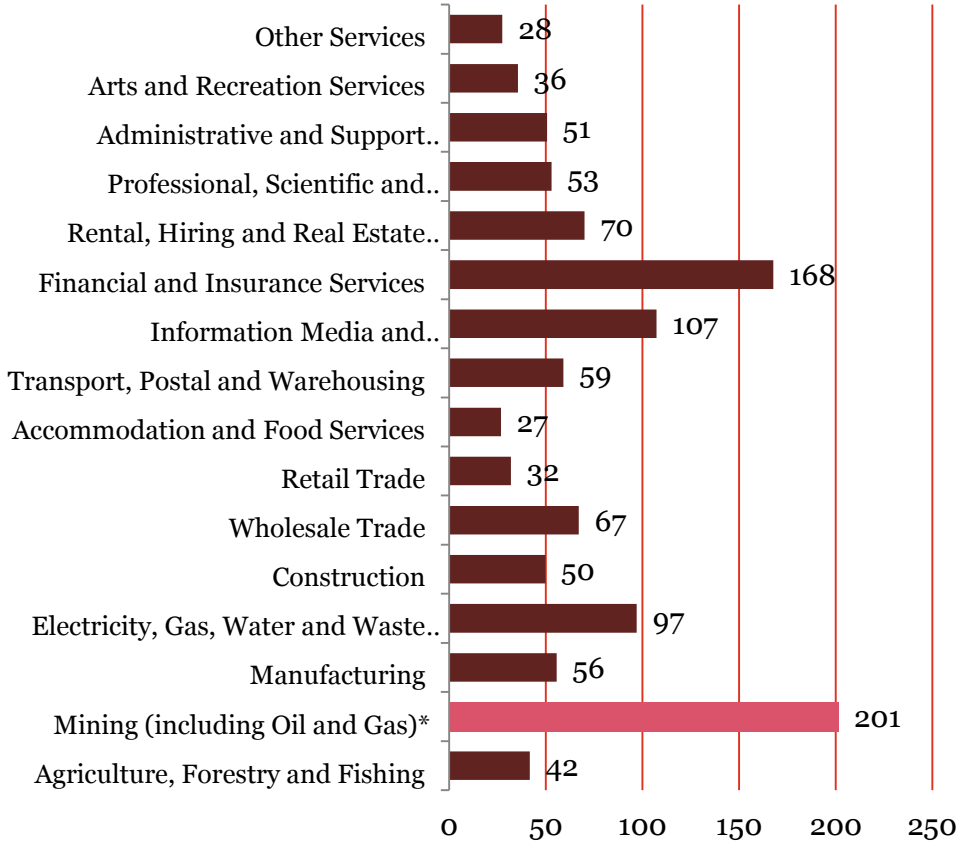
Goldfields / Esperance

There is a slight increase in incremental demand in minerals and energy projects in the Goldfields/Esperance region to 2018. A decrease in construction activity is offset by an increase in operations staff, leading to a net increase in employment of 1,000 workers by 2018 (from a base of 22,000).

3.4 Productivity

Labour and capital productivity – Mining sector

Labour Productivity by Sector - 2012
(Gross value added per hour)



Labour productivity in the mining sector is the highest of any industry in Australia.

Labour productivity can be measured as gross value added per hour worked. The calculation of gross value added used by the ABS is in terms of volume of output (not value) and as a result is not effected by changes in output prices (for example commodity price movements).

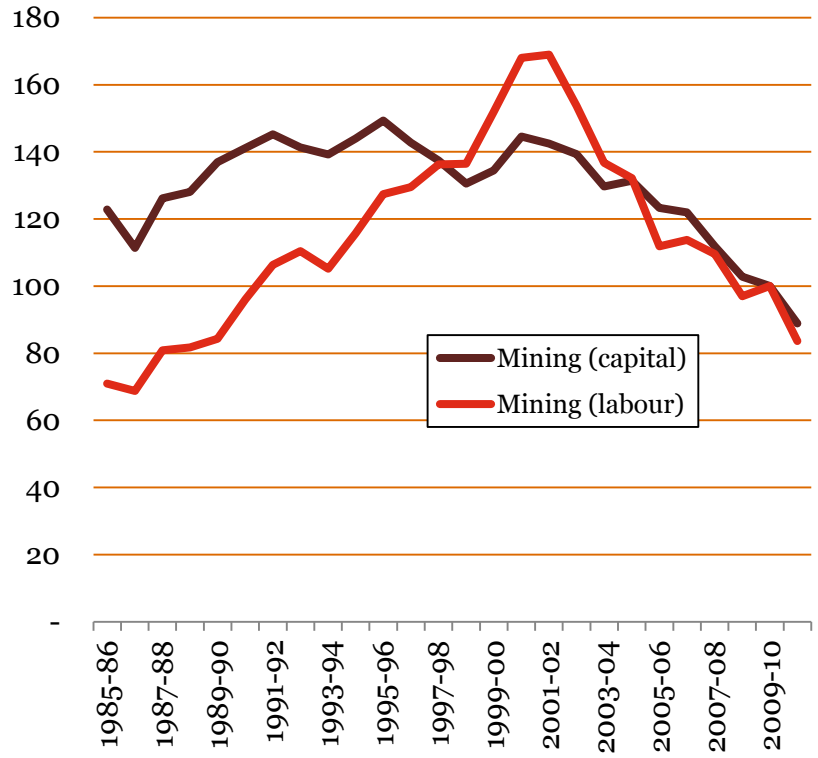
Gross value added per hour worked in mining is 20% higher than the second most productive sector (financial and insurance services).

Note: *ABS categorisation of Mining includes Oil and Gas extraction (see discussion in section 3.2.1)

Source: PwC, *Productivity Scorecard*, March 2012

Labour and capital productivity – Mining sector

Mining (including Oil and Gas)
Productivity Indices – Capital and Labour
(2010=100)



Source: PwC, *Productivity Scorecard,* March 2012

Mining sector productivity has been in decline since 2001, both for capital and labour productivity.

Economists think of industry productivity performance in terms of multi-factor productivity, which is composed of labour productivity and capital productivity. Both of these factors have fallen significantly since 2001; labour productivity has fallen by 50%, and capital productivity by 37%.

The decline in productivity stems in part from the sector's rapid growth.

The high commodity prices and rapid output growth of the past decade has contributed to the industry's productivity challenges in three key ways.

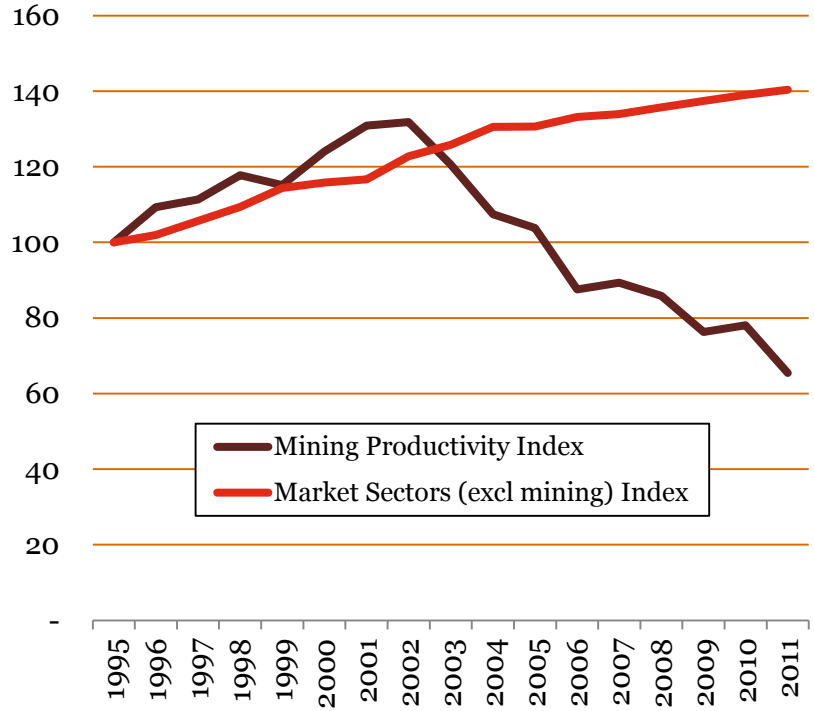
First, large capital investments are made ahead of time as new capacity is being constructed. This leads to a lag before the benefits of the expansion are realised.

Second, higher prices lead to more marginal mines being pursued. These have higher strip ratios and lower ore grades, requiring more labour hours per tonne of output.

Third, rapid employment growth has placed a strain on the skills of the workforce. New workers entering the industry with lower experience and training, reducing average labour productivity.

Labour and capital productivity – Mining sector

Labour Productivity Index – Mining (including Oil and Gas) vs Other sectors
(1995=100)



The productivity challenges experienced in mining have not been seen in the rest of the Australian economy.

While mining productivity has fallen since 2001, labour productivity in other sectors has increased steadily.

Productivity will remain a challenge for the mining industry in Western Australia.

New projects and major expansions in Western Australian mines are considered by operators in the context of the range of investment opportunities available to them around the world. The productivity of the mining industry in WA is central to the industry's ability to continue to attract international capital.

Productivity challenges will remain for the sector in Western Australia as mining activity shifts toward increasingly remote areas and increasingly challenging resources.

Source: PwC, *Productivity Scorecard,* March 2012

3.5 Implications and Opportunities

3.5.1 Growth and Competitiveness

3.5.2 Environment and Liveability

Meeting the Demand for Skilled Labour

The ability to respond to the demand for skilled labour will be a determining factor in the on-time delivery of minerals and energy projects. The changing nature of demand from construction to operations highlights the importance of appropriate skills rather than aggregate labour numbers.

While the construction workforce peaks in 2013 and total minerals and energy workforce peaks in 2014, there is an increasing requirement for operational staff, particularly in the Pilbara and Mid West.

The changing demand from construction to operational workers increases the importance of training to provide workers with skills appropriate to mineral and energy workforce requirements.

The WA minerals and energy sector's investment in training is highlighted by recent data from the National Centre for Vocational Education Research which shows the total number of apprentices and trainees in the sector has increased 42% from March 2010 to March 2012.

Demographic and economic factors are likely to increase the challenges faced by the resource sector in attracting and maintaining appropriately skilled staff.

The ageing workforce is an economy-wide challenge for Australian industry. The large number of retirements expected over the next two decades means that a significant recruitment and training effort will be required simply to replace existing staff. The same factors create the risk of meaningfully lower workforce participation rates in the absence of significant international migration.

There is a need to continue to promote increased interstate labour agility as a means of meeting skilled labour demand. However, barriers to interstate mobility reduce the attractiveness of relocating to the State.

Barriers to interstate mobility include transaction costs (such as stamp duty on homes), inconsistent professional accreditation and the high cost of living in the Pilbara.

Source: NCVER, *Australian vocational education and training statistics: apprentices and trainees 2012 - March quarter*, 2012

Meeting the Demand for Skilled Labour

The ability to draw on international workers with the required skills will be important in maintaining growth in the sector.

International labour is utilised through employer sponsored visas such as 457s and labour agreements. Processing times for labour agreements remain a concern for industry.

It is crucial that the skilled migration program is flexible enough to meet the skilled labour requirements of the sector. There is an opportunity to use the Pilbara as a testing ground for new models for temporary migration.

Continued opportunities to increase workforce participation in the sector should be pursued, focusing on under-represented groups such as indigenous and women, to supplement FIFO and migration programs.

WA has the highest labour participation rate in Australia, so opportunities to increase this may be limited. However there may be opportunity to increase participation within specific groups such as women and the indigenous population.

Alternative labour sources will be required to ensure that sections of the skilled labour pool in WA are not drained as resources are drawn to the minerals and energy sector and away from other industries and the public sector. However, the reduced construction workforce requirements in the minerals and energy sector will increase the availability of workers with construction skills for other sectors.

As an indication of the competition for labour, between 2005 and 2012, wage inflation in the minerals and energy sector has been above average. Annual percentage growth in the labour price index over the period 2005-2010 was 4.1% across all industries, 5.0% for mining and 4.4% for construction.

Challenges to Managing Continued Population Growth

Population increase will place increasing demands on social and hard infrastructure in Perth and regional towns, requiring advanced planning and investment.

WA has recently experienced the highest population growth of all cities in Australia. Much of this growth has been absorbed in Perth's outer suburbs. Continued expansion of low density growth will place further pressure on civil infrastructure such as roads and public transport.

To attract the required population and skills to Perth to meet the demands of the minerals and energy sectors, maintaining the liveability of Perth is essential.

To attract and retain skilled and highly mobile resource sector workers, it is important that efforts continue to improve the liveability and vibrancy of Perth and regional towns.

While Perth is an attractive place to live, Perth businesses face competition from other capital cities for labour, especially for young qualified professionals.

Perth businesses have been able to attract technical skills in engineering and science due to minerals and energy driven demand, but there has been a net migration from WA of young professionals in areas of business, education, arts and media.

Additionally, according to surveys conducted in Australia and the US the majority of people who had recently moved cities had made the decision based on where they would like to live, not work. This demonstrates that investment in both social and hard infrastructure in WA will be necessary to grow skills diversity in the State.

Source: ABS, *Housing Intentions Survey, CEOs for Cities*, 2006
ABS, *6345.0 - Labour Price Index, Australia, Jun 2012*, 2012, Table 5a

Contents

Section Four

Energy

4.1 Summary

Key Findings Relating to Electricity

State Overview

- The estimated total State electricity consumption growth rate over the period to 2023 is 5.6% per year; substantially higher than the long term electricity growth forecast from BREE[1] (1.9% per year to 2035).
- Electricity consumption in WA could increase by approximately 52% by 2018, largely driven by projects in the minerals and energy sector.
- Across all industries, in the area serviced by the SWIS, 12% of new electricity generation demand to 2018 is projected to be purchased. Outside the SWIS and across all industries, 14% is projected to be purchased from third party generators.
- Minerals and energy sector electricity demand to 2018 is projected to increase by the equivalent of 2.7 GW[2] of generation capacity. The majority of minerals and energy sector demand is projected to be met through self generation (95%) and fuelled by natural gas (94%), a far higher proportion of self-generation than for other industries.

High Growth Regions

- The majority of new electricity generation required by the sector in 2018 is for projects in the Pilbara (70%) and the Mid West (15%).
- Incremental electricity demand in the Pilbara from minerals and energy projects is forecast to reach 9,700 GWh per year or the equivalent of 1.9 GW[2] of generation capacity by 2018, predominantly self generated and gas fired.
- Minerals and energy projects in the Mid West are projected to require 2,100 GWh above 2012 levels, or 0.4 GW[2] additional generation capacity by 2018, around 23% of which would be purchased.

Network Outlook

- Project proponents propose to use self generated electricity supply for minerals and energy projects in the Pilbara rather than the NWIS.
- Completion of the Mid West Energy Project *(see section 4.3.1)* would increase capacity to meet the demands of minerals and energy projects in the Mid West.
- The SWIS will require 1,000 MW additional generation capacity over the next decade; 95 MW of additional capacity is forecast to be required for minerals and energy projects by 2018, which is within existing generation capacity.

1. The Bureau of Resources and Energy Economics
2. Equivalent GW estimated at 0.6 load factor

Key Findings Relating to Domestic Gas

State Overview

- Natural gas demand in WA is projected to increase 65% from an estimated 430 PJ in 2012 to 700 PJ in 2023 (excluding gas used in gas production and processing).
- Activity in the minerals and energy sector over the period to 2023 will drive much of the gas demand. However new gas fired electricity generation (not specific to minerals and energy projects) will drive high levels of demand related to other industries.
- Minerals and energy project demand for gas is expected to increase to 81 PJ above 2012 levels by 2018 – a 47% increase on 2012 estimated consumption.
- The incremental natural gas demand is predominantly for electricity generation.

High Growth Regions

- The incremental natural gas demand from minerals and energy projects will predominantly be consumed in the Pilbara (incremental 60 PJ by 2018).
- The Mid West will also exhibit significant incremental demand of 11 PJ above 2012 levels by 2018. Electricity generation is the primary driver of domestic gas demand.

Supply Outlook

- Projections by the Department of Mines and Petroleum suggests that domestic gas supply (that is, natural gas supplied to third parties) will, at a minimum, increase by around 220 PJ per annum by 2016.
- Using the Department of Mines and Petroleum supply forecasts, it appears that the supply will be tight. The Department's low supply case is not sufficient to meet forecast demand.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Electricity

- The current survey forecasts a similar steep increase in electricity demand between 2012 and 2015 as was forecast in the 2011 Growth Outlook Study, around 13,000 GWh per year above current levels. However, the forecast increase is from a lower base.
- Additional electricity demand in the Pilbara between 2012 and 2015 is projected to be greater than in the previous survey. The increase is larger but from a lower base due to project delays.
- Additional electricity demand in the Mid West to 2015 is forecast to be lower in the current survey, with project delays pushing additional demand to later dates.
- There has been an increase in the proportion of self generated demand since the previous survey, along with an increase in the proportion of generation to be fuelled by natural gas.
- Significant progress has occurred on transmission networks within the SWIS, particularly with regard to the Mid West Energy Project. However, the reliance on self generation indicates that intentions to purchase grid electricity in the previous survey could not be met.

Natural Gas

- A similar growth rate in minerals and energy demand for gas was forecast in this survey. However, growth in gas consumption since the last survey results in higher forecast total demand.
- On a regional basis, the forecast of additional gas usage in the minerals and energy sector is significantly lower for the Mid West, and is slightly lower for the Pilbara.
- There is a tighter demand/supply outlook in the current survey, with supply expected to meet demand only in the high supply case projected by the Department of Mines and Petroleum.

Growth and Competitiveness

- Self generation will remain the predominant source of additional electricity supply for minerals and energy projects in the Pilbara.
- Potential future projects in the Mid West provide an opportunity for coordinated development of energy infrastructure.
- Delivery on the energy infrastructure needs of WA will require facilitation by the WA and Federal Governments, including streamlining regulatory frameworks.
- There is a need to match the regulatory framework and decision making timeframes that apply to access requests and investment in transmission and generation infrastructure with other project approval processes in order to encourage the optimal balance between self-generation and networked power supply, and to avoid delays to projects.
- The WA Government's framework for the WA energy market should focus on achieving competitive markets, security and reliability of supply, and sustainability .
- There is increasing demand for domestic gas (natural gas supplied to third parties) and indications are that the balance between supply and demand will be tight.
- Increasing gas prices and the potential for higher electricity costs will increase energy costs for business.

Environment and Liveability

- An increase in electricity prices to achieve cost reflective pricing would affect all business sectors and residential electricity users.
- Technical and commercial hurdles to the introduction of widespread networked generation makes the introduction of renewables challenging.

4.2 State Overview – Electricity

Electricity Market in WA

The primary interconnected system in WA is the South West Interconnected System (SWIS). WA does not form part of the National Electricity Market (the NEM) due to the geographic diversity and the physical separation from remaining states.

The SWIS supplies to approximately 910,000 residential, 85,000 business and 19,000 major customers in the South West. SWIS infrastructure includes 5,733 MW of installed generation capacity, 7,300km of transmission lines and 88,900km of distribution lines. The SWIS is operated by the Independent Market Operator (IMO).

There is a North West Interconnected System (NWIS), which is significantly less expansive than the SWIS and centred on the industrial towns of Karratha and Port Hedland. Given its size, the NWIS does not operate in a similar way to more expansive interconnected systems like the SWIS. The NWIS has an installed generation capacity of 500 MW.

Beyond the SWIS and NWIS, there is an interconnected transmission network between Kununurra and Wyndham and 34 isolated systems in operation.

WA Electricity System

Source: Western Power, *Annual Report 2011*, 2011
Horizon Power, *Annual Report 2010-11*, 2011
Western Power, *2011 Annual Planning Report*, 2011

Sources of Generation in WA

57% of WA's installed generation capacity is fuelled by natural gas and 33% by coal, with the remainder fuelled by liquids and renewables.

In FY11, renewable energy accounted for an estimated 2.1% of electricity consumption in WA and 5% in the SWIS, with the predominant source of renewable generation being wind, followed by hydro and bio-energy.

The percentage of renewable generation in FY11 (2.1%) was a decrease on the previous year (2.8% in FY10) due to an increase in electricity demand, a decline in wind generation and no new renewable energy generators commissioned.

Growth in solar PV has been strong, with 250% growth from 2009-10 to 2010-11. However, solar PV remains a relatively small proportion of total electricity supply.

Gas may play a role as a transition fuel to lower-carbon intensity electricity production, both through reducing average carbon emissions per unit of generation and facilitating grid connection of renewable energy projects.

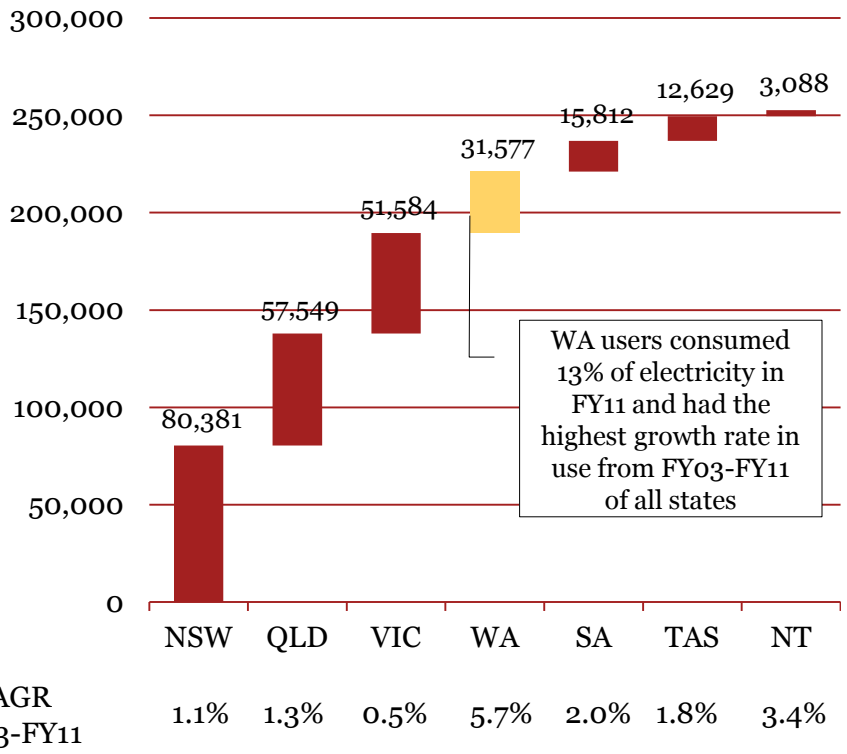
Electricity Consumption in WA 2010-11

	2008-09	2009-10	2010-11
Non-Renewable Fuels (GWh)	26,911	28,009	30,911
Coal	8,738	9,612	10,352
Gas	14,556	16,006	18,116
Other	3,617	2,391	2,443
Renewable Fuels (GWh)	795	818	666
Biogas	120	121	111
Wind	675	664	441
Solar PV	NA	32	113
Total WA Consumption	27,706	28,827	31,577
Proportion Consumed from Renewable Energy	2.8%	2.8%	2.1%

Source: Independent Market Operator, *2012 Statement of Opportunities*, 2012
BREE, *2012 Australian Energy Update*, 2012, Table O

Electricity Consumption by State

Electricity Consumption in Australia
(GWh, FY11)



In FY11, electricity users in WA accounted for 13% of electricity consumption in Australia, which is above the proportion of the Australian population residing in Western Australia (11% as at December 2011).

NSW, Victoria and Queensland users dominated Australian electricity consumption, consuming 75% between the three states. Western Australian users represent an increasing share of Australian electricity consumption, with their share increasing from 9% in 2003 to 13% in 2011.

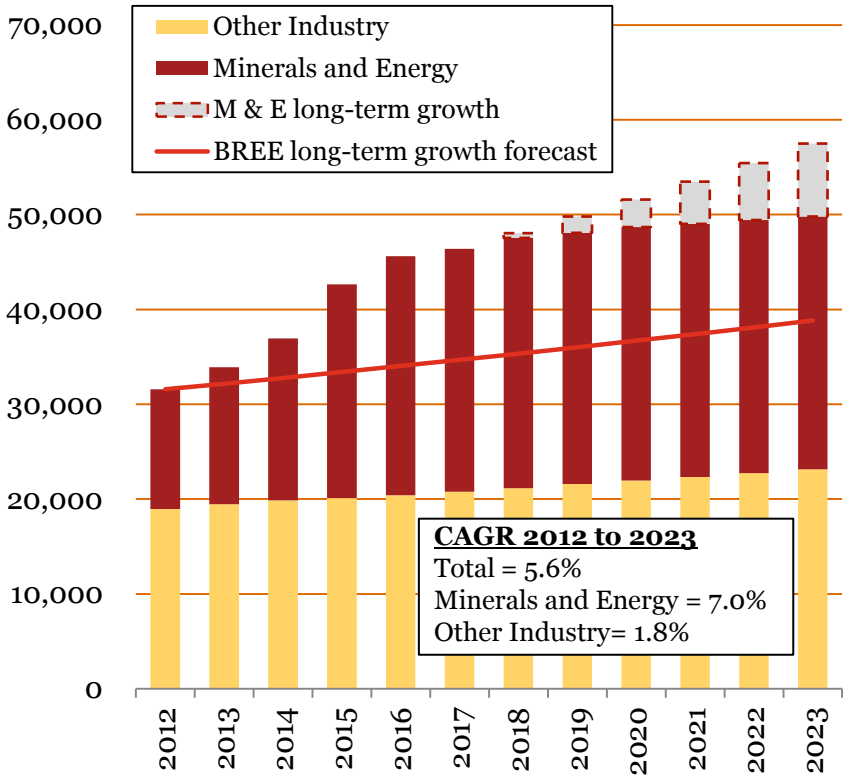
Growth in electricity consumption in WA has been at around 4.7% per year (CAGR) between FY81 and FY11.

WA users had the highest growth rate over the period 2003 to 2011, with a CAGR of 5.7% per year. The growth has been particularly pronounced in recent years, with 9% growth between 2008 and 2011.

Source: BREE, *2012 Australian Energy Update*, 2012, Table I
ABS, *3101.0 Australian Demographic Statistics, Dec 2011*, 2012

Total Electricity Consumption

Forecast Total Electricity Consumption
(GWh p.a.)



Electricity consumption in WA is projected to increase by approximately 52% by 2018, with that increase largely driven by projects in the minerals and energy sector.

Electricity demand is forecast to continue to grow steadily through to 2023.

The estimated electricity demand growth rate over the period to 2023 is 5.6% per year; higher than the long-term electricity generation growth forecast from BREE (1.9% out to FY35).

It is forecast that electricity demand growth would be front loaded, with step change growth until 2015, coinciding with the commissioning of new minerals and energy projects.

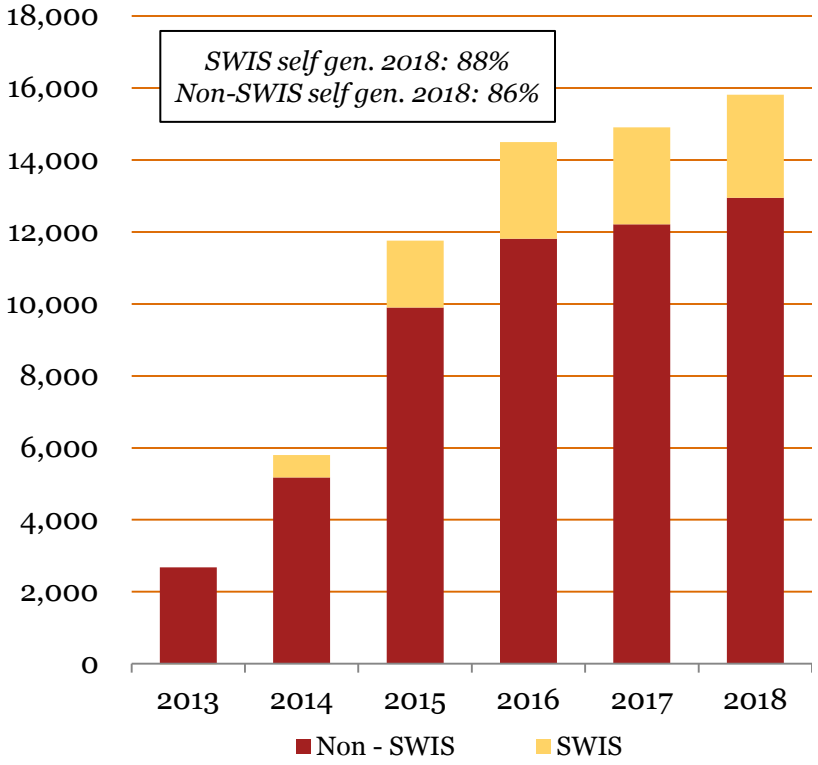
The estimated growth in consumption of 5.6% per year is below the growth rate of 6.9% per year estimated in the State Growth Outlook 2011 due to lower estimated demand in the Mid West. The growth rate of 5.6% is similar to the annual growth rate of 5.7% in WA between 2003 and 2011.

Note: Total growth extrapolated after 2017 as period extends beyond the typical planning period of most companies. Historical annual growth rate of 5% applied.

Source: State Growth Outlook Survey. Baseline electricity consumption from BREE, *2012 Australian Energy Update*, 2012, Table I. Growth forecast from BREE, *Australian energy projections to 2034-35*, 2011.

Location of New Demand – SWIS Area and Beyond

Electricity Demand by Area: SWIS geographical area vs. Non-SWIS area
(GWh p.a., Increment above 2012 level)



In the area serviced by the SWIS (Perth/Peel, Great Southern/South West, Wheatbelt and selected Mid West projects), there is forecast to be 2,900 GWh additional electricity demand by all industries in 2018 as compared to 2012.

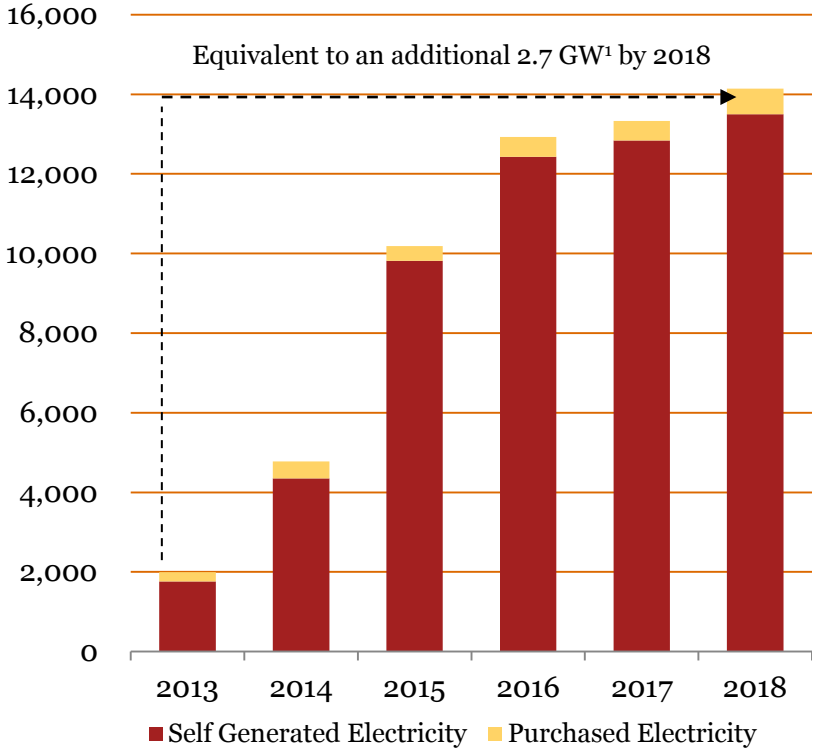
The existence of the SWIS could present the opportunity for companies with projects in this area to purchase electricity from the network. However, 88% of the new electricity generation in the SWIS geographic area is forecast to be self generation.

Note: Total electricity consumption by geographical area – SWIS includes projects located in the area of the South West Interconnected System – not necessarily connected to the grid. Purchased equals all electricity purchased whether it be from the grid or other third parties.

Source: State Growth Outlook Survey

New Minerals and Energy Electricity Generation

Minerals and Energy Electricity Demand
(GWh p.a., Increment above 2012 level)



Incremental minerals and energy electricity demand is projected to be equivalent to 2.7 GW[1] of additional generation capacity by 2018.

Incremental electricity required by the sector in 2018 is projected to be 14,000 GWh. As gas is the major fuel source for generation, the increased electricity demand is responsible for a significant increase in gas use.

95% of the increase in minerals and energy demand is forecast to be met through self generation. As other industries are more likely to meet their needs through networks, this is a higher proportion than the expected State-wide values across all industries of 88% within the SWIS area and 86% outside the SWIS.

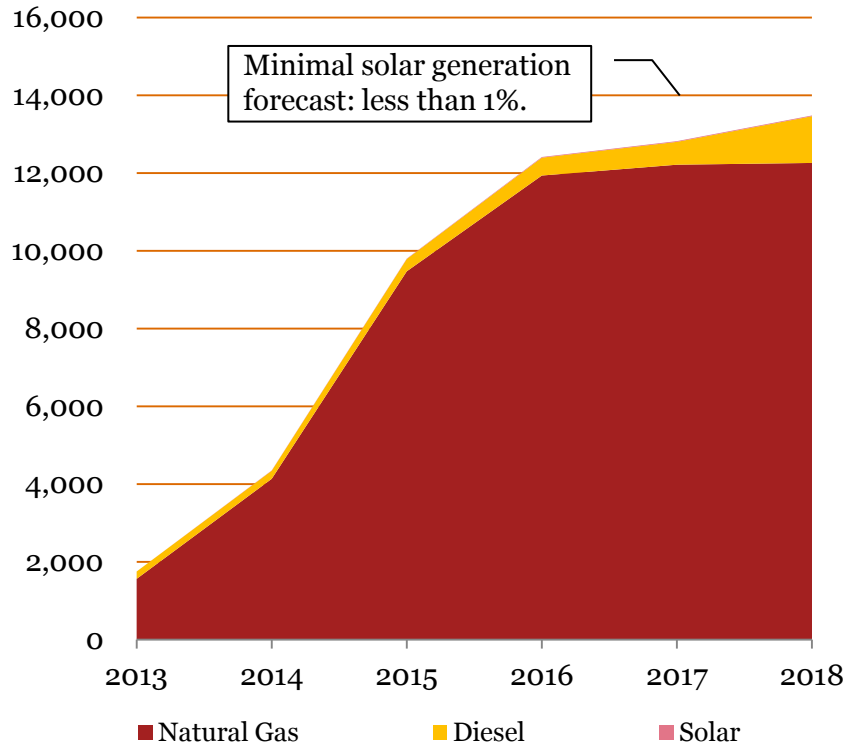
Due to the isolated nature of the minerals and energy projects, the electricity demand in the sector will predominantly be self generated.

1. Equivalent GW estimated at 0.6 load factor

Source: State Growth Outlook Survey

Fuel Source for New Self Generation in the Minerals and Energy Sector

Source of New Self Generated Electricity
(GWh p.a., Increment above 2012 level)



The majority of additional self generation is projected to be fuelled by domestic gas (approximately 94%).

Around 5% of the new self generated demand is likely to be met through diesel. No coal is proposed to be used for self generation.

Some participants expected to meet a small portion of their self generated electricity demand through solar energy. However, this constituted only 0.1% of the incremental demand.

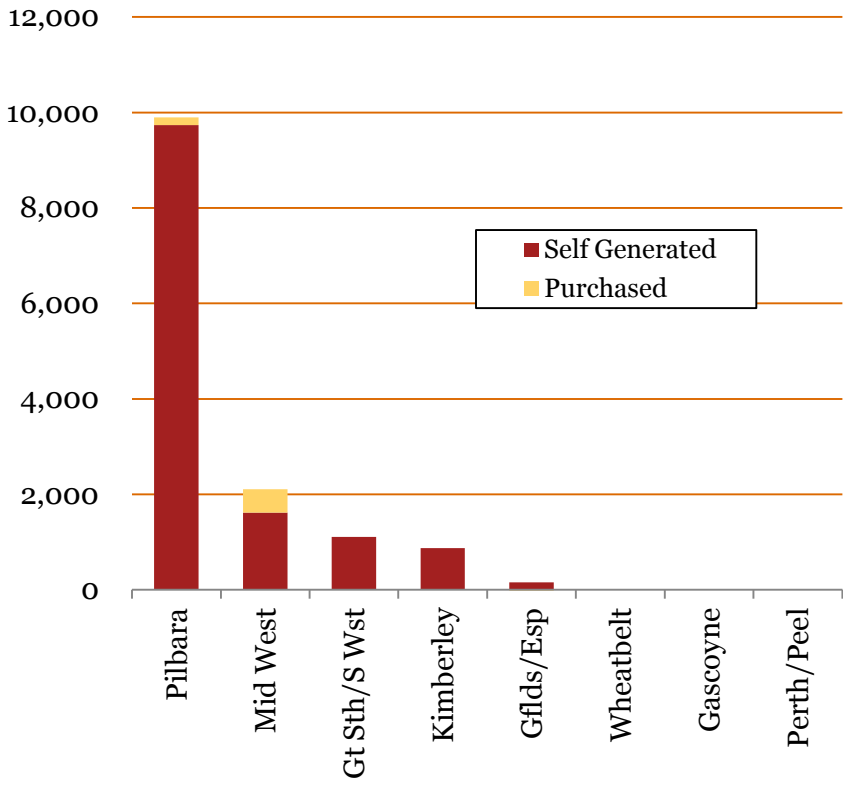
There are significant technical and commercial barriers to the uptake of renewable energy for self generated electricity in remote un-networked areas. We are likely to see its implementation through large-scale grid generation rather than isolated generation.

The supply of gas to meet this demand is discussed in *Section 4.4.3 Gas Supply Outlook*.

Source: State Growth Outlook Survey

New Minerals and Energy Generation by Region

Electricity Generation by Region – 2018
(GWh p.a., Increment above 2012 level)



The majority of new electricity generation required by the minerals and energy sector is for projects in the Pilbara and Mid West.

Iron ore expansions and greenfields projects, along with associated infrastructure projects, drive the majority of new electricity demand in the Pilbara. Demand in the Mid West is driven by fewer, yet more energy intensive, magnetite projects.

Minerals and energy electricity generation in the Pilbara is planned to be predominantly self generated. This is also the case in the Mid West and Great Southern/South West, despite the presence of the SWIS.

Source: State Growth Outlook Survey

4.3 Regional Overview – Electricity

4.3.1 Key Growth Regions

4.3.2 Other Regions

Overview of High Growth Regions

Growth in the Pilbara

- Total incremental electricity demand in the Pilbara (due to minerals and energy projects) is forecast to reach 9,700 GWh per year (or approximately 1.9 GW of additional generation capacity[1]) by 2018.
- Electricity demand in the Pilbara will be predominantly met through self generation, and will be fuelled through natural gas.

Growth in the Mid West

- Upcoming minerals and energy projects in the Mid West are likely to require approximately 2,100 GWh per year above 2012 levels (or approximately 0.4 GW of additional generation capacity[1]) by 2018.
- Of the additional demand, 23% is planned to be purchased.
- 90% of the additional self generated electricity in the Mid West will be fuelled by natural gas, with the remainder to use diesel.
- The Mid West Energy Project may allow increased use of purchased electricity for future developments beyond the range of this Study.

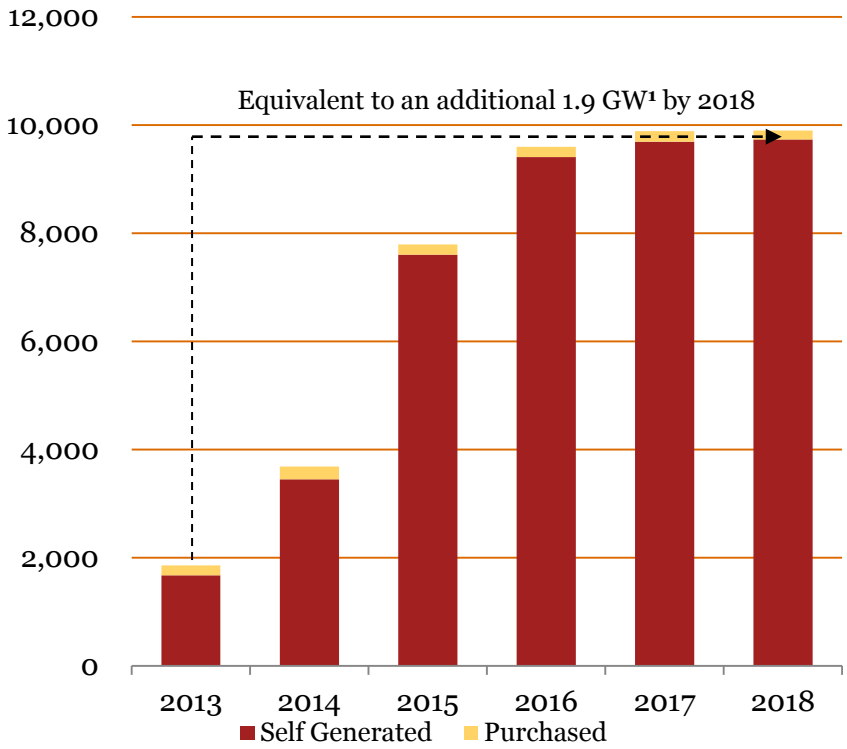
Growth in the Great Southern/South West

- Incremental minerals and energy electricity demand in the Great Southern/South West is forecast to reach over 1,100 GWh per year by 2018.
- All of the incremental demand is projected to be self generated.

1. Equivalent GW estimated at 0.6 load factor

Pilbara – New Minerals and Energy Electricity Demand: Self Generation Vs. Purchased

Incremental Electricity Demand
(GWh p.a., Increment above 2012 level)



Incremental electricity demand in the Pilbara due to minerals and energy projects is projected to reach 9,700 GWh by 2018.

Survey results indicate that electricity development in the Pilbara is to continue to be predominantly self generated.

1. Equivalent GW estimated at 0.6 load factor.

Source: State Growth Outlook Survey

Pilbara – Self Generation by Fuel Type

Pilbara Self Generated Electricity 2018
(%, Increment above 2012 level)

	Generation (GWh)	Proportion
Gas	9,688	99.7%
Diesel	13	0.1%
Solar	18	0.2%
Total	9,718	100%

The majority of new self generated electricity in the Pilbara will be fuelled by natural gas.

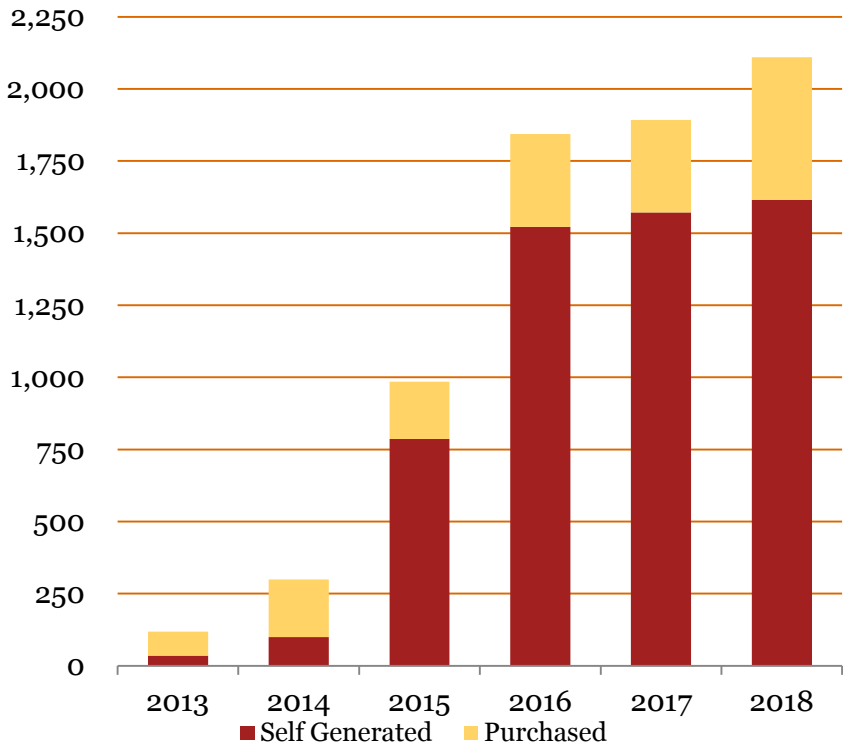
Cost and access to natural gas in the Pilbara lead to it being the prominent source of fuel in the region (almost 100% of new generation).

Diesel is listed as the primary generation fuel for some projects, as well as for back up generation.

Source: State Growth Outlook Survey

Mid West – New Minerals and Energy Electricity Demand: Self Generation Vs. Purchased

Incremental Electricity Demand
(GWh p.a., Increment above 2012 level)



Additional minerals and energy sector electricity demand in the Mid West over the 2012 level is projected to reach 2,100 GWh above 2012 levels by 2018.

The increase is largely driven by step changes in 2015 and 2016 as regional magnetite projects commence operation.

Incremental demand is lower in the Mid West than forecast in the 2011 State Growth Outlook due to delays in projects in the region.

Of the additional electricity demand required by 2018, 23% is planned to be purchased.

The Mid West Energy Project will allow some minerals and energy projects in the Mid West to purchase electricity from the SWIS.

1. Equivalent GW estimated at 0.6 load factor.

Source: State Growth Outlook Survey

Mid West – Minerals and Energy Sector Self Generation by Fuel Type

Mid West Self Generated Electricity 2018
(%, Increment above 2012 level)

	Generation (GWh)	Proportion
Gas	1,446	90%
Diesel	168	10%
Solar	1	0.06%
Total	1,614	100%

New self generated electricity within the Mid West will be fuelled through two sources: gas and diesel.

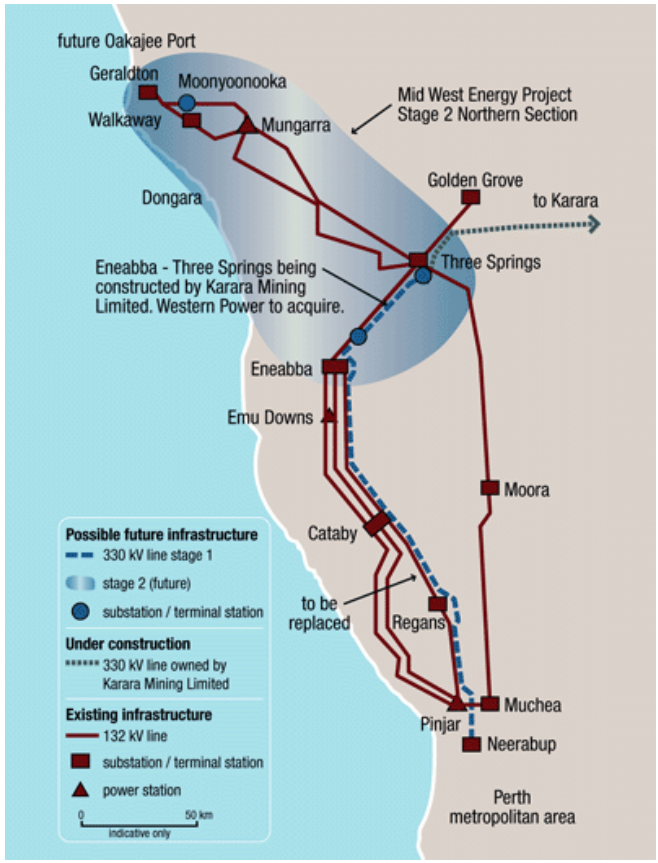
Gas will used as fuel for 90% of the incremental self generation in 2018, while diesel will be used for most of the remainder. A minor level of solar generation will also be utilised.

Gas as a fuel source for electricity generation has increased in importance since the 2011 State Growth Outlook, in which 44% of additional electricity generation was to be fuelled using diesel. The shift from diesel to gas is due to increasing availability of gas, although the continuing use of diesel indicates that gas is not available in some areas.

Source: State Growth Outlook Survey

Mid West Energy Project

Mid West Energy Project Proposal



The Country North (Mid West) area of the SWIS is reaching capacity, requiring significant investment in transmission infrastructure to meet demand from minerals and energy projects.

The Mid West Energy Project will provide a double circuit 330 kV line (initially operated as one 330 kV and one 132 kV circuit) from Neerabup to Eneabba where it will connect to a 330 kV line to supply proposed mining loads. Anticipated timing is for completion in 2014. A 330/132 kV terminal station will also be established at Three Springs.

Karara Mining is constructing a 330 kV transmission line from Eneabba to its mine site. The transmission line will be transferred to Western Power on completion.

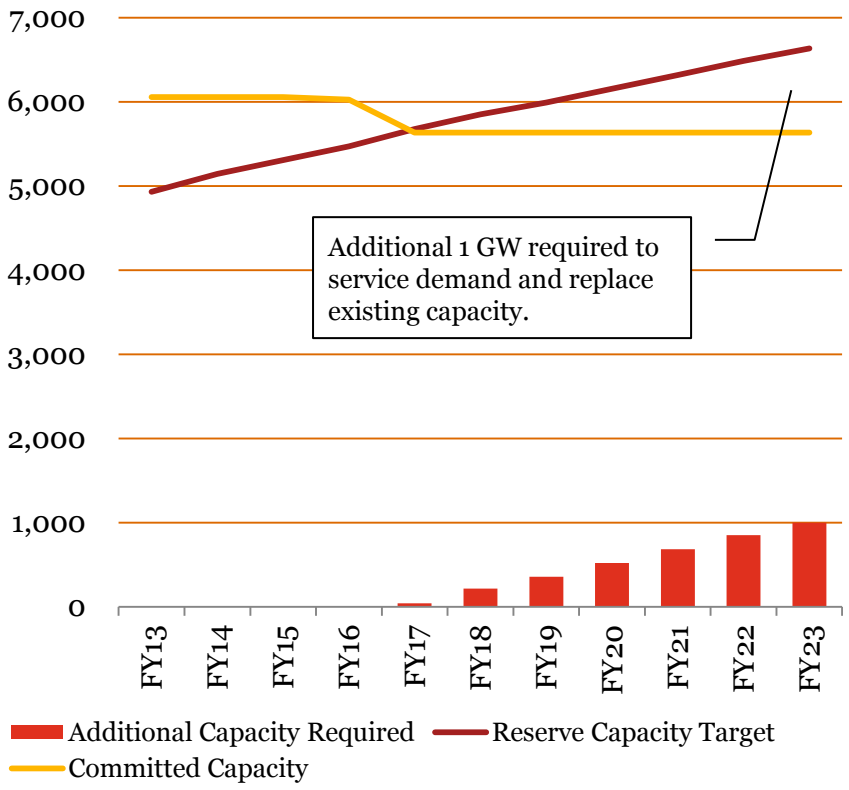
Funding for the transmission line from Neerabup to Eneabba was announced as part of the 2012-13 State Budget.

Planning has commenced on an extension of the 330 kV line to Geraldton.

Source: Western Power, *Mid West Energy Project*, 2012

SWIS – Generation Capacity

Supply – Demand Balance – SWIS
(MW)



Based on committed capacity and known plant retirements, an additional 210 MW of generation capacity will be required in the SWIS by FY18, increasing to approximately 1 GW by FY23.

The Independent Market Operator (IMO) believes the capacity requirements can be met with new generation and Demand Side Management investment.

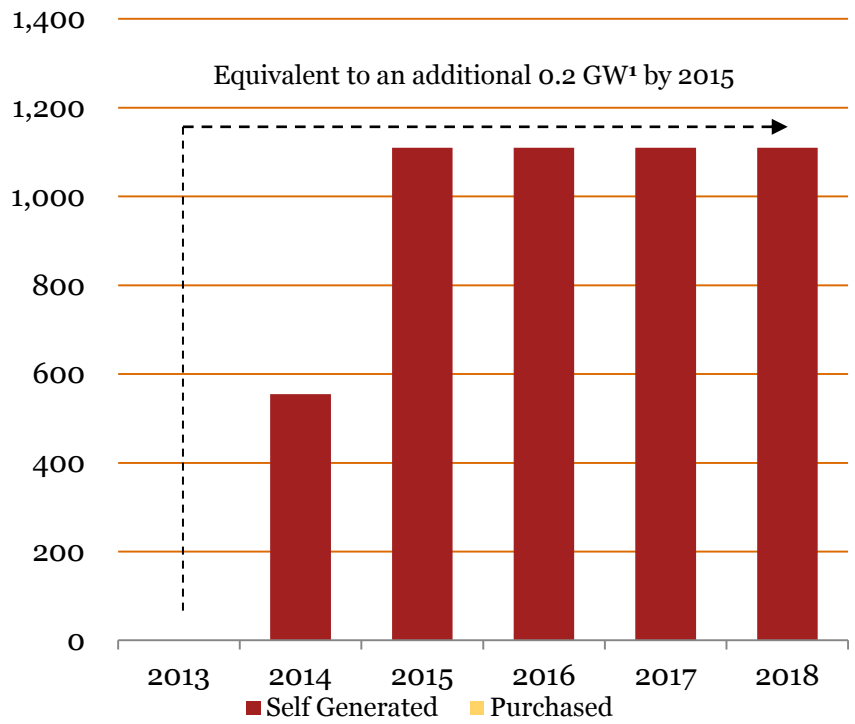
500 GWh per year, or the equivalent of approximately 95 MW[1] of additional generational capacity, has been identified in this Study as direct additional demand from the minerals and energy sector through to 2018.

1. Equivalent GW estimated at 0.6 load factor.

Source: Independent Market Operator, *2012 Statement of Opportunities*, 2012

Great Southern/South West – New Minerals and Energy Electricity Demand: Self Generation Vs. Purchased

Incremental Electricity Demand
(GWh p.a., Increment above 2012 level)



Incremental minerals and energy sector electricity demand in the Great Southern/South West is forecast to reach 1,100 GWh above 2012 levels in 2018.

All of the incremental demand is projected to be self generated.

The additional self generated electricity within the Great Southern/South West is forecast to be fuelled predominantly by natural gas.

1. Equivalent GW estimated at 0.6 load factor.

Source: State Growth Outlook Survey

Other Regions

Perth/Peel

Limited incremental electricity generation is required in this region for new minerals and energy projects. However, additional demand for other growth enablers such as water desalination are likely to increase electricity demand in the region.

Goldfields/Esperance

With numerous new projects in this region, additional electricity consumption reaches 160 GWh per year in 2015, and then stabilises through to 2018. Of this, 150 GWh per year is self generated, predominantly using diesel as fuel.

Gascoyne

Limited incremental electricity generation is required in this region.

Kimberley

870 GWh of incremental electricity demand above 2012 levels is projected in this region due to minerals and energy projects by 2018. Over 99% of this electricity is to be self generated.

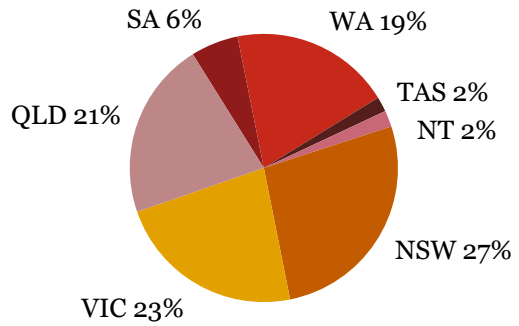
Wheatbelt

Limited incremental electricity generation is required in this region for new minerals and energy projects.

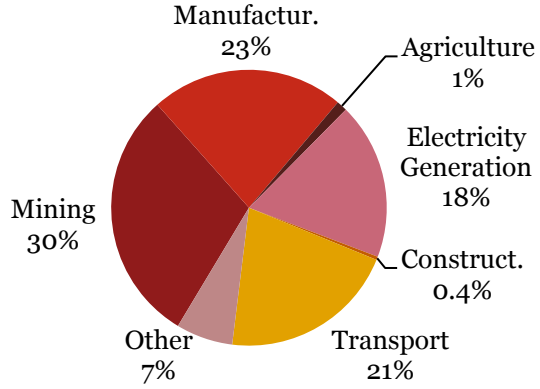
4.4 State Overview – Gas

Energy Consumption in WA by Activity

Energy Consumption in Aus – by State
(%, FY11)



WA Energy Consumption by End Use
(%, FY11)



While WA constitutes 11% of the Australian population, activities in WA are responsible for 19% (1,180 PJ per year) of energy consumption in Australia.

This highlights the energy intensive nature of the economy of WA and the extent of value added processing undertaken in the State.

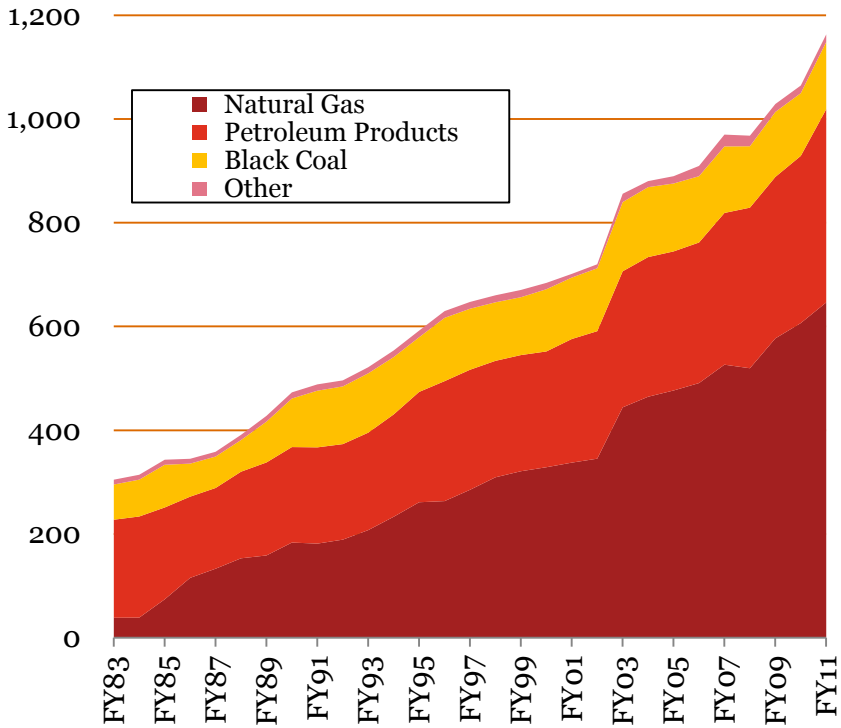
Energy consumption in WA in the minerals and energy sector has increased from 14% of WA energy consumption in FY90 to 30% in FY11. The minerals and energy sector is now the largest consumer of energy.

Other energy intensive sectors in WA include electricity generation (that is, energy consumption that is not transferred to downstream users in the form of electricity), transport and manufacturing. Electricity generation and use on a mine site is categorised between mining and electricity generation based on energy delivered to mining activities and energy consumed without transfer in the electricity generation process.

Source: BREE, *2012 Australian Energy Update*, 2012, Table B and C
ABS, *3101.0 Australian Demographic Statistics, Dec 2011*, 2012

Historic Energy Consumption

WA Energy Consumption by Fuel Type
(PJ p.a.)



Energy consumption in WA has increased at a annual growth rate of 4.9% over the 28 years to FY11. The energy demand in WA is increasingly being met through natural gas.

Demand for natural gas has increased at around 11% per year since FY83 and now constitutes 55% of energy consumption in WA.

Demand for natural gas in the minerals and energy sector has increased from just 1.1 PJ in FY83 to 258 PJ in FY11. This is a long term growth rate of 22% per year. More recently, natural gas consumption in the minerals and energy sector has increased from 67 PJ in FY01; equivalent to a 14% increase per year.

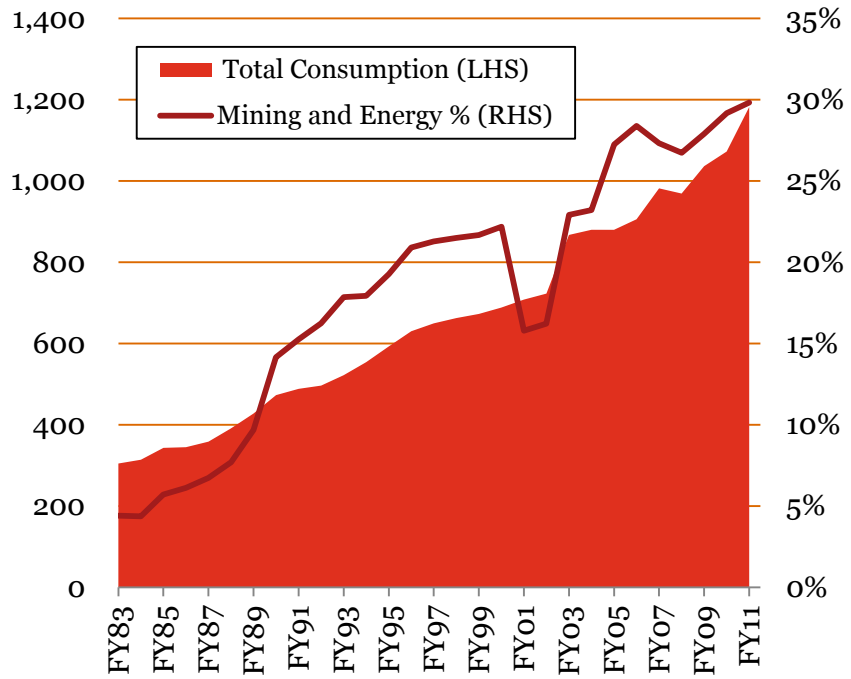
Natural gas processing and liquefaction is a major driver of WA's natural gas consumption. For this reason total natural gas consumption in WA is meaningfully larger than "domestic gas" consumption, which does not include gas consumed in processing and liquefaction.

Note: Natural gas consumption as shown above is broader than "domgas" consumption. It includes consumption in gas production, processing and liquefaction. 'Other' constitutes renewables and electricity less production of derived fuels

Source: BREE, *2012 Australian Energy Update*, 2012, Table C and F

Historic Mining Energy Consumption

Minerals and Energy Consumption in WA
(PJ p.a. LHS, % mining RHS)



Energy consumption in the minerals and energy sector in WA has increased from 4% of total WA energy consumption in FY83 to 30% in FY11.

As is shown on the previous page, the increase in energy consumption is predominantly sourced from natural gas.

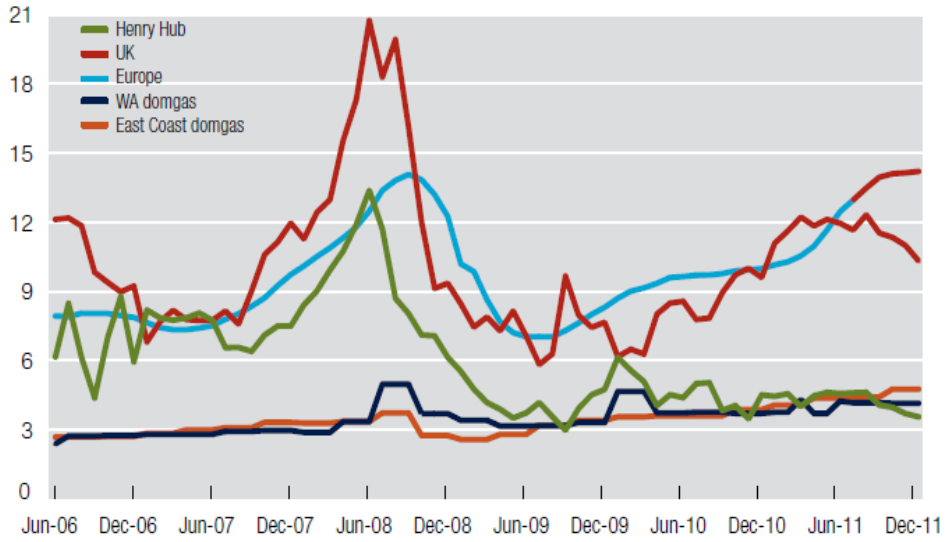
The increasing proportion of energy consumption by the minerals and energy sector is mainly at the expense of manufacturing (decline from 27% to 23%) and transport (decline from 32% to 21%).

Note: Some of the year on year fluctuations in the proportion of mining energy use are driven by definitional changes between mining and manufacturing.

Source: BREE, *2012 Australian Energy Update*, 2012, Table B and F

Domestic Gas Market in WA

Average Natural Gas Prices
(US $/GJ)



Historically, domestic gas prices in WA have been low by international standards.

Low domestic gas prices have been maintained through legacy contracts and State agreement obligations on gas producers in the North West. These include the obligation for the North West Shelf producers to supply 5,064 PJ of domestic supply, with the obligation expected to be completed in 2014.

Evidence is emerging that parties entering into new domestic gas supply agreements are agreeing to prices significantly in excess of the current average price paid by domestic gas users.[1] The expiry of legacy contracts and obligations for domestic supply may result in significant increases in the average price paid by WA gas users.

1. For example, submissions to the Parliamentary Inquiry into Domestic Gas Prices reported new contract prices in the range of $16 per gigajoule.

Source: Argus Monthly LNG, EnergyQuest and DMP. Available in DMP, *2011 WA Mineral and Petroleum Statistics Digest*, 2012

Natural Gas Transmission Pipelines

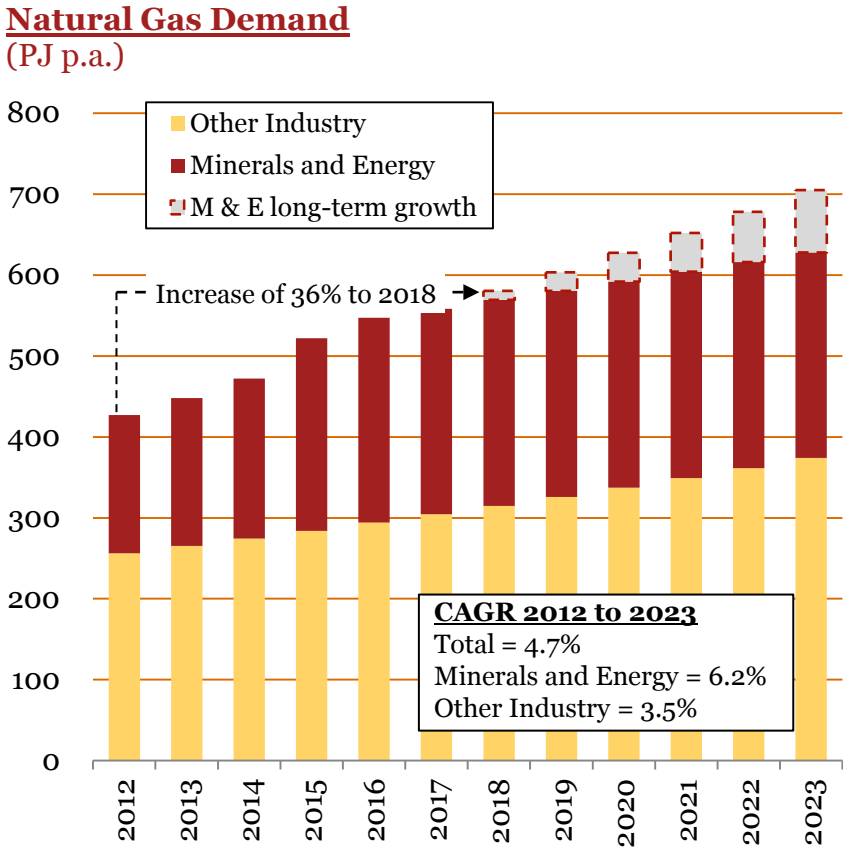
Pipeline	Length (km)	Capacity (TJ/d)	Constructed	Owner
Dampier to Bunbury	1600	845	1984	DUET Group Alcoa
Goldfields Gas	1427	150	1996	APA Group
Parmelia	445	70	1971	APA Group
Pilbara Energy	219	188	1995	Epic Energy
Midwest Pipeline	353	20	1999	APA Group, Horizon Power
Telfer Pipeline	443	25	2004	Energy Infrastructure Investments
Kambalda to Esperance	350	6	2004	ANZ Infrastructure
Kalgoorlie to Kambalda	44	20		APA Group

WA's gas transmission system contains four main pipelines: the Dampier to Bunbury (DBNGP), the Goldfields, the Parmelia and the Pilbara Energy pipelines.

The DBNGP transports the majority of natural gas from the Carnarvon Basin to the South West, and has capacity to carry around 845 TJ per day. The Pilbara Energy (188 TJ per day) and Goldfields Gas (150 TJ per day) pipelines also transport gas from the Carnarvon basin. The Parmelia (70 TJ per day) transports gas from the Perth Basin. Other pipelines are outlined in the table (left).

Source: DBP, Direct communication, 2012
Australian Energy Regulator , *State of the Energy Market*, 2011

Forecast Total Natural Gas Demand



Annual natural gas demand in WA (excluding gas used in gas production and processing) is projected to increase from 430 PJ in 2012 to 700 PJ in 2023.

This represents an 'all industries' growth rate of 4.7% over the period. This compares to the 6.7% growth rate in gas consumption in WA between 2000-01 and 2010-11.

Activity in the minerals and energy sector to 2023 will drive much of the additional gas demand. New gas fired electricity generation that is not specific to minerals and energy projects will also drive high levels of other industry demand.

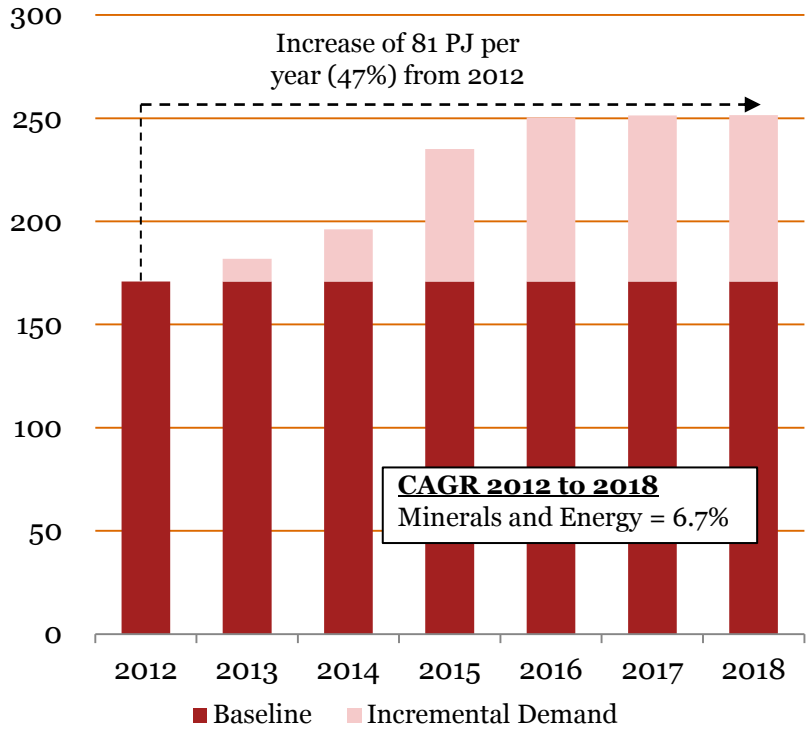
Over the period to 2023, minerals and energy sector demand is forecast to increase by 6.2% per year, with other industry demand projected to increase by 3.5% per year.

Note: The base consumption of 427 PJ per year is based on the Department of Mineral and Petroleum's high supply case for 2012. The base has been allocated 40% to the minerals and energy sector based on 2010-11 natural gas consumption by industry estimate by BREE. The base is lower than 2011 gas demand shown in Section 4.4.1 as the base excludes LNG processing gas use.

Source: DMP, *2011 WA Mineral and Petroleum Statistics Digest*, 2012
BREE, *2012 Australian Energy Update*, 2012, Table F
State Growth Outlook Survey

Forecast Minerals and Energy Natural Gas Demand

Minerals and Energy Natural Gas Demand
(PJ p.a.)



Minerals and energy demand for natural gas (excluding gas used in gas production and processing) is projected to increase by 81 PJ from 170 PJ in 2012 to 251 PJ in 2018 – a 47% increase based on 2012 estimated consumption (or a 6.7% year on year increase).

Comparatively, the historic growth rate for the industry was 14% over the 10 year period to FY11.

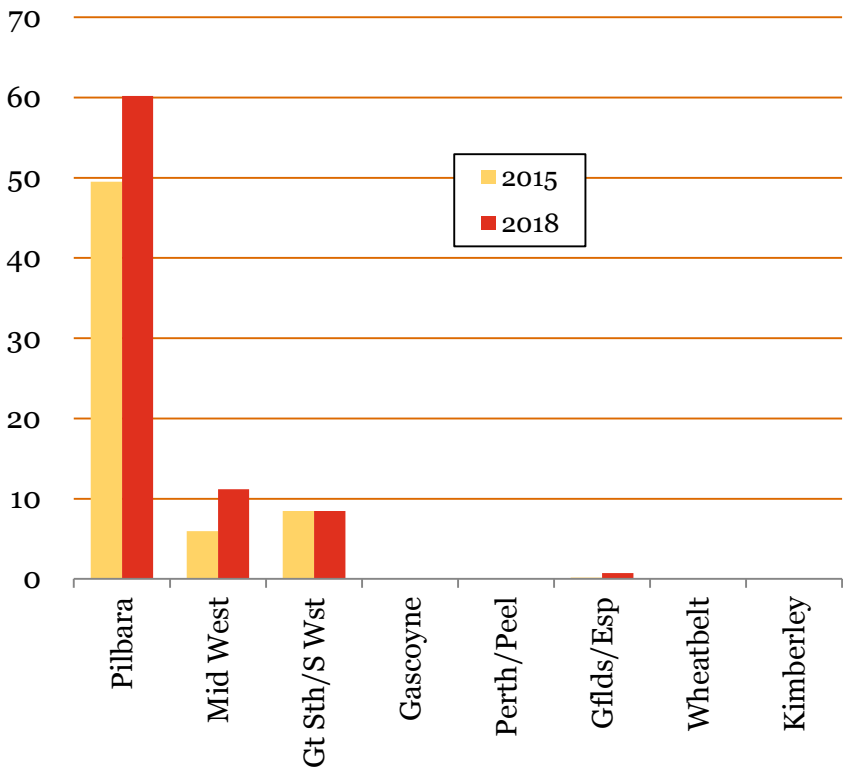
This demand growth is predominantly due to self generation using natural gas, along with small amounts of natural gas for industrial process and mobile plant.

There will be a minor amount of additional natural gas demand driven by minerals and energy projects through incremental purchased electricity demand. This growth is captured in other industry (electricity generation) demand growth.

Source: State Growth Outlook Survey
BREE, *2012 Australian Energy Update*, 2012, Table C

Incremental Natural Gas Demand by Region

Natural Gas Demand by Region
(PJ p.a., Increment above 2012 level)



The incremental natural gas demand from minerals and energy projects will predominantly be consumed in the Pilbara.

An additional 50 PJ per year is projected to be consumed in the Pilbara by 2015 and an additional 60 PJ per year by 2018.

The Mid West will also exhibit significant incremental demand over this period. Material additional demand will also occur in the Great Southern / South West.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Source: State Growth Outlook Survey

Domestic Natural Gas Supply Outlook

DMP – Assumptions underpinning potential gas supply to 2030

Project	Assumed start up	High case supply (TJ/d)	Low case supply (TJ/d)
North West Shelf	Operational	600 to 2030	600 to 2020 declining to 300 by 2030
Varanus Island	Operational	450 to 2020 declining to 300 by 2030	450 in 2011 declining to 100 in 2030
Devil Creek[1]	2011	110 to 2024 declining to 50 by 2030	110 to 2024 only
Macedon	2013	170 to 2025 declining to 90 by 2030	145 to 2025 only
Gorgon	2015	150 to 2020 then 300 to 2030	Same as high case
Wheatstone	2016	200 to 2030	Same as high case
Pluto	2016	100 to 2030	Same as high case
Browse	2023	190 to 2030	Nil
Scarborough	2023	190 to 2030	Nil
Unconventional gas	2012	10 to 2030	Nil

The Department of Mines and Petroleum produces a high and low gas supply outlook. There is considerable potential for the outlook to change with new gas being brought to the market, new investment or changes in marketing strategy and pricing.

The Department of Mines and Petroleum suggests that WA will have sufficient capacity in its domestic gas production facilities to meet the anticipated growth in demand over the next 20 years. The challenge is in finding and developing new gas fields to feed in to these facilities.

The major difference between the supply projections to 2020 are the assumptions around the output of the gas plants at Varanus Island, Devil Creek and Macedon.

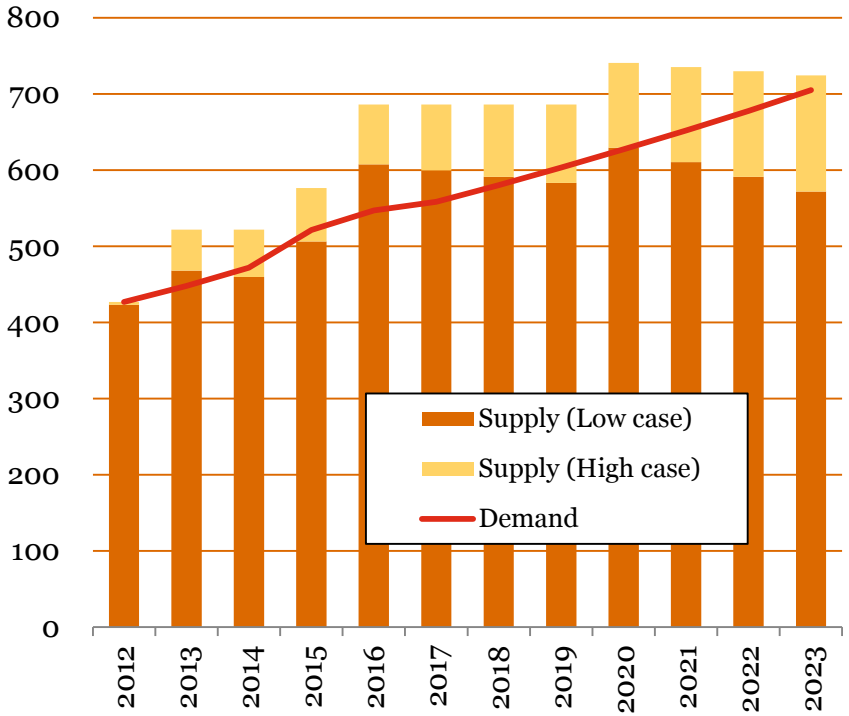
Given the significant supply capacity (in terms of processing facilities and pipelines), there is potential for the supply outlook to change with new gas discoveries and revised marketing strategies. Changes in relative pricing between the domestic gas and global LNG markets will also influence supply decisions.

1. Subsequent to the DMP report, the Devil Creek Gas Plant was completed in late 2011, and officially opened in February 2012.

Source: Separovic and Perez, "Western Australia's Potential Domestic Gas Demand and Supply Outlook", *Petroleum WA*, April 2011

Domestic Natural Gas Demand and Supply Outlook

Domestic Gas Demand/Supply Outlook
(PJ p.a.)



The balance between domestic gas supply and demand appears tight through to 2023. While the high supply case is easily sufficient, the low supply case does not meet forecast demand.

The domestic gas market in WA continues to mature. In the coming years the market will move from two producers to six, bringing a significant increase in gas plant capacity - estimated by the Australian Petroleum Production and Exploration Association to be around 80%.

In addition, the Independent Market Operator will introduce in 2013 a Gas Bulletin Board and Gas Statement of Opportunities. These developments will increase the certainty around the supply outlook for domestic natural gas.

The demand outlook presented in this study reflects survey responses from project proponents. There is potential for movement in this outlook as new projects are identified, or current plans delayed.

1. These demand/supply projections do not include gas consumed in gas production and processing, where gas is available as part of the process.

Source: State Growth Outlook; Separovic and Perez, "Western Australia's Potential Domestic Gas Demand and Supply Outlook", *Petroleum WA*, April 2011

4.5 Regional Overview – Gas

4.5.1 Key Growth Regions

4.5.2 Other Regions

Overview of High Growth Regions

Growth in the Pilbara

- Incremental natural gas demand from the minerals and energy sector in the Pilbara is expected to reach 60 PJ above 2012 levels by 2018.
- Electricity generation is the primary driver of gas demand in this region.

Growth in the Mid West

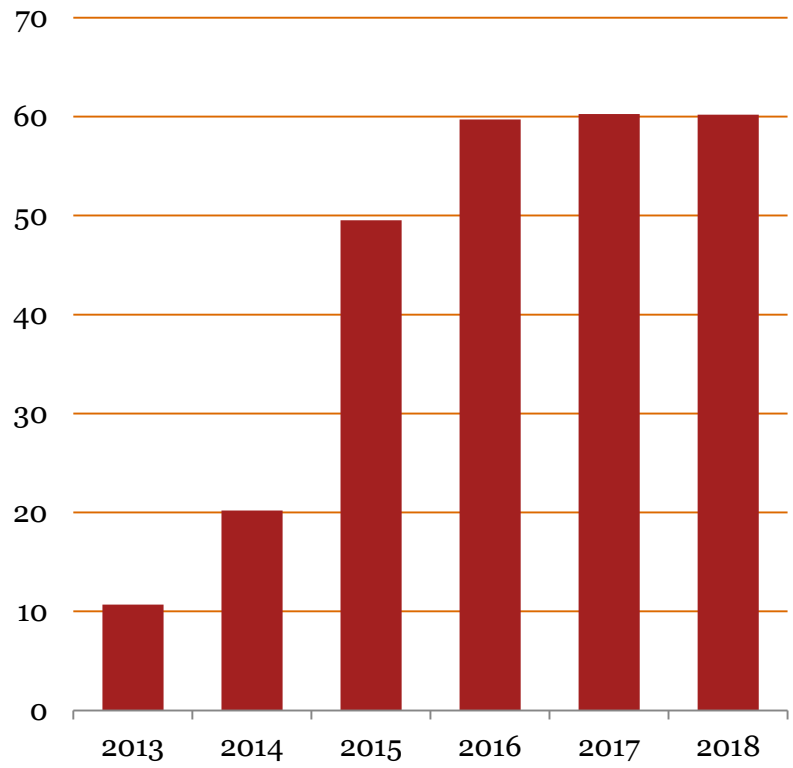
- Incremental natural gas demand from the minerals and energy sector in the Mid West is expected to reach 11 PJ above 2012 levels by 2018.
- Electricity generation is the primary driver of gas demand in this region.

Growth in the Great Southern/South West

- Incremental natural gas demand from the minerals and energy sector in the Great Southern/South West is expected to be over 8 PJ above 2012 levels by 2018.
- As for the other regions, electricity generation is the primary driver of gas demand.

Pilbara Natural Gas Demand (excluding LNG production)

Natural Gas Demand by Use – Pilbara
(PJ p.a. Increment above 2012 level)



Incremental natural gas demand from the minerals and energy sector in the Pilbara is expected to reach 60 PJ above 2012 levels by 2018.

Current plans suggest a large increase in 2015, as large scale iron ore projects are commissioned.

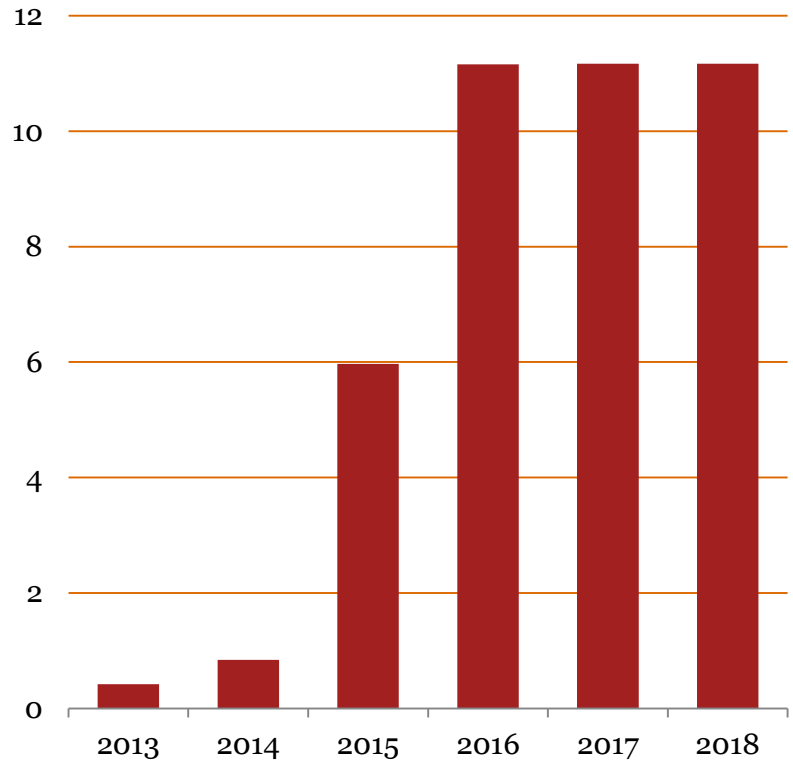
Electricity generation is the primary driver of natural gas demand in the Pilbara.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Source: State Growth Outlook Survey

Mid West Natural Gas Demand

Natural Gas Demand by Use – Mid West
(PJ p.a. Increment above 2012 level)



Incremental natural gas demand from the minerals and energy sector in the Mid West is expected to reach over 11 PJ above 2012 levels by 2018.

Current plans suggested the largest step change increase is expected in 2015 and 2016, as iron ore projects with gas fired self generated electricity are commissioned.

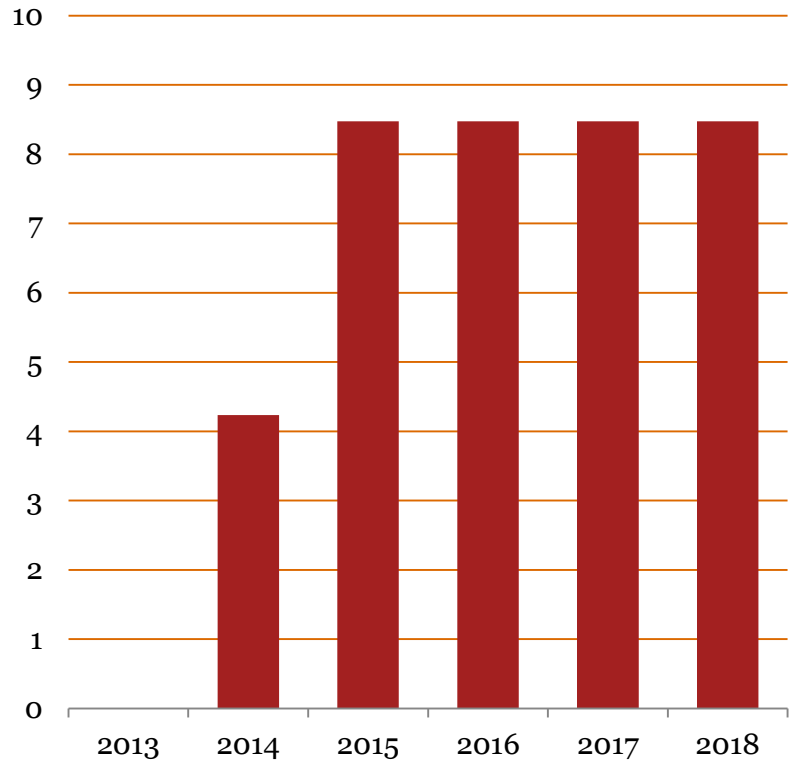
Electricity generation is the primary driver of domestic gas demand in this region.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Source: State Growth Outlook Survey

Great Southern/South West Natural Gas Demand

Natural Gas Demand by Use – GSth/SW
(PJ p.a. Increment above 2012 level)



Annual incremental natural gas demand from the minerals and energy sector in the Great Southern/South West is forecast to increase by 8 PJ over 2012 levels by 2018.

As for other regions in WA, electricity generation is the primary driver of additional domestic gas demand.

Note: Incremental gas demand includes gas required for industrial process and mobile plant, along with gas required for self generated electricity. It does not account for companies sourcing purchased electricity which may or may not be gas fired.

Source: State Growth Outlook Survey

Other Regions

Perth/Peel

Limited growth in natural gas demand due to minerals and energy activity is expected for this region. There will be increased residential demand in the region due to population growth.

Goldfields/Esperance

There is an increase in self generated electricity in this region leading to a small amount of incremental domestic gas consumption. However this is minimal as most electricity generation in the region (self generated) will be diesel sourced.

Gascoyne

Demand due to minerals and energy growth is expected to be negligible in this region.

Kimberley

There is limited projected growth in natural gas demand due to minerals and energy growth in this region. However this could change rapidly given the extensive opportunities for resources development in the Kimberley.

Wheatbelt

Demand due to minerals and energy growth is expected to be negligible in this region.

4.6 Implications and Opportunities

4.6.1 Growth and Competitiveness

4.6.2 Environment and Liveability

Coordinated Development of the NWIS and Mid West

Self generation will remain the predominant source of additional electricity supply for minerals and energy projects in the Pilbara.

High commodity prices and the advanced state of many projects have created near-term demand for new energy. The long and uncertain lead time to meet energy needs utilising the NWIS makes this option unattractive relative to self generation for the current wave of projects.

The level of self generation proposed for the Pilbara may mean that further network development will not be underpinned by current energy demand, as the infrastructure base to service that demand will already be installed.

Potential future projects in the Mid West provide an opportunity for coordinated development of energy infrastructure.

Concurrent development of several new mining developments provides an opportunity for planning of energy infrastructure development.

The development of the Mid West Energy Project is a positive step towards delivering the required energy infrastructure. It is critical that Stage 2 is funded and progressed in a timely manner.

Regulatory and policy frameworks

Delivery on energy infrastructure needs in WA will require facilitation by the WA and Federal Governments, including streamlining regulatory frameworks.

Early identification of energy infrastructure needs will assist government and infrastructure businesses in the planning of capital works and will facilitate regulatory approvals and financing.

The regulatory framework must be stable, allow for the timely approval of capital expansion programs and set appropriate investment incentives to attract economically efficient investment in required infrastructure.

The WA Government's framework for the WA energy market should focus on achieving competitive markets, security and reliability of supply, and sustainability .

The framework should focus the following outcomes :

- Competitive markets and efficiency to ensure energy supplies are delivered cost effectively;
- Security and reliability of supply through providing investment certainty and competitive pricing;
- Sustainability through innovation and flexibility to adapt to emerging constraints over time.

Energy2031 provides support for these outcomes.

There is a need to match the regulatory framework and decision making timeframes that apply to access requests and investment in transmission and generation infrastructure with other project approval processes in order to encourage the optimal balance between self-generation and networked power supply, and to avoid delays to projects.

The regulatory framework for investment in electricity transmission infrastructure can give rise to first-mover disadvantages for new electricity customers in a region where transmission investment is required. The first new user to connect may be liable for large capital contributions to finance the investment. Further, the regulatory tests associated with the investment may delay the development of the transmission infrastructure.

New transmission lines have a five to six year lead time for planning, approvals and construction. Self generation has the potential advantages of:

- Avoided network costs and delays; and
- Increased efficiency and lower carbon footprint where co-generation or tri-generation is used.

Source: Department of Finance – Public Utilities Office, *Strategic Energy Initiative, Energy 2031*, 2012

Domestic Gas Supply and Energy Price Outlook

There is increasing demand for domestic gas (natural gas supplied to third parties) and indications are that the balance between supply and demand will be tight.

Supply of gas for domestic usage is dependent upon factors including the future development of gas fields (including onshore unconventional gas), the development of additional domestic gas production capacity, the intentions of LNG producers concerning supply of domestic gas and government policy on domestic gas requirements.

A tight balance between supply and demand would suggest that evidence of recent price increases may be the beginning of a broader increase in gas prices to be incurred by users.

Increasing gas prices and the potential for higher electricity costs will increase energy costs for business.

Given the intended reliance on natural gas for self generated electricity production, an increase in natural gas prices will increase energy costs for minerals and energy projects.

The Federal Government's carbon price, via an interim carbon tax that transitions to an emissions trading scheme, will also contribute to the cost of energy in WA. Reducing State emissions, while sustaining strong growth in the minerals and energy sector, will require significant investment in the deployment of energy efficient technologies and renewable energy generation.

Environment and Liveability

An increase in electricity prices to achieve cost reflective pricing would affect all business sectors and residential electricity users.

Recent estimates by the Economic Regulation Authority suggest that electricity tariffs in the SWIS remain below the true cost of electricity production. This will present challenges to the WA Government in managing increases in regulated retail electricity prices for residential customers.

Cost of living increases in WA may have flow-on effects to labour markets through affecting the attractiveness of WA as a place to live for potential immigrants.

Technical and commercial hurdles to the introduction of widespread networked generation makes the introduction of renewables challenging.

The use of discrete, un-networked electricity generation poses challenges for developing a portfolio of generation options to include renewables. Networks allow renewable generation to be sited at locations for scale and energy yield to supply power directly related to load demand.

Section Five
Water

5.1 Summary

Key Findings Relating to Water

State Overview

- The agriculture (including irrigation) and mining sectors are the major water users in WA, comprising 32% and 24% of use in WA respectively. Residential domestic use also comprises a significant portion of water use, with 19% of use in this category.
- Total water use in WA is forecast to increase by 39% to 2023, from 1,900 GL in 2012 to 2,640 GL in 2023.
- Incremental minerals and energy water use is projected to reach 400 GL above 2012 levels by 2018, totalling an annual 980 GL.
- Dewatering will be a significant activity in minerals and energy projects: around 180 GL per year above 2012 levels by 2018. [1]
- Survey responses indicate that almost 20% of 'new' minerals and energy dewatering in 2018 would be re-injected into aquifers, and 14% supplied to third parties.

High Growth Regions

- The majority of the new minerals and energy water use in WA will be located in the Pilbara, with an average annual growth rate in the Pilbara to 2018 of 13%.
- The Mid West region is also projected to experience significant growth in minerals and energy sector water use (growth of 10% per year).

Water Availability

- Increasing volumes of water abstraction may place pressure on allocation limits and affect the likelihood of approvals.
- While groundwater allocation limits suggest room for growth in many regions, localised water constraints may restrain water abstraction and/or consumption.
- Most water abstraction for minerals and energy abstraction is from 'fractured rock' areas where allocation limits are not used. The unreliability of these types of aquifers and the cumulative effect of high levels of abstraction require careful management and can constrain project approvals.
- Water Corporation forecasts suggest a potential demand-supply imbalance in Perth beyond 2020, with an annual supply shortfall of 140 GL by 2040.

1. Dewatering levels may be higher as some water use reported by survey respondents was not categorised by source.

- The outlook from the current survey is comparable to the 2011 Growth Outlook Study. However, the profile of the increase in minerals and energy water use is delayed by one to two years due to delays associated with projects with significant dewatering requirements.
- The high growth regions remain the same between studies, with the Pilbara and the Mid West experiencing the strongest growth in water use.
- Minerals and energy projects will continue to meet demand predominantly through self extracted ground water and dewatering (consistent with the 2011 Growth Outlook Study).
- Many of the implications and opportunities presented in the 2011 Growth Outlook Study are applicable to the current environment.

Growth and Competitiveness

- Further work is needed to understand the cumulative and downstream impact of abstraction from fractured rock aquifers, including dewatering, aquifer re-injection, and discharge to rivers and creeks.
- In some areas, competition between players in the minerals and energy sector and other water intensive industries will increase as water becomes relatively more scarce.
- Logistical and commercial barriers limit better beneficial use of water from mine dewatering.
- Increasing water scarcity in some locations will stimulate calls for the creation of a water market. Water trading is possible under current laws but legislative changes are required for a more efficient water market in WA.
- Technology improvements and innovation in the water supply industry will assist in meeting future water demands. However, additional investigation of new sources will be required to meet the majority of supply needs.
- While the Mid West has sufficient groundwater availability in the aggregate, the distribution and salinity of water can lead to challenges in securing supply for specific projects.
- Recent investments in water supply for Pilbara communities are expected to meet demand from population growth in the medium term.

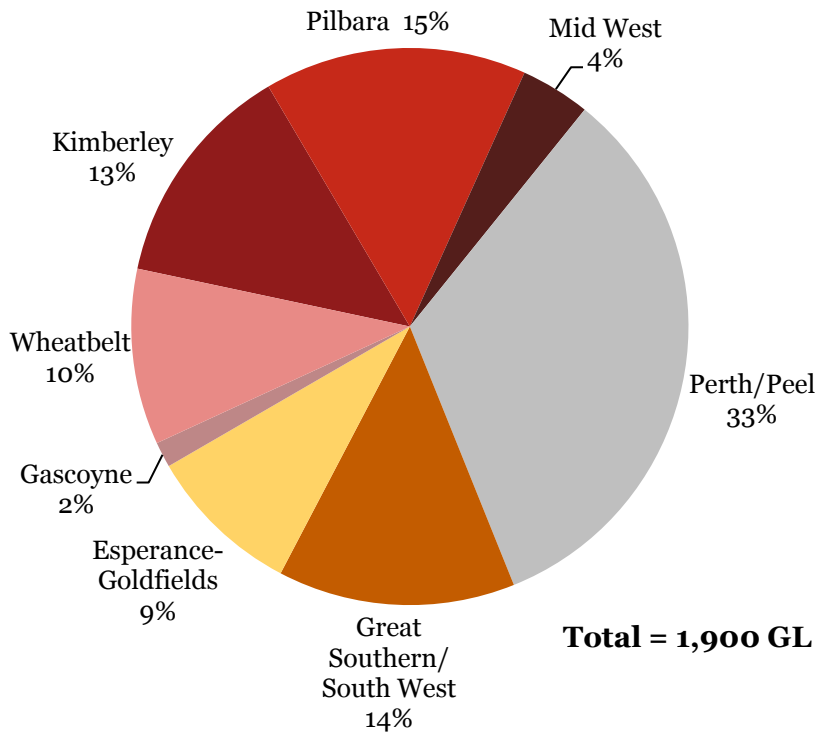
Environment and Liveability

- Reduction in sustainable groundwater yields due to declining rainfall in the Perth/Peel and Great Southern/South West regions will require contingency planning and increased cooperation between the public and private sector to ensure water use demands continue to be met.
- As the scarcity of water increases, price may be used to allocate scheme water or reflect an increased cost of abstraction and production, potentially further increasing the cost of living in WA.

5 . 2 State Overview

WA Water Use By Region

WA Water Consumptive Use by Region
(2011)



In 2011, 1,900 GL of water was used in WA.

The majority of water demand in WA is met through groundwater, which is also the primary source for the increase in demand.

On a regional basis, the Perth/Peel region had the greatest level of use in WA, accounting for 33% of the total.

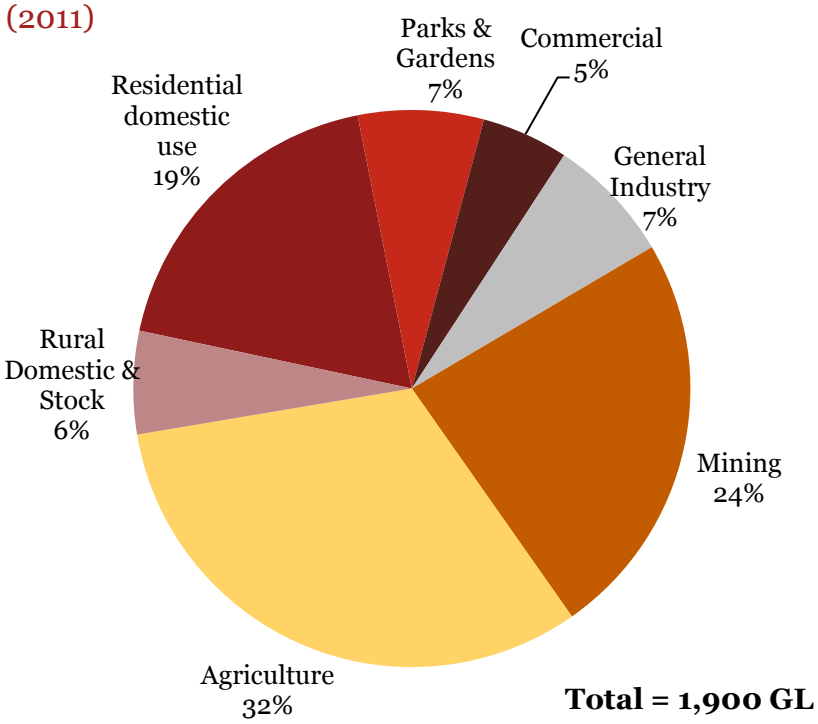
There are significant water entitlements in the Pilbara and Kimberley due to the predominance of water intensive industries in agriculture and minerals and energy. Water use in the Pilbara and Kimberley accounted for 15% and 13% of WA water entitlements respectively, and the combined Great Southern / South west for 14%.

Note: Consumptive use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers. Includes all water sources.

Source: Department of Water, *Unpublished Report*, 2012

WA Water Use By Activity

WA Water Consumptive Use by Sector
(2011)



The agriculture (including irrigation) and mining sectors are the major water users in WA, comprising 32% and 24% of use respectively.

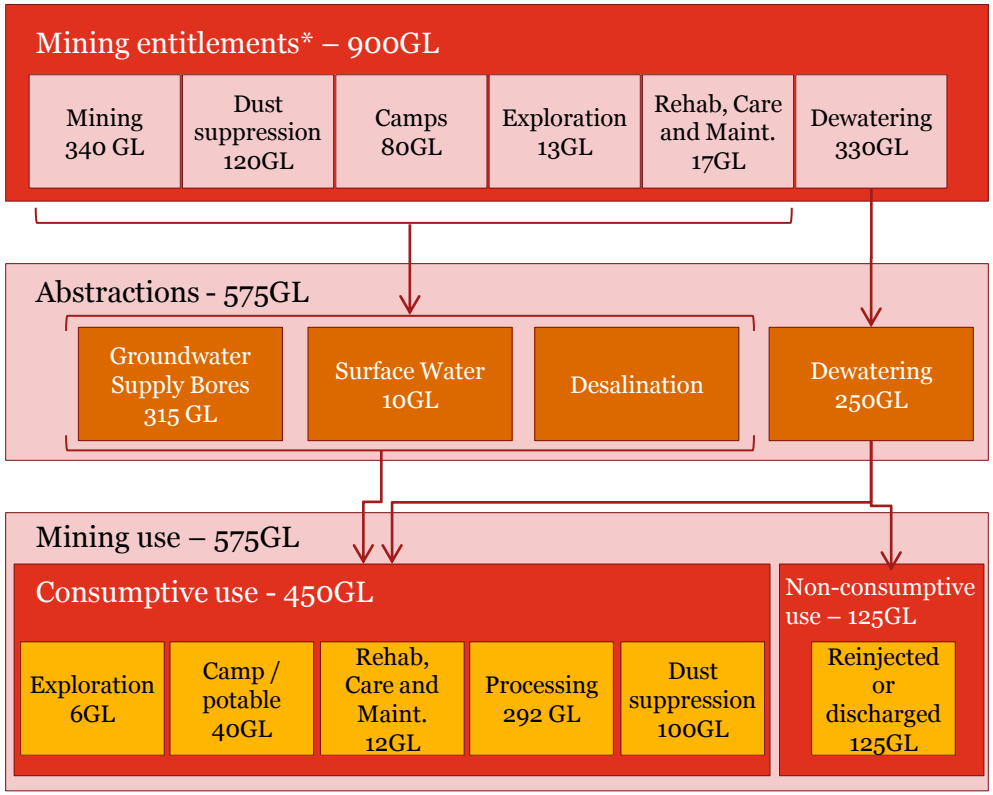
Residential domestic use also comprises a significant portion of water use, with 19% of water use in this category.

Note: Consumptive use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers. Includes all water sources.

Source: Department of Water, *Unpublished Report*, 2012

Water Terminology - Entitlement, Abstraction and Use

Mining entitlement, abstraction and use
(2012 Estimate)



The mining industry holds around 900 GL of water entitlements in WA in 2012.

A water entitlement allows the holder of the entitlement to abstract a specified amount of water during the licence period.

Available figures relate to mining activity only, and exclude oil and gas.

Mining entitlement holders are expected to abstract approximately 575 GL of their 900 GL entitlement in 2012.

Entitlement holders tend to abstract less than their entitlement as the entitlement sets a limit on abstraction, not the proposed level of abstraction. Further, entitlements are often held in advance of the requirement to abstract.

Of the 575 GL abstracted, 450 GL is for consumptive uses, and 125 GL is returned to the environment.

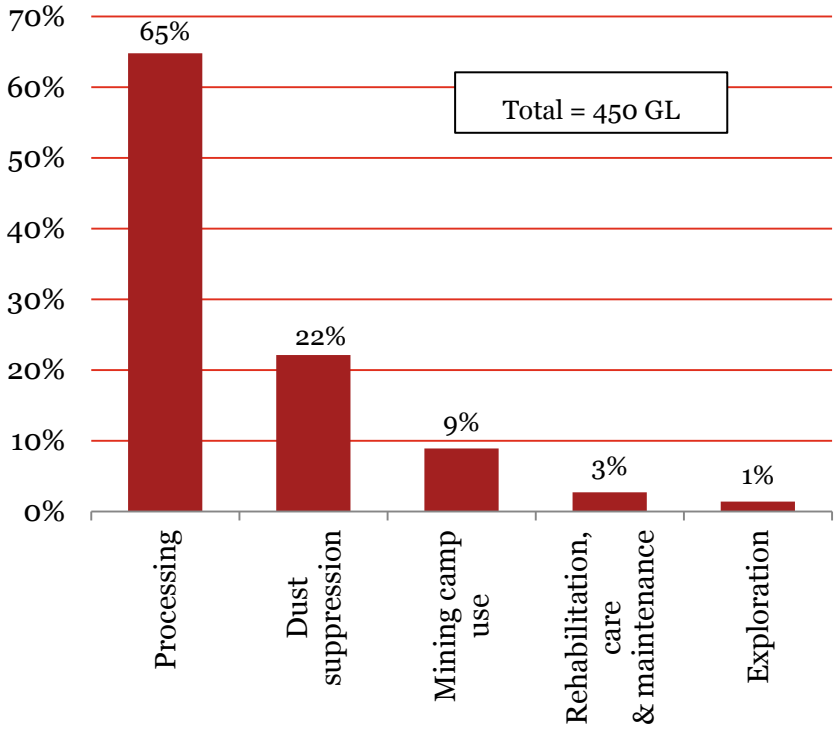
Abstracted water is returned to the environment through discharge to rivers and creeks, and through reinjection to aquifers.

Note: *Entitlement refers to license limits (generally issued on a fixed-volume fixed-term basis), as WA legislation does not provide for 'perpetual water entitlements' as in the National Water Initiative. Includes oil and gas water entitlements and abstraction, though these are considered negligible relative to mining.

Source: Department of Water

WA Water Use in Mining by Activity

WA Consumptive Water Use in Mining
(2012 Estimate)



Consumptive water use within mining derives from three main activities: mineral processing, dust suppression and mining camp supply.

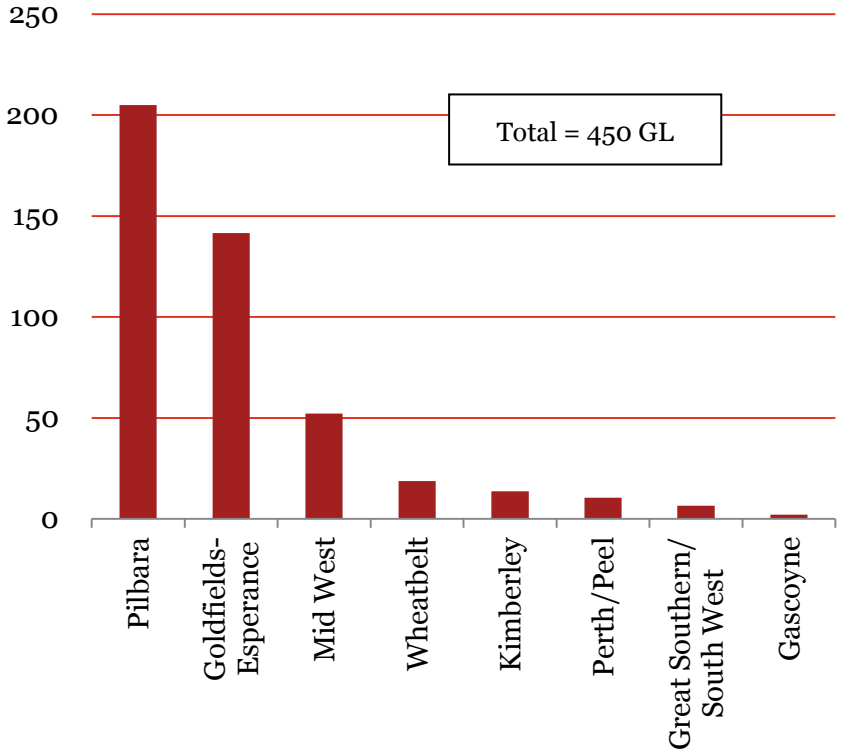
In fractured rock environments, mines may "create" water when large open pits are excavated or underground mines are pumped (dewatering) to access the mineral resource. Water from dewatering is used in processing, dust suppression and rehabilitation, care and maintenance.

Note: Consumptive use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers.

Source: Department of Water, *Unpublished Report*, 2012

Minerals and Energy Water Use By Region

Minerals & Energy Consumptive Water Use by Region
(GL p.a., 2012 Estimate)



In 2012, water use by the minerals and energy sector was estimated at 450 GL. Water users in the Pilbara will account for around 45% of this use.

Significant water entitlements also exist in the Goldfields-Esperance region.

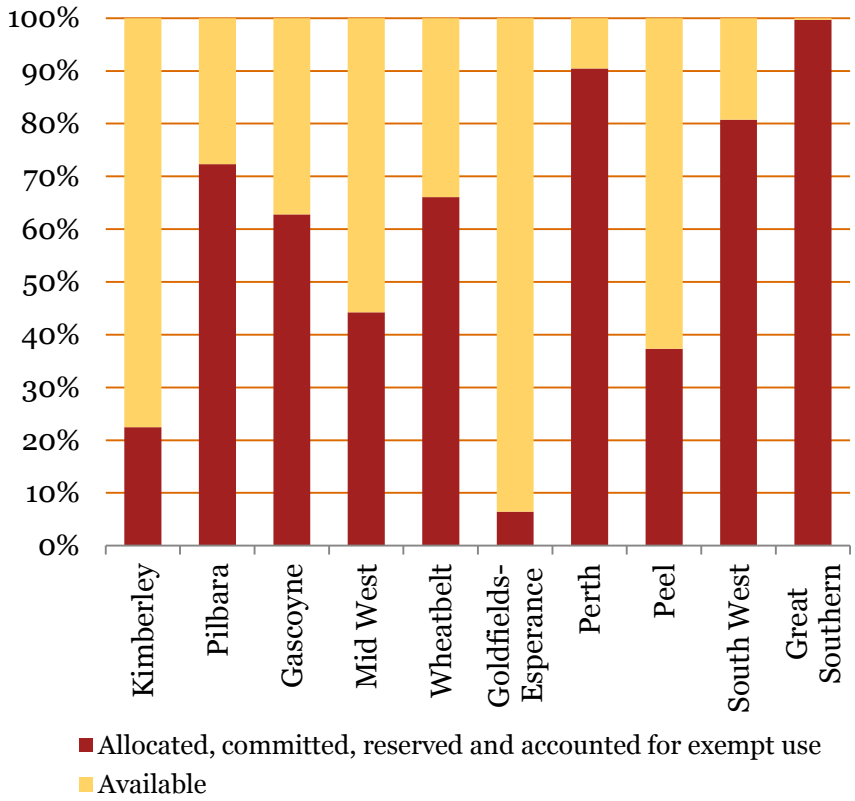
The wide geographical spread of the minerals and energy industry means that the sector uses water in all regions. However the industry is not a dominant user in the Perth/Peel, Great Southern/South West or Gascoyne regions.

Note: Consumptive use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers.

Source: Department of Water, *Unpublished Report*, 2012

Groundwater Allocation and Availability

Groundwater Allocation Status
(% allocated, 2012)



Source: Department of Water, *Working Paper*, 2012

The Perth, South West and Great Southern regions are reaching full allocation. Most regions contain groundwater subareas that are fully or over allocated.

The allocation limit is the amount of water that can be sustainably extracted annually from a water resource. The limits are based on a range of considerations including current knowledge of the water resource, water demand and environmental water requirements.

The Great Southern is the only region that is fully allocated (on average), although only a small portion of the Great Southern is proclaimed.

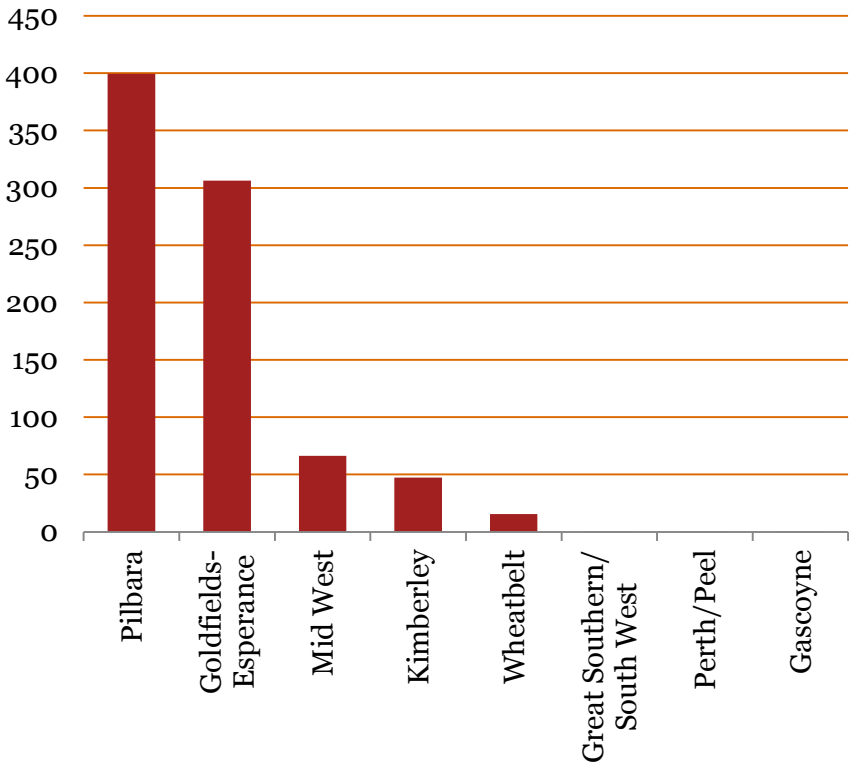
While scope remains for increased water use under allocation limits in sedimentary aquifers, the uneven distribution of unallocated water may result in insufficient water to meet demand at some locations.

The location of unallocated water resources within each region may not align with current and future demand for water resources. Accordingly, water scarcity may occur in all regions.

Fractured rock aquifers, which comprise most of the groundwater abstraction in mining activities in the Pilbara, Midwest and Goldfields, are assessed on an impact management basis and are not included in allocation limits.

Fractured Rock Water Entitlements

Water entitlements for fractured rock aquifers
(GL, 2012)



Entitlements to abstraction from fractured rock aquifers amount to 835 GL, which is over 90% of the 900 GL of water entitlements held by the minerals and energy industry in WA.

Most abstraction from fractured rock aquifers occurs in the Pilbara and Goldfields-Esperance regions, with material volumes also abstracted in the Mid West and Kimberley.

The use of fractured rock aquifers is assessed on an impact management basis and are not subject to specified allocation limits. They are not normally managed under an allocation limit as they are difficult to quantify and to set a realistic allocation limit for.

Increased demand for water abstraction from fractured rock aquifers, particularly for dewatering, may result in cumulative effects that constrain planned abstraction levels.

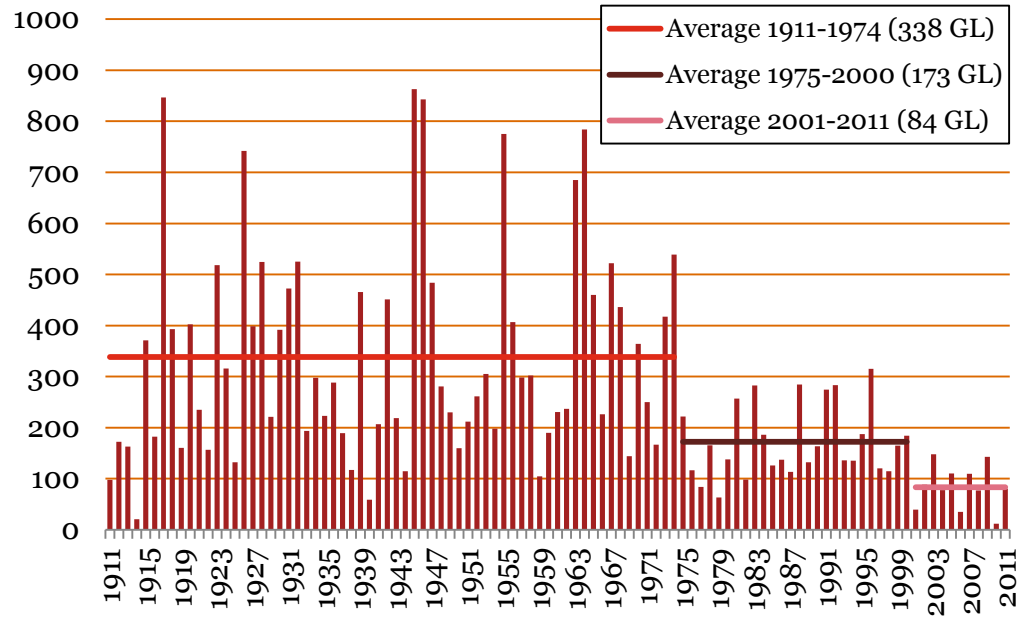
Cumulative impacts of project abstractions from fractured rock aquifers can limit further project approvals in an area, regardless of apparent allocation limits.

Note: Water entitlements for fractured rock aquifers are largely, but not exclusively, for mining purposes.

Source: Department of Water, *Working Paper*, 2012

Declining Water Availability in Perth/Peel and Great Southern/South West

Inflows to Perth Dams
(GL p.a.)



Declining rainfall and inflow to dams in the Perth/Peel and Great Southern/ South West regions are forecast to continue, significantly affecting long term water availability.

Average annual inflow into Perth dams has reduced from an average of 173 GL per year between 1975 and 2000 to 84GL per year between 2001 and 2011.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology have forecast that rainfall will continue to decrease over the next 50 years due to climate change, significantly affecting groundwater and surface water availability.

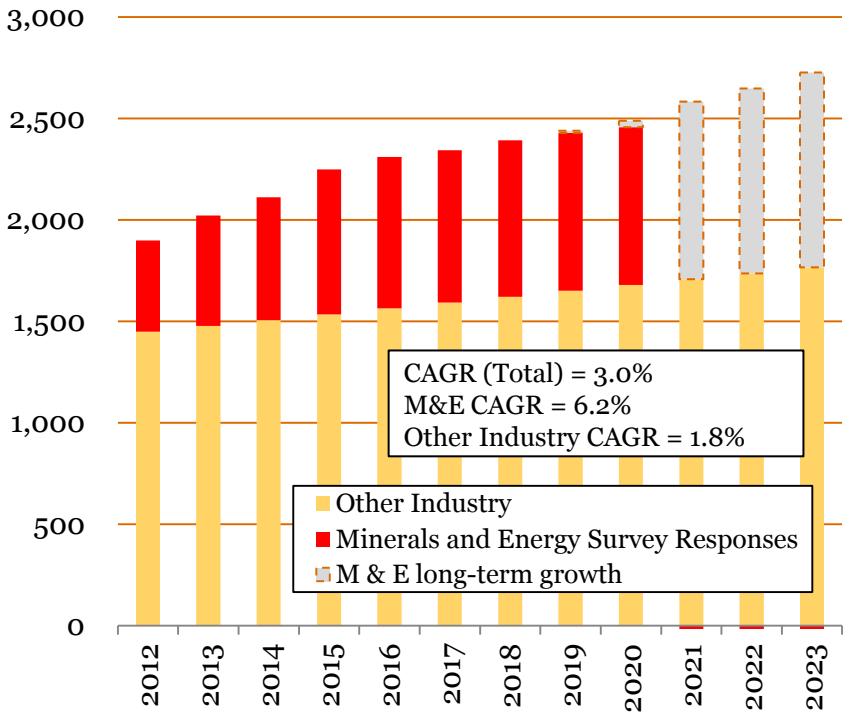
The central estimate by the CSIRO for rainfall in Western Australia in 2030 also suggests decreased rainfall through the remainder of WA, with the exception of the East Kimberley.

Source: Water Corporation, 2012
CSIRO, *Climate Change in Australia: Technical Report* ,2007

Total WA Water Use

Forecast Total Water Use in WA

(GL p.a.)



Water use in WA is forecast to increase by 39% to 2023, from 1,900 GL in 2012 to 2,640 GL in 2023.

A significant proportion of this demand growth is driven by minerals and energy projects. Demand in this sector is forecast to grow at 9.4% per year until 2018, or 6.2% per year over the period 2012 to 2023.

As detailed water plans typically do not extend beyond five years, we apply a long-term growth rate beyond 2018.

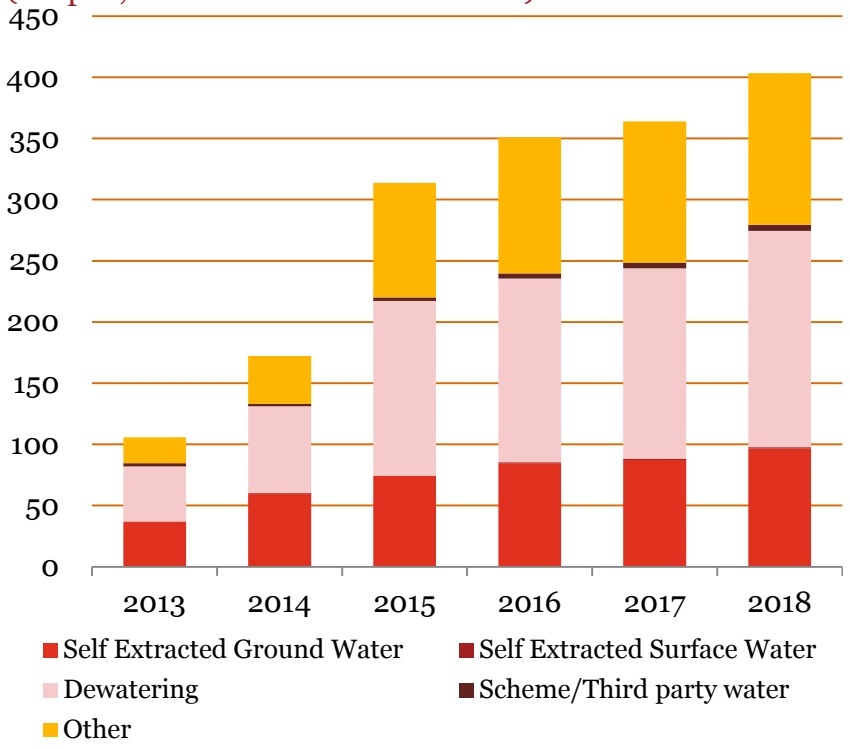
Note: Water Use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers.
Other industry demand is estimated to increase at 1.8% per year to 2023 based on the Water Futures for Western Australia 2008-2030 report.
CAGR of 2.5% between 2015-2018 applied beyond 2018 as this extends beyond the normal planning horizons of many companies.

Source: State Growth Outlook Survey
Department of Water, *Water Licensing System*, 2012
Resource Economics Unit, *Water Futures for Western Australia 2008-2030*, Department of Water, 2008

Incremental Minerals and Energy Water Abstraction

Minerals & Energy Water Abstraction by Source

(GL p.a., Increment above 2012 level)



By 2018, incremental minerals and energy water abstraction in WA is forecast to reach 400 GL above the 2012 level of 575 GL, with total abstraction at 975 GL in 2018.

This represents a 70% increase on current water abstraction by the minerals and energy sector or a compound growth rate of 9.3% per year.

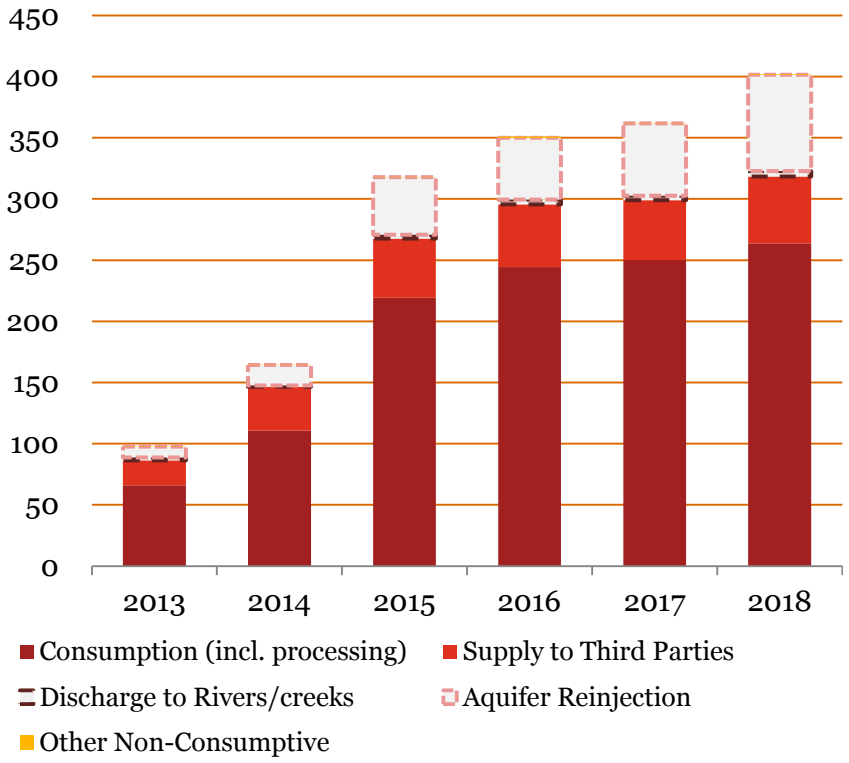
The main source of additional water for the minerals and energy sector in 2018 will be dewatering, which will account for 43% of incremental water abstraction, and self-extracted ground water which will account for 26% of incremental water abstraction. A significant proportion of water is categorised to other (29%) which reflects water abstraction that was not categorised by survey respondents.

Note: Actual groundwater use or dewatering may be higher than indicated as water sources reported as "Other" have not been included in the groundwater or dewatering categories. Further, dewatering is a sub-set of groundwater abstraction, although it has been separated for the purpose of this analysis.

Source: State Growth Outlook Survey

Incremental Minerals and Energy Water End Use

Minerals & Energy Water End Use
(GL p.a., Increment above 2012 level)



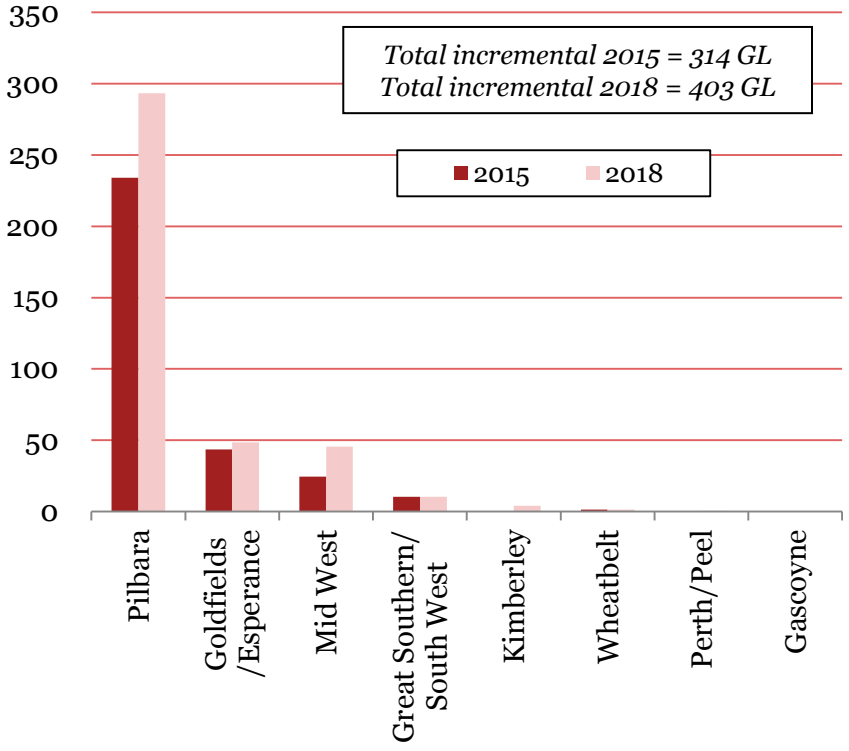
Consumptive use (260 GL) and aquifer re-injection (79 GL) are the largest end uses of incremental water in the minerals and energy sector by 2018. Aquifer re-injection will increase to account for 20% of incremental water use by 2018.

Consumptive use flattens out from 2016, with future increases in dewatering being re-injected into aquifers.

Source: State Growth Outlook Survey

Incremental Minerals and Energy Water Abstraction By Region

Minerals & Energy Water Abstraction by Region
(GL p.a., Increment above 2012 level)



The majority of incremental growth in water abstraction in the minerals and energy sector to 2018 will be located in the Pilbara.

73% of incremental water abstraction above 2012 levels in 2018 is forecast to occur in the Pilbara, with 12% to occur in the Goldfields/Esperance region and 11% in the Mid West.

Source: State Growth Outlook Survey

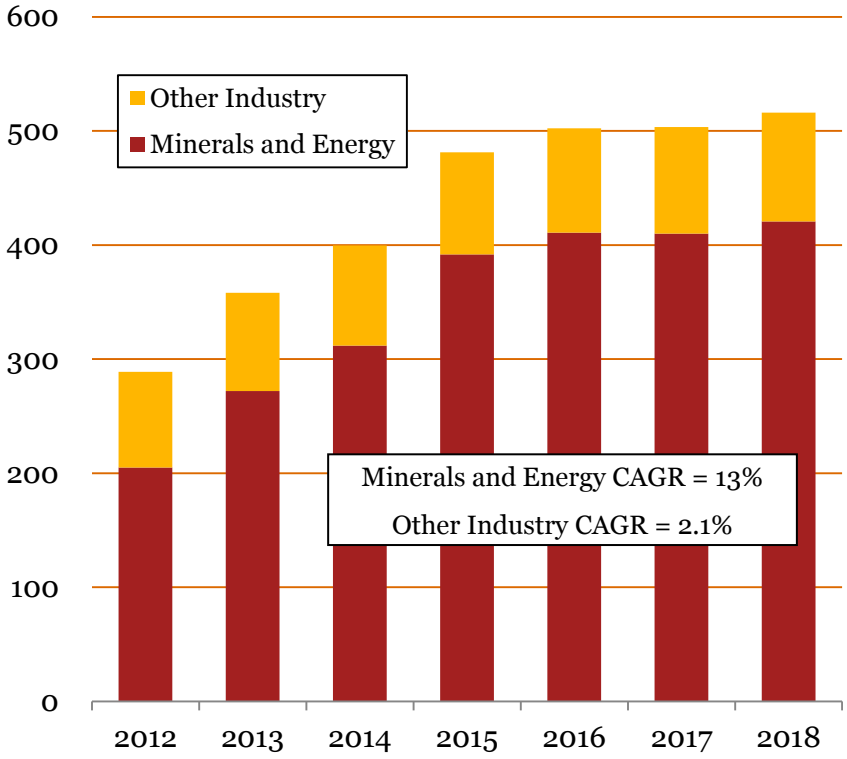
5.3 Regional Overview

5.3.1 Key Growth Regions

5.3.2 Other Regions

Pilbara – Total Water Use Outlook

All Industry Consumptive Water Use in the Pilbara
(GL p.a.)



Total water use in the Pilbara is forecast to increase by 10% per year to 2018, which compounds to result in an increase of 78% from 2012 levels.

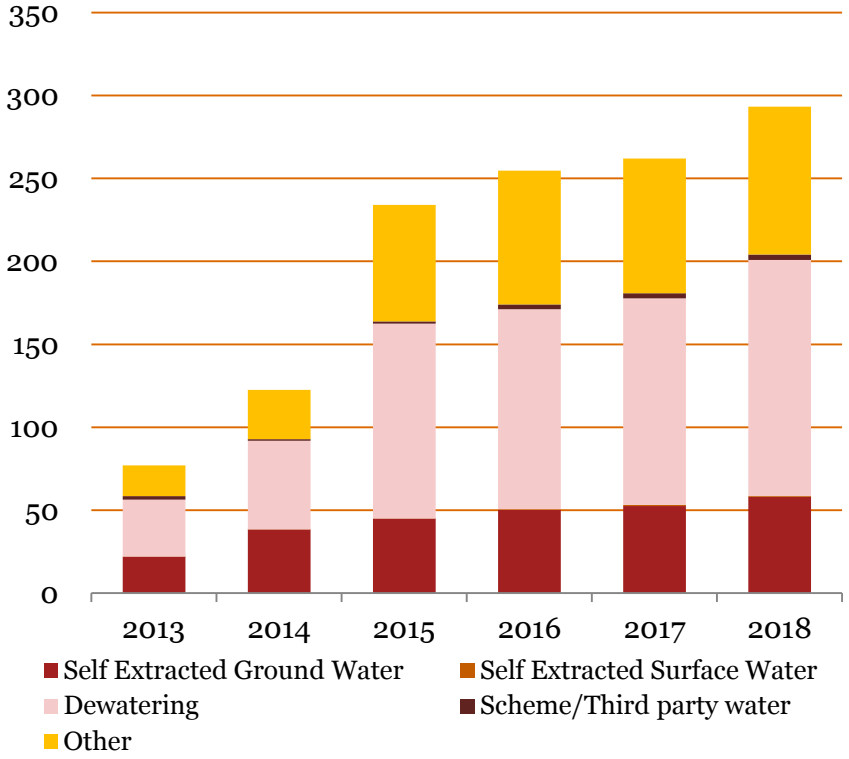
Water use in the minerals and energy sector is the primary driver of this increase, with water use increasing from 205 GL in 2012 to 420 GL in 2018, an increase of 105% at a compound rate of 13% per year.

Note: Water Use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers.

Source: State Growth Outlook Survey
Department of Water, *Water Licensing System*, 2012
Resource Economics Unit, *Water Futures for Western Australia 2008-2030*, Department of Water, 2008

Pilbara – Incremental Minerals and Energy Water Abstraction

Minerals & Energy Water Abstraction by Source - Pilbara
(GL p.a., Increment above 2012 level)



In 2018, incremental water abstraction by the minerals and energy sector in the Pilbara is 290 GL above 2012 levels.

Dewatering comprises the majority of the increase, with an additional 140 GL above 2012 levels to be extracted by 2018. Other sources are also significant, with an additional 89 GL growth above 2012 levels. As "other" reflects survey responses where water abstraction was not categorised, a significant proportion of that abstraction is also likely to relate to dewatering activities.

Scheme water consumption in the Pilbara will increase by around 3 GL per year by 2018, predominantly for use in the construction and operation of associated iron ore mining infrastructure.

Most water abstraction for mining activities in the Pilbara is from fractured rock aquifers. The unreliability of these types of aquifers and the cumulative effect of high levels of abstraction from these aquifers may have impacts that constrain project approvals.

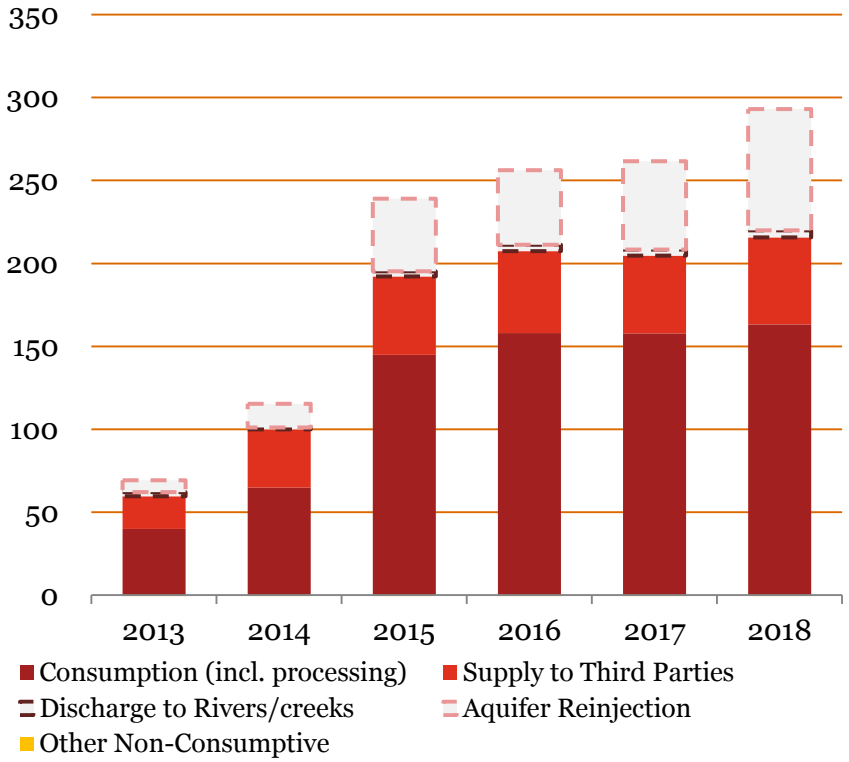
Note: Actual groundwater abstraction or dewatering may be higher than indicated as water sources reported as "other" have not been included in the groundwater or dewatering categories.

Source: State Growth Outlook Survey

Pilbara – Incremental Minerals and Energy Water End Use

Minerals & Energy Water End Use– Pilbara

(GL p.a., Increment above 2012 level)



Consumption and processing is the largest incremental minerals and energy sector end use of water in the Pilbara, accounting for 160 GL above 2012 levels by 2018.

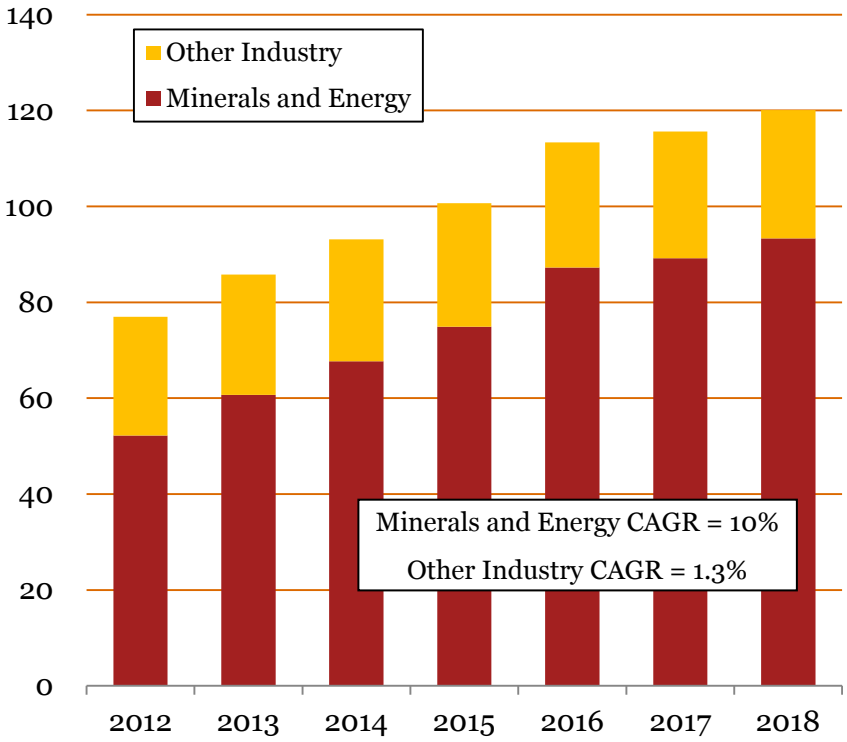
Aquifer re-injection also increases significantly, with 73 GL per year of additional re-injection by 2018. This comprises 25% of additional annual water use.

Supply to third parties is also a major use of water, with 18% or 53 GL per year of intended incremental water use in the Pilbara directed to this purpose in 2018.

Source: State Growth Outlook Survey

Mid West – Total Water Use Outlook

All Industry Consumptive Water Use in the Mid West
(GL p.a.)



Strong growth is forecast in minerals and energy sector water use in the Mid West, increasing by 78% (compound growth of 10% per year) from 52 GL in 2012 to 93 GL in 2018.

Water use growth in the Mid West will be largely driven by the minerals and energy sector, with other industry demand to increase at 1.3% per year.

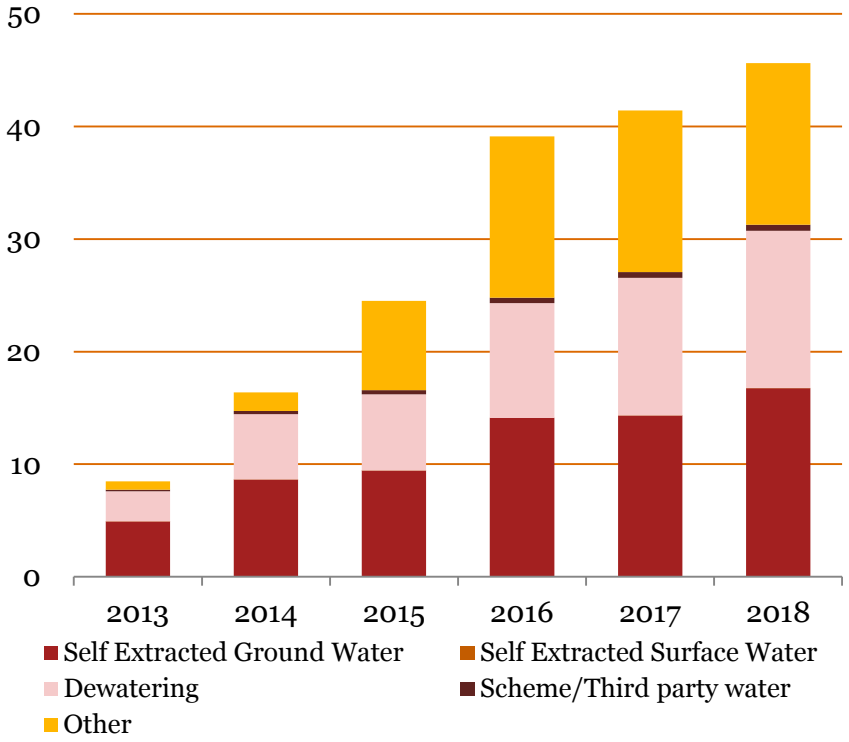
The combined effect of minerals and energy plus other industry growth rates is a combined growth rate for Mid West water consumption of 7.7% per year.

Note: Water use does not include dewatering when discharged to rivers and creeks or re-injected to aquifers.

Source: State Growth Outlook Survey
Department of Water, *Water Licensing System*, 2012
Resource Economics Unit, *Water Futures for Western Australia 2008-2030*, Department of Water, 2008

Mid West – Incremental Minerals and Energy Water Abstraction

Minerals & Energy Water Abstraction by Source – Mid West
(GL p.a., Increment above 2012 level)



Water abstraction by the minerals and energy sector in the Mid West is expected to reach 46 GL above 2012 levels in 2018.

Growth in water abstraction is driven primarily by groundwater extraction (37% of the increase) and dewatering (31% of the increase). These figures may be understated as abstraction categorised as "other" reflects survey responses where water abstraction was not categorised. A significant proportion of that abstraction is likely to relate to dewatering activities.

Current groundwater allocation limits allow room for growth in water allocations in the Mid West.

However, some locations within the region are close to fully allocated, so localised water issues may emerge.

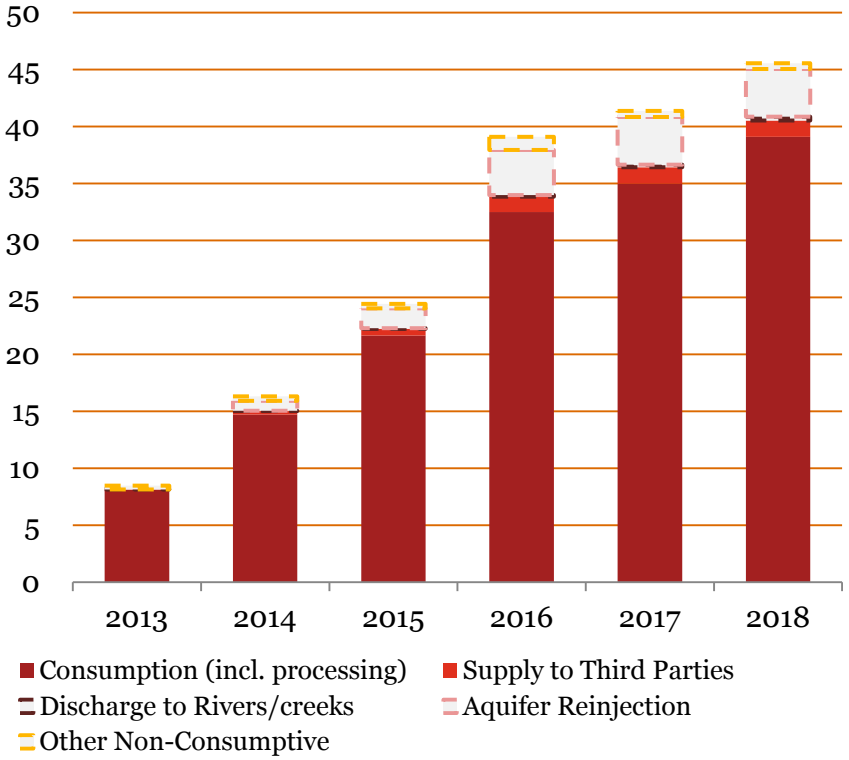
Much water abstraction for mining activities in the Mid West is from fractured rock aquifers. The unreliability of these types of aquifers and the cumulative effect of high levels of abstraction from these aquifers may have impacts that constrain project approvals.

Note: Actual groundwater abstraction or dewatering may be higher than indicated as water sources reported as "other" have not been included in the groundwater or dewatering categories.

Source: State Growth Outlook Survey

Mid West – Incremental Minerals and Energy Water End Use

Minerals & Energy Water End Use – Mid West
(GL p.a., Increment above 2012 level)



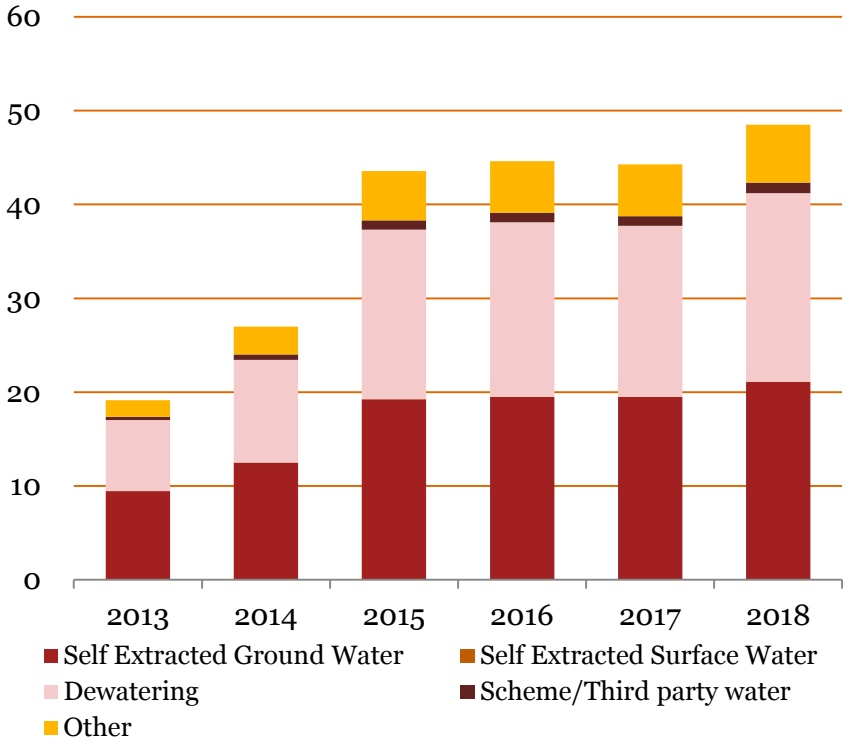
Incremental water end use by the minerals and energy sector in the Mid West is predominantly consumptive use, comprising 39 GL (86%) of the increase to 2018.

A small amount of the increment is supplied to third parties (1.4 GL per year).

Source: State Growth Outlook Survey

Goldfields/Esperance – Incremental Minerals and Energy Water Abstraction

Gold-Esp. Minerals & Energy Water Abstraction by Source
(GL p.a., Increment above 2012 level)



Incremental water abstraction in the minerals and energy sector in the Goldfields-Esperance region is forecast to be approximately 48 GL above 2012 levels in 2018.

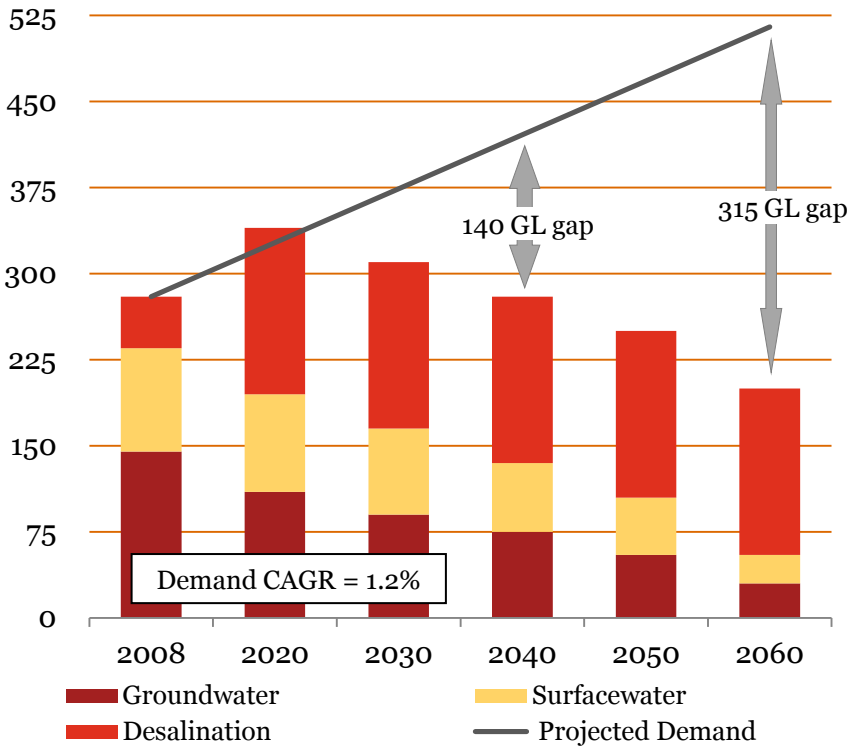
Of the additional 48GL, an extra 21 GL per year (45%) is planned to be sourced from groundwater sources, while 20 GL per year (41%) will result from dewatering.

Note: Actual groundwater abstraction or dewatering may be higher than indicated as water sources reported as "other" have not been included in the groundwater or dewatering categories.

Source: State Growth Outlook Survey

Long Term Outlook for the Perth Region

Long Term Water Availability – Perth
(GL p.a.)



Forecasts from the Water Corporation suggest an excess of demand over supply in the Perth region beyond 2020 if current water usage trends continue.

To address this imbalance, the Water Corporation has identified three focus areas :

1. Reducing water use: 25% reduction target in per person scheme water consumption over the next 50 years;
2. Increasing water recycling: from 6% to 60% recycling of all metropolitan wastewater over the next 50 years; and
3. Developing new sources: with new source options to be identified, investigated and secured by 2060.

Water use growth in the Perth/Peel region is largely driven by industries outside of the minerals and energy sector.

Water use in the minerals and energy industry in the Perth Peel region is forecast to grow at only 0.7% per year, compared to the 2.0% per year growth rate of other industries.

Source: Water Corporation, *Water Forever: Towards Climate Resilience 2009*, 2009. Plus additional desalination capacity (50GL) since publication of report

Summary of Other Regions

Great Southern/South West

There is some growth forecast for the region in minerals and energy sector water use, with up 10 GL per year of additional use by 2018.

Water availability will continue to be an issue in parts of the region, with allocation limits already met or exceeded. Declining rainfall is forecast to affect sustainable groundwater yields for the Great Southern/South West area in the long term. Desalination is expected to play an important role in meeting future demand growth.

Gascoyne

There is no projected growth in water use in the minerals and energy sector in the Gascoyne.

Wheatbelt

The area is dominated by agriculture, with minerals and energy the second largest user of water by sector.

Incremental minerals and energy sector water use is projected to be minimal to 2018 (1 GL increase in annual use).

Kimberley

Water demand in the minerals and energy sector in the Kimberley will largely remain steady over the period to 2018, with a slight increase of 4 GL in annual use.

5.4 Implications and Opportunities

5.4.1 Growth and Competitiveness

5.4.2 Environment and Liveability

Further work is needed to understand the cumulative and downstream impact of abstraction from fractured rock aquifers, including dewatering, aquifer re-injection, and discharge to rivers and creeks.

The absence of appropriate management of cumulative impacts may create barriers to further development. The existing regulatory framework is unclear on how to measure and manage cumulative impacts (i.e. the result of the impacts of multiple operators), how separate project approvals interact (particularly across time) and how impact management strategies should be developed by individual proponents.

In some areas, competition between players in the minerals and energy industry and other water intensive industries will increase as water becomes relatively more scarce.

This may be a particular issue in the Mid West and Great Southern/South West. Better use of water from dewatering activities may present opportunities to address these water supply issues. Legislative changes will also be critical in facilitating bespoke responses to regional and catchment conditions.

Logistical and commercial barriers limit better beneficial use of water from mine dewatering.

Survey responses suggested that a significant amount of dewatering water will be supplied to third parties or re-injected into aquifers. Legal rights around supply of dewatering volumes to third parties have recently been clarified, however there remain barriers to better and more beneficial use. Demand for water is often at considerable distance from dewatering supply, leading to a high capital cost associated with supplying to third parties. The unpredictability of supply from dewatering sources also challenges the ability to take advantage of the opportunity provided by water availability.

Increasing water scarcity in some locations will stimulate calls for the creation of a water market. Water trading is possible under current laws but legislative changes are required for a more efficient water market in WA.

While water trading is possible within current laws, legislative changes are needed to better facilitate trade within and between water using industries.

Adoption of the National Water Initiative outcomes and commitments while retaining current licensing arrangements would promote efficacy in any water market created in WA, while retaining flexibility to respond to a wide range of conditions across the State.

Technology improvements and innovation in the water supply industry will assist in meeting future water demands. However, additional investigation of new sources will be required to meet the majority of supply needs.

For example, desalination of sea water in coastal areas and saline groundwater in inland areas will increasingly provide water supply for industry and residential consumers. Innovations to reduce water consumption such as dry tailings management and alternative dust suppression technologies are being explored.

While the Mid West has sufficient groundwater availability in the aggregate, the distribution and salinity of water can lead to challenges in securing supply for specific projects.

Opportunities exist for the forthcoming Mid West Regional Water Supply Strategy to identify water supply options, along with a range of water management responses enabled under new water resources legislation, where water resources are becoming scarce or are becoming a binding constraint to production.

Recent investments in water supply for Pilbara communities are expected to meet demand from population growth in the medium term.

Although scheme water demand by the minerals and energy sector is small relative to their total water use, it reflects a material use of available scheme water supplies.

Reduction in sustainable groundwater yields due to declining rainfall in the Perth/Peel and Great Southern/South West regions will require contingency planning and increased cooperation between the public and private sector to ensure water use demands continue to be met.

The increased residential population in these regions will further increase residential water demand in an already water constrained region.

As the scarcity of water increases, price may be used to allocate scheme water or reflect an increased cost of abstraction and production, potentially further increasing the cost of living in WA.

Different industries have differential abilities to absorb increases in scheme water costs. Similarly, the distributional effects of increases in residential tariffs is an important consideration.

Contents

Section Six

Infrastructure

6.1 Summary: Infrastructure

Key Findings Relating to Infrastructure

Aviation

- WA's airports have experienced significant growth in demand over the last decade.
- Passenger volumes at Perth Airport grew from 4.9m in 2001 to 11.3m in 2011, a growth rate of 9% p.a. Growth rates at Port Hedland, Newman, Paraburdoo and Karratha have averaged over 16% p.a., meaning that passenger volumes have more than quadrupled since 2001.
- Perth Airport reaches capacity on weekday mornings, reflecting demand from FIFO traffic.

Ports

- Total trade volume through Port Authority ports has more than doubled from 200 Mt in 2002 to 428 Mt in 2011. This growth was driven almost entirely by export volumes.
- Port Hedland and Dampier are the dominant export ports, while Fremantle accounts for around 70% of WA imports (by volume).

Road

- Interviews for the State Growth Outlook indicated that transport of heavy equipment and construction materials by road is a challenging issue for mining and energy companies, Main Roads and the Department of Transport.

Rail

- The majority of WA's mineral exports are carried to ports by privately owned railways in the Pilbara.
- The majority of WA's public freight rail network is managed by Brookfield Rail. The Australian Rail Track Corporation manages the East-West main line into Kalgoorlie.

Social Infrastructure

- Growth in WA's mining and energy industries has been supported by significant levels of international migration.
- Career factors are a major motivator to ensuring a city is an attractive place to live in or move to. Safety, culture, education and public infrastructure also play a role.
- Perth is consistently rated as being amongst the world's most liveable cities.
- The cost of living in the Pilbara is far higher than in Perth. A mismatch between supply and demand has seen rapid growth in housing and land prices.
- The Pilbara lacks a full range of high quality community infrastructure to support liveability.

Aviation

- There is a bottleneck at Perth Airport during peak hours. Current traffic patterns reflect shift patterns designed around best practices in safety, fatigue management and operational efficiency. For this reason, flying outside of current peak hours is expensive for resource companies.
- Dealing with the peak capacity problem at Perth Airport requires shifting some traffic outside of the peak, or capacity expansion through improving efficiency of existing infrastructure or through an additional runway.

Ports

- Bulk mineral export facilities are operating at capacity. There is not yet a clear pathway to delivering new port facilities at Anketell, Oakajee and Esperance. These developments are required to facilitate resource developments in the Pilbara, Yilgarn and Mid West.
- Production growth plans rely on successfully executing infrastructure plans.

Road

- The Regional Freight Transport Network Plan will evaluate investments in key corridors to address the increasing number of oversize loads. Improved port facilities in the Pilbara are essential to facilitate a move from road transport to coastal shipping for some loads.

Rail

- Continued growth in exports will require additional rail capacity, and the protection of rail corridors for future growth.

Social Infrastructure

- Perth is competing for internationally mobile, highly skilled minerals and energy workers. These workers are able to choose from a wide range of international resource hubs.
- While Perth scores well on many liveability factors, culture and the incidence of crime are areas for potential improvement.
- Housing affordability and town amenity are critical enablers to maintaining a residential operational workforce. Housing costs in mining communities continue to be significantly higher than Perth.

6.2 State Overview: Infrastructure

Western Australian Airports

1	Perth	Perth & Peel
2	Broome	Kimberley
3	Derby-Curtin	
4	Kununurra	
5	Karratha	Pilbara
6	Newman	
7	Paraburdoo	
8	Port Hedland	
9	Learmonth – Exmouth	Gascoyne
10	Geraldton	Mid West
11	Busselton	Great Southern
12	Albany	
13	Kalgoorlie	Goldfields
14	Esperance	

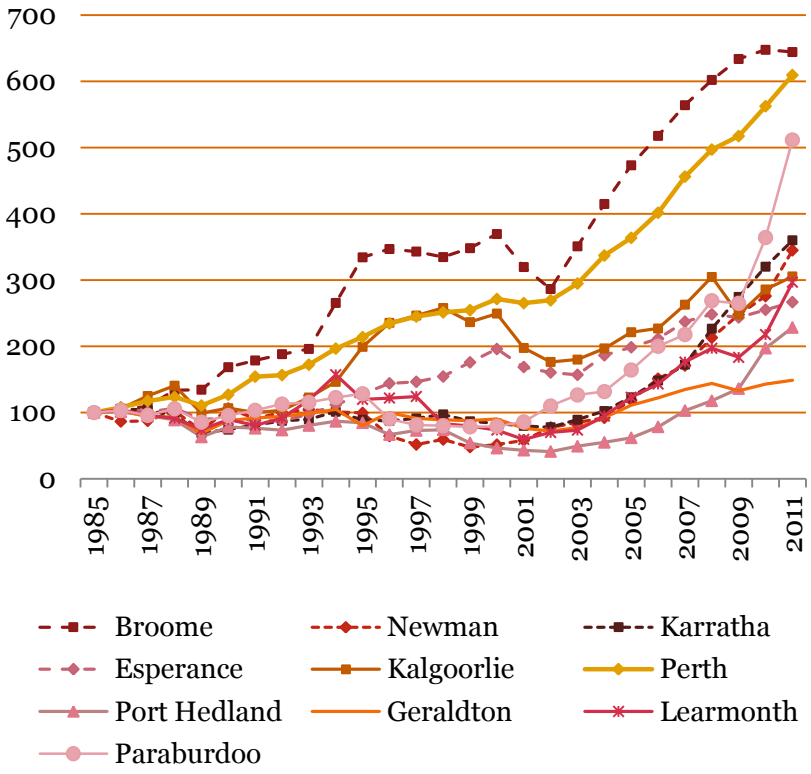
1. PAX = Total passenger movement (arrivals and departure)
2. Perth not drawn to scale – PAX value is 16 times the scale of the second largest PAX airport, Karratha.

Source: Department of Infrastructure and Transport – Australian Government (BITRE.gov.au – 2011)

Regional WA and Perth Airport PAX

WA Airports – PAX index since 1985

(Indexed on a base of 100 in 1985)



WA Airports – PAX since 2001

% (10 year CAGR from 2001)

Airport	2001	2011	CAGR
Perth	4,929,182	11,328,099	9%
Karratha	156,864	707,123	16%
Broome	200,722	404,570	7%
Port Hedland	75,549	400,013	18%
Kalgoorlie	171,951	265,964	4%
Newman	42,389	251,556	19%
Paraburdoo	41,403	246,624	19%
Geraldton	55,106	107,688	7%
Learmonth	13,762	68,670	17%
Esperance	30,422	48,092	5%

Regional airports have experienced substantial growth in PAX over the last decade.

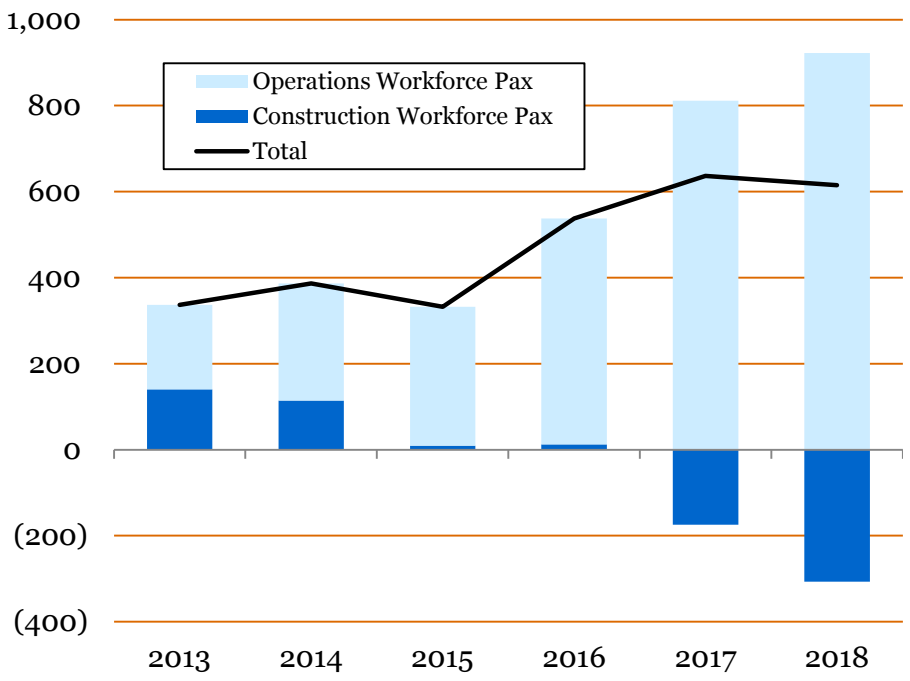
Perth Airport has also seen substantial and consistent PAX growth throughout the period.

1. PAX = Total passenger movement (arrivals and departure)

Source: Department of Infrastructure and Transport – Australian Government (BITRE.gov.au – 2011)

Perth Airport Usage

Perth Airport Usage – Mining and Energy Workforce
(Thousands of Incremental PAX, 2012 – 2018, PAX)



1. Incremental workforce PAX values are a combination of both committed and potential projects on a 100% basis.
2. Does not include charter volumes.

Analysis for the CME Airports Study forecasts additional mining and energy PAX at Perth Airport of between 390,00 and 640,000. This compares to an expected total of 12.3 million PAX in 2012.

The significant growth expected in flights for operations staff will be partially offset by the expected reduction in flights for the construction workforce. Despite the relatively constant resource sector workforce, the change in mix drives growth in flights.

Based on committed/probable projects, the peak is expected to be 390,000 pax above 2012 levels in 2014. On an all projects basis, the peak is expected to be 640,000 pax above 2012 levels in 2017.

On average, FIFO operations staff fly more often than FIFO construction workers.

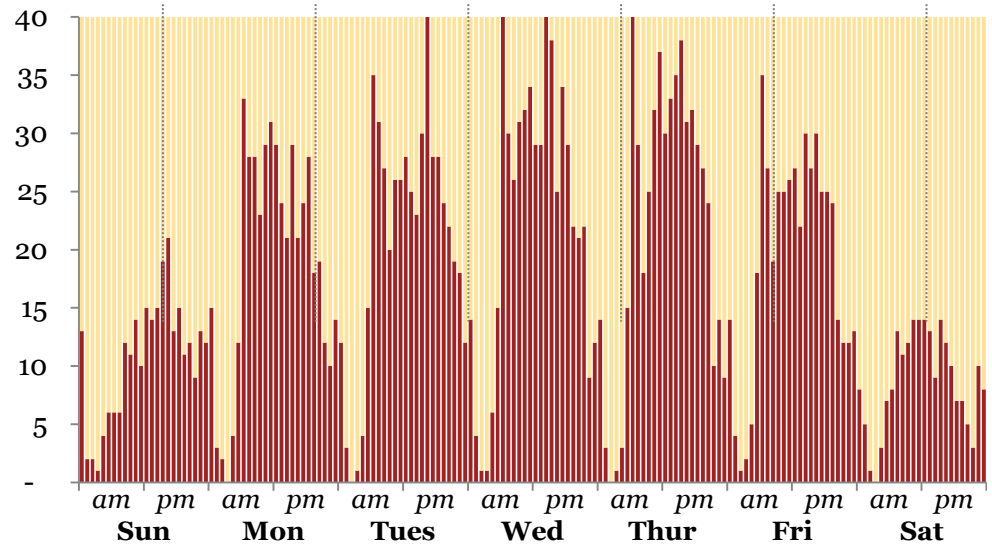
Rosters for FIFO operations staff typically have shorter rotations than those for FIFO construction staff, meaning more flights per person per year on average. For this reason, total flights required by the mining and energy sector increases at a faster rate than total employment in the sector, as operations staff are expected to steadily increase as a proportion of the total workforce.

Source: CME Airports Study (October 2012), which utilises detailed staffing and aviation plans based on surveys in October 2012.

Utilisation At Perth Airport

Aircraft Movements at Perth Airport[2]

(Number of aircraft movements per hour)



Resource sector companies are heavy users of Perth airport during the peak periods of 6am-8am and 2pm-4pm Monday to Thursday.

Demand is exceeding supply at some times during the day, driven by the specific demands of resource sector FIFO activity. During other times of the day there is substantial remaining capacity.

The busiest slot times at Perth Airport are between 6am and 8am as well as 2pm and 4pm. The Airport often reaches capacity during these times with 40+ aircraft movements per hour on Tuesday – Thursday.

The majority of the 640,000 additional resource sector PAX are expected to require flights between peak periods.

This could be equivalent to about:

- 5 additional flights during each peak hour slot (3 flights for committed/probable projects only)[3]; or
- An average flight size increase of 21 PAX.[3]

1. Maximum capacity at Perth Airport is currently about 40 movements per hour (Perth Airport Sept 2012).
2. Flight movements for one week only in September 2012 and may vary due to updated schedules and seasonal impacts.
3. Calculations based on: 75% of the 320,000 additional resource sector passenger departures from Perth airport will require flights in one of 10 peak hour slots. Also assumes that average flight size to resource sector destinations is 110 PAX and that 55% of peak hour slots are allocated to resources sector destinations. Also overlayed with an 85% flight utilisation factor. Similar requirements should be expected for arrivals.

Source: Perth Airport (Sep 2012)

Development Initiatives at Perth Airport to Maximise Capacity

Perth Airport – Development initiatives

Initiative	Comments	Due
New domestic terminal[1]	Construction of a new domestic terminal to meet the needs of the resource sector ("Terminal WA"). This terminal will cater to operators flying into regional WA with some inter-state services.	Early 2013
Aircraft Scheduling & Operation	Scheduling of aircraft is not currently co-ordinated across the 6 airfield aprons. To maximise throughput, it is necessary to manage/coordinate aircraft scheduling centrally. Perth Airport is progressing its planned "slot coordination system".	2013
Airfield Infrastructure	Approximately $50m will be spent to deliver expanded airfield aprons, taxiways and aircraft parking areas. These investments are designed to increase airfield capacity and on-time performance.	2014
Air Space Redesign	UK Nats' draft report[2] recommends actions to materially enhance WA air space capacity, including changes to air space design. Their final report will be released shortly.	TBA
Air Traffic Control Resourcing & Practices	UK Nats' draft report[2] contains recommendations relating to improving resourcing & air traffic control practices/methods. If implemented, these changes could substantially enhance the capacity of the existing air space.	TBA

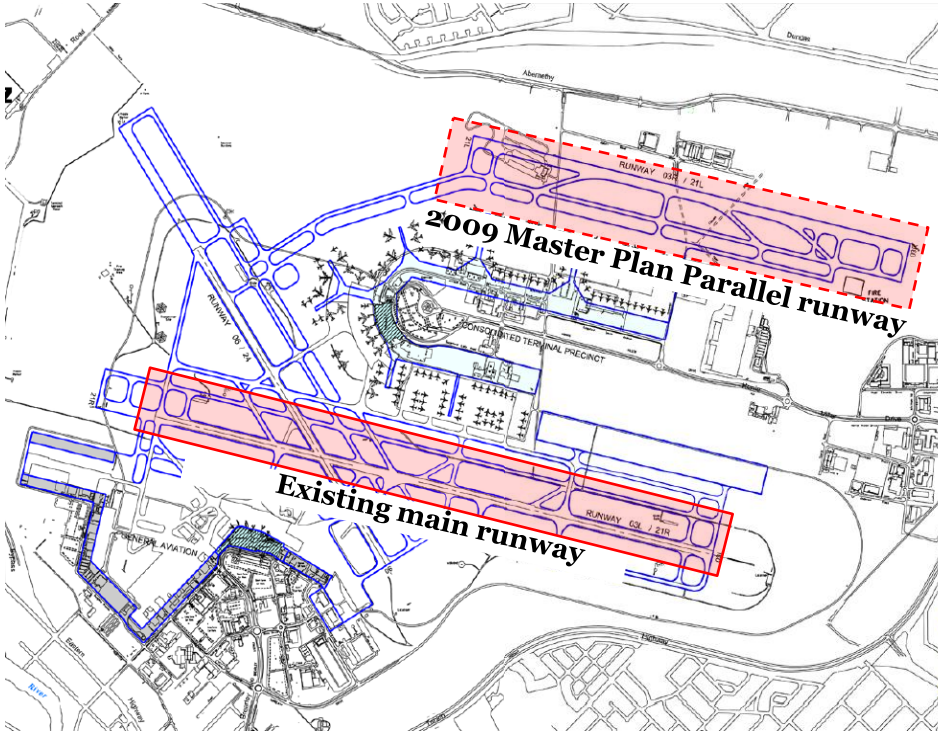
Perth Airport is investing in initiatives to increase the maximum slot capacity by over 18%.

By implementing the initiatives in the table (left), Perth Airport expects peak hour slot capacities to increase from about 40 aircraft movements to about 47. If achieved, this would alleviate some pressure on the airport.

1. Unlikely to have a material impact on increasing maximum slot capacity
2. UK NATS (UK National Air Traffic Services) has been hired to review the operations of Perth Airport, and is in the process of releasing a final report highlighting their findings. Draft comments have been noted above and are indicative only.

Source: Perth Airport Master Plan 2009; Perth Airport Website (Current Developments); Perth Airport Presentation (July 2012)

Perth Airport Runway Developments



The growth in FIFO demand suggests that some of the major runway developments may be needed earlier than forecast in the 2009 Master Plan.

Perth Airport has identified three potential future runway developments. Each of these would have a significant impact on capacity, but at a significant capital cost:

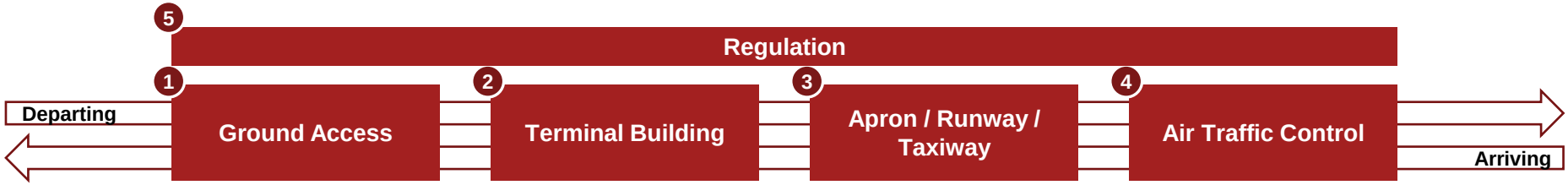
1. Extend main runway (known as 03/21) from 3444m to 3800m
2. Extend cross runway (known as 06/24) from 2163m to 3000m
3. Construct 3rd runway – 2700m

In the 2009 Master Plan these developments were not forecast to occur within the 20 year planning horizon.

The feasibility study for constructing the 3rd runway is currently underway.

Source: Aerodrome Chart – Perth Airport (AirServices Australia, 2012), Perth Airport Master Plan (2009); Perth Airport Website (2012)

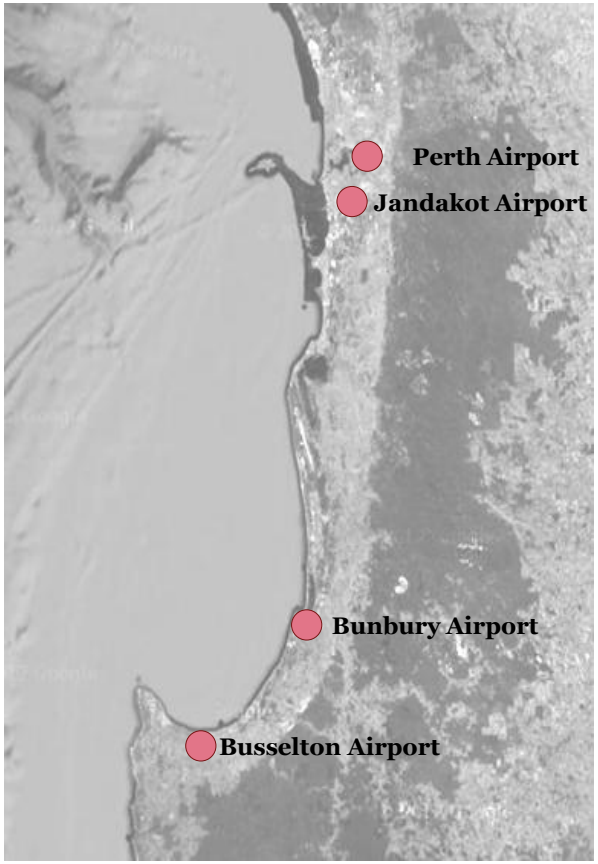
Capacity constraint factors



ID	Airport Sub-System	Constraining Factors	Description
1	**Ground Access**	**Airport Services**	• Airport / airside and landside services operating hours (e.g. security) • Infrastructure and transport access to the airport (e.g. capacity of car parks, public transport, taxi areas, airport entrance etc.)
2	**Terminal Building**	**Terminal Building**	• Current size of terminal and throughput capacity (e.g. check-in, security, lounge, floor area etc.) • Ability to expand terminal building
3	**Apron / Runway / Taxiway**	**Apron and Taxiway**	• Apron and taxiway strength rating • Apron capacity / ability to handle versatile aircraft • Taxiway width and connection to the runway
		Runway	• Runway strength rating • Runway width and length (ability to service larger craft and larger loads) • Ability for runway to be upgraded/extended (financially and physically)
4	**Air Traffic Control**	**Surrounding Environment**	• Availability of land to use for infrastructure expansions • Topography/characteristics of surrounding land and development uses of that land (e.g. obstruction of Obstacle Limitation Surfaces (OLS) or Procedures for Air Navigation Services – Aircraft Operations (PANS-Ops) surfaces obstructed)
		Navigation Aids	• Use/availability of navigational technology (e.g. Lighting, GNSS, ILS, ADS-B etc.) • Ability to install and upgrade navigational technology
		Airspace	• Airspace classification (i.e. Class A to G), control and restrictions (e.g. Defence zones) • Infrastructure in place to control airspace • Technology in place to control airspace
5	**Regulation**	**Regulation**	• Expansion approval requirements/processes/hurdles

Source: State Growth Outlook Analysis

Perth Area Airports Snapshot



Relative rating of factors constraining capacity at airports

Constraining Factor	Perth Area Airports				
	Perth (1)*	Perth (2)*	Bunbury	Busselton	Jandakot
Airspace	High	High	Low	Low	High
Surrounding Environment	Medium	Medium	High	Medium	High
Runway	High	Low	High	Medium	High
Apron and Taxiway	Low	Low	High	Medium	High
Terminal Building	Low	Low	High	Medium	High
Navigation Aids	Medium	Low	Low	Low	Low
Airport Services	Medium	Medium	High	Medium	High
Regulation	Medium	High	Medium	High	High

Key:

H	Future increase in capacity difficult to manage OR limited strategic plans, operational plans or capability exists to address or manage future increase in capacity.
M	Future increase in capacity can be appropriately managed OR future work is planned to address or manage future increase in capacity.
L	Future increase in capacity is unlikely to be an issue OR work in progress or due to commence in the near future to address or manage future increase in capacity.

Note: *Perth (1) relates to the (current) set of constraints without a third parallel runway. Perth (2) observes the constraints in the scenario of an additional third runway.
Source: State Growth Outlook research and interviews

Regional Airports Snapshot

Relative rating of factors constraining capacity at airports

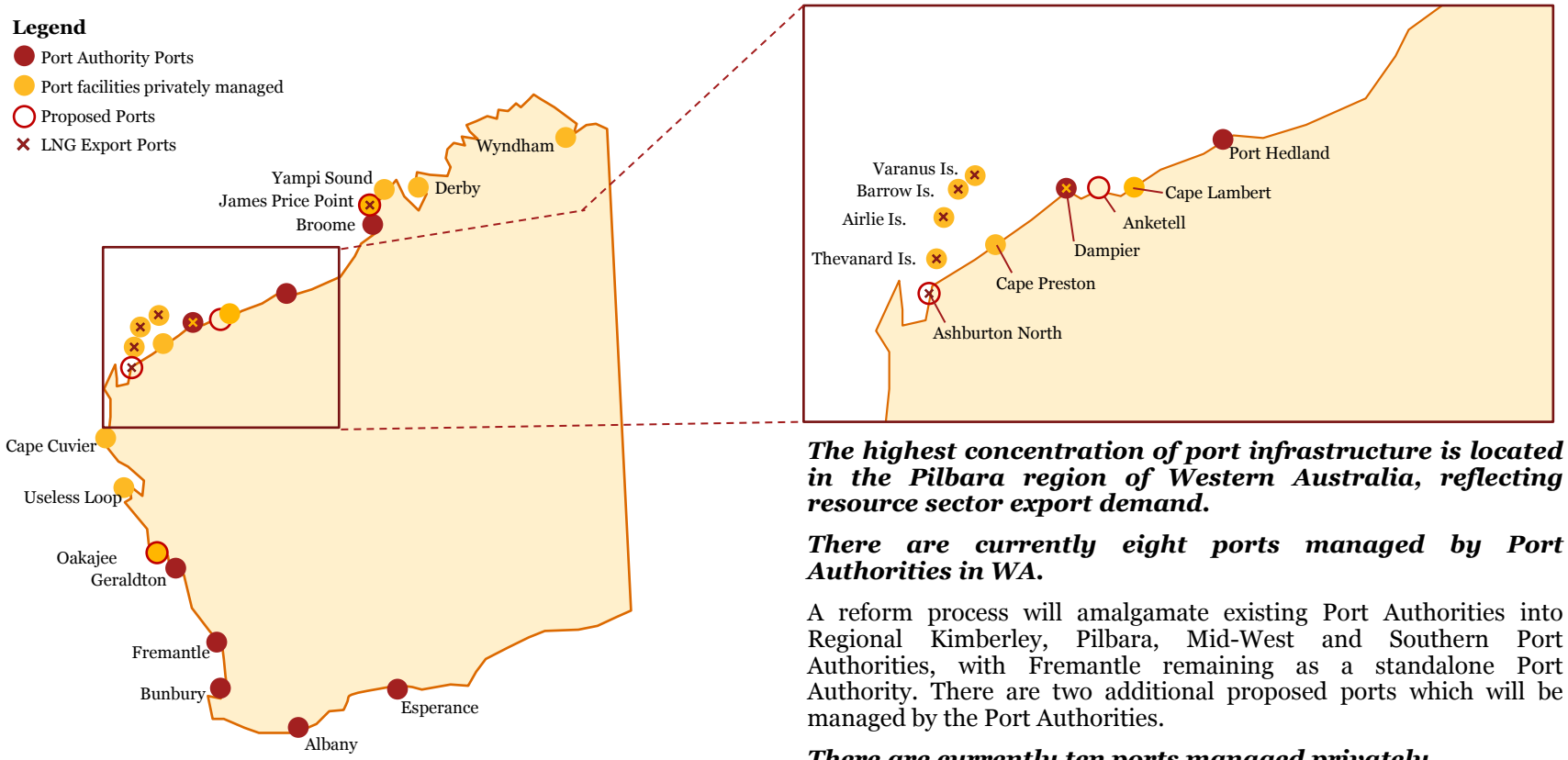
Constraining Factor	Regional Area Airports					
	Karratha	Port Hedland	Newman	Broome	Geraldton	Kalgoorlie
Airspace	Low	Medium	Medium	Medium	Medium	Low
Surrounding Environment	Low	Low	Medium	Medium	Low	Low
Runway	Low	Medium	Low	Low	Medium	Low
Apron and Taxiway	Low	Medium	High	High	High	Low
Terminal Building	Medium	High	High	Medium	Medium	High
Navigation Aids	Low	Medium	Low	Low	Medium	Medium
Airport Services	Low	Medium	Low	Low	Low	Medium
Regulation	Low	Medium	Medium	Medium	Low	Medium

Key:

H	Future increase in capacity difficult to manage OR limited plans or capability exists to address or manage future capacity increases.
M	Future increase in capacity can be appropriately managed OR work is planned to address or manage future capacity increases.
L	Future increase in capacity is unlikely to be an issue OR work in-progress or to commence in the near future to address or manage future capacity increases

Source: Karratha Airport Master Plan(2009); Port Hedland Master Plan (2011); Port Hedland Land Use Master Plan (2007); Shire of East Pilbara Annual Report (2010 2011); Broome Airport Master Plan (2012); CASA Geraldton Airspace Review (2009); Geraldton Airport Master Plan (2011); PwC Interviews (Sep 2012)

Western Australian Ports



The highest concentration of port infrastructure is located in the Pilbara region of Western Australia, reflecting resource sector export demand.

There are currently eight ports managed by Port Authorities in WA.

A reform process will amalgamate existing Port Authorities into Regional Kimberley, Pilbara, Mid-West and Southern Port Authorities, with Fremantle remaining as a standalone Port Authority. There are two additional proposed ports which will be managed by the Port Authorities.

There are currently ten ports managed privately.

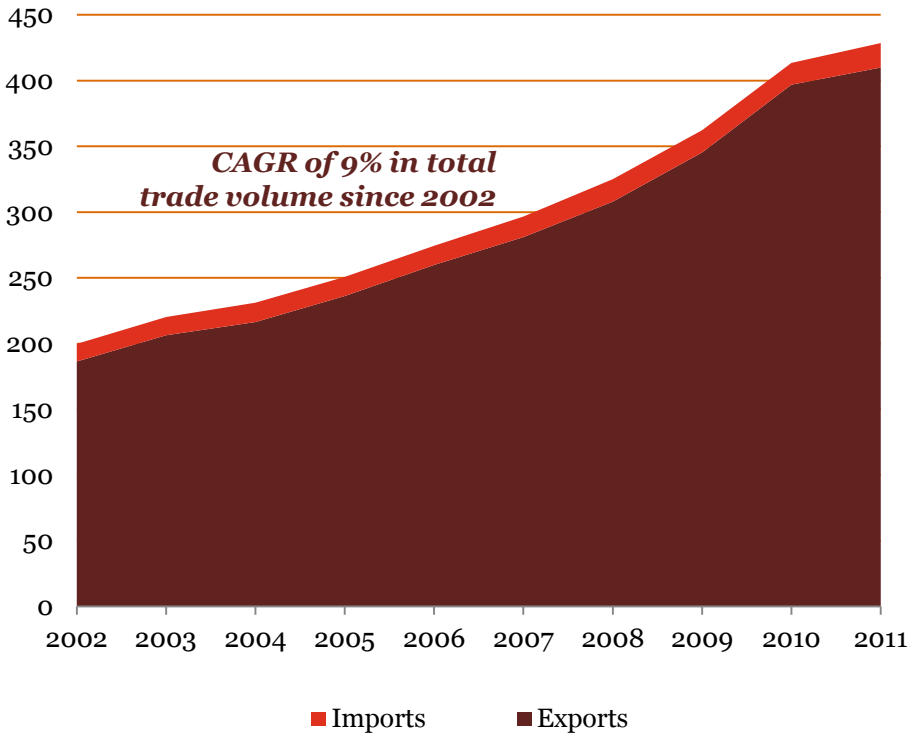
There are two additional proposed ports which will be managed privately. Regulatory change will bring all WA ports under the control of Port Authorities, however the operations of private ports are likely to remain with current proponents.

Source: WA Ports Handbook (2011); A Vision for Western Australia's Ports (2012)

Trade volume at Port Authority Ports

Port Authority Ports – Total Trade Volumes

Trade Throughput (Million tonnes)



Total trade volume through Port Authority ports has more than doubled from 200 Mt in 2002 to 428 Mt in 2011.

This growth is almost entirely driven by export volumes.

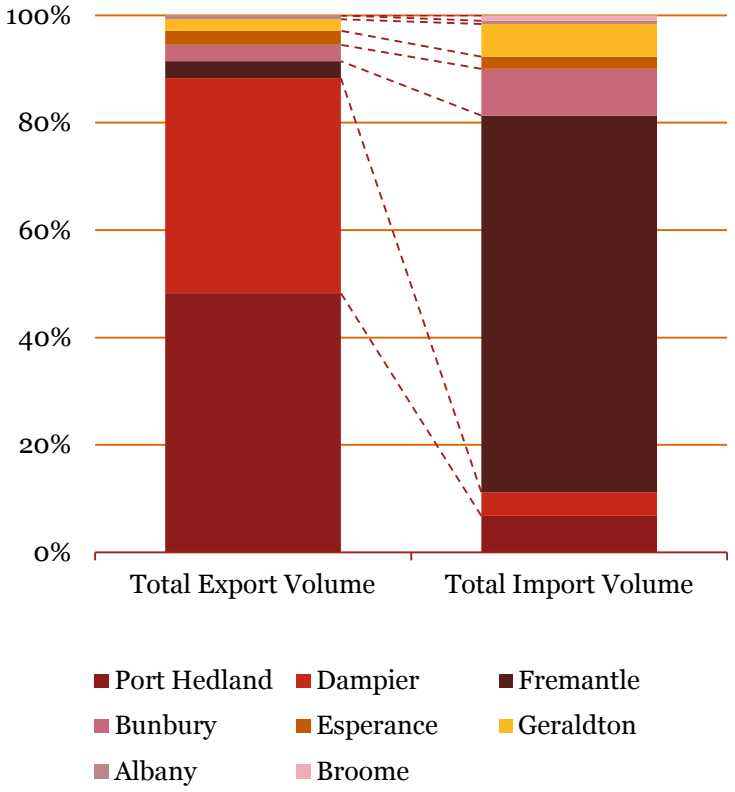
Export volumes grew at an average of around 9% p.a. from 2002 to 2011, while import volumes grew at around 4% p.a.

Source: WA Ports Handbook (2011)

Western Australian Port Activity at Port Authority Ports

WA Port Authorities – Share of Trade Volume by Port

Percentage of Total Trade Throughput (by tonnes)



Port Hedland and Dampier are the dominant export ports, together accounting for nearly 90% of export volume. Fremantle accounts for around 70% of Western Australian imports by volume.

The dominant export task at Port Hedland and Dampier is iron ore. Dampier also exports significant quantities of LNG.

Despite accounting for around 70% of the State's imports, the Port of Fremantle is not primarily an import facility. Import and export volumes at the Port of Fremantle were almost equal in 2011, and export volumes are often larger.

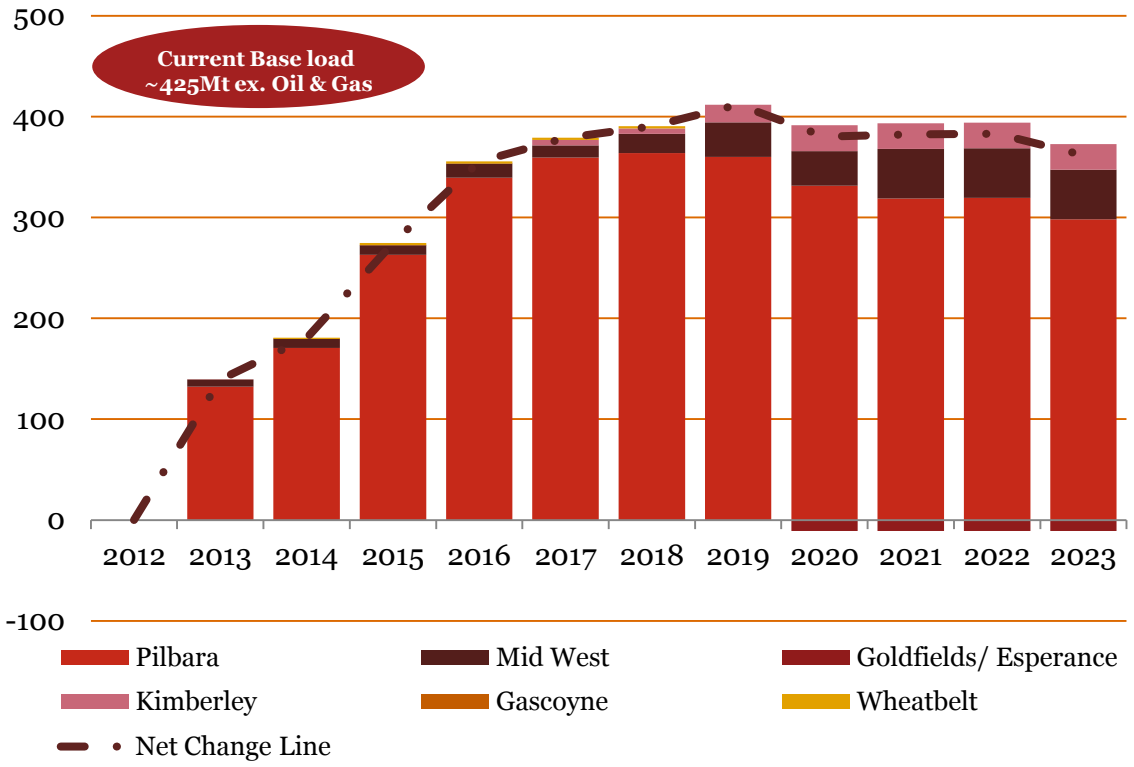
Fremantle's largest import volumes are from crude petroleum, containerised freight and bulk products such as cement clinker, caustic soda and phosphates.

Fremantle's largest export volumes are refined petroleum, containerised freight and bulk wheat and alumina.

Source: WA Ports Handbook (2011); Fremantle Port Authority Annual Report

Port Usage By Region

Port Usage by Mining and Energy companies
(Incremental Tonnes, 2012 – 2025, millions)



The Pilbara will represent between 80-95% of the new trade volume handled by WA ports.

Oil and Gas exports will be handled primarily at single-user terminals.

Port expansions and/or increased utilisation at Dampier, Barrow Island, Ashburton North, Varanus Island and Thevanard Island are expected to support increasing oil and gas output.

1. Includes oil and gas equivalent tonnes for those projects who submitted data

Source: State Growth Outlook Survey

Western Australian Port Infrastructure Development

Development of Western Australian port infrastructure is primarily aimed at supporting the iron ore industry with a potential $25bn of expenditure to create over 460mt/a of additional capacity.

Port Name/Location	Capital Expenditure	Primary Commodity	Expected capacity (Mtpa)	Date of Completion
Cape Lambert Port Expansion	$3.3bn	Iron Ore	133	2015
Anketell Port Facility	$7.0bn	Iron Ore	115	n.a
NWIOA Port Hedland	$2.7bn	Iron Ore	50	2014
Oakajee Port	$4.4bn	Iron Ore	45	n.a
Esperance Multi-User Facility	$300m	Iron Ore	20	2013
Port Hedland Expansion[1]	$7.5bn	Iron Ore	150	n.a
Albany Port	$300m	Iron Ore	11	n.a
Ashburton North	-	LNG - Wheatstone	50	2016
James Price Point	-	LNG - Woodside	50	2015
Lumsden Point	-	Various Imports	-	n.a

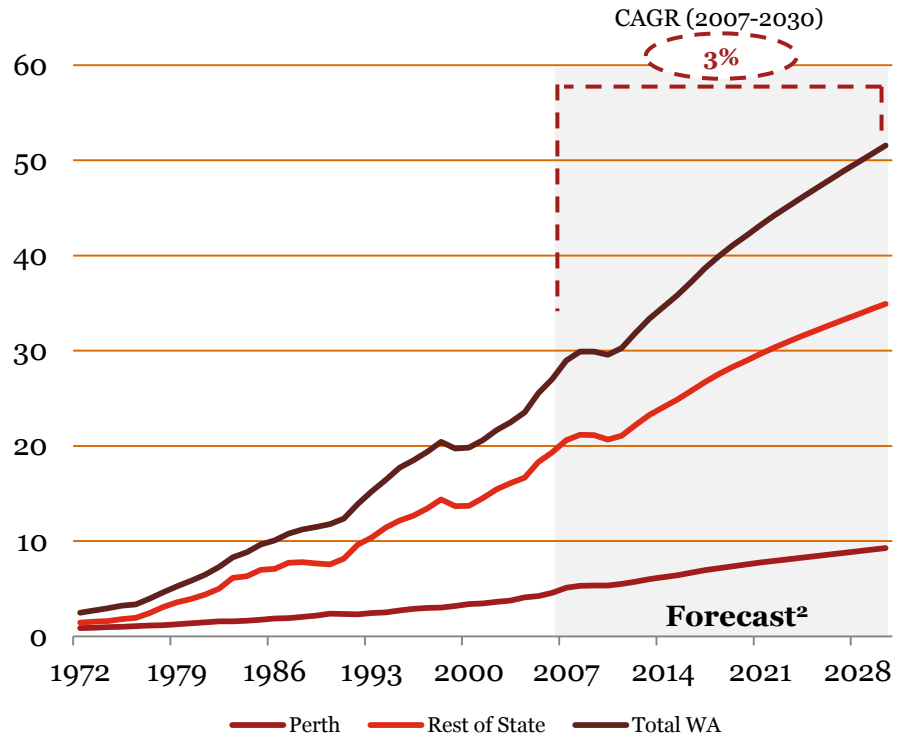
1. Composite values of BHP (2 berths), Roy Hill (2 berths) and FMG (1 berth) Port Hedland expansion projects. Assumptions per berth – 30Mt/a and $1.5bn capital expenditure.

Source: WA Ports Handbook (2011); ABARES' list of major minerals and energy projects (2011); Dampier Port Authority; DSD - Kimberley LNG Precinct Scope of the Strategic Assessment; EPA - Anketell Port PER; Various media releases and press reports

Western Australia Road Freight Demand Outlook

Road Freight Estimates and Forecasts

Western Australia, 1972-2030 (billion tkm[1])



BITRE's outlook for road freight in WA is for growth at an average CAGR of 3% to 2030.

BITRE's overall outlook was published in 2010, based on 2007 data, meaning that the forecasts are potentially outdated.

Further information is likely to be made available following the release of the Regional Freight Transport Network Plan.

Government is currently considering the Western Australian Regional Freight Transport Network Plan, which includes forecasts of the freight task for key corridors.

1. tkm = Tonne Kilometres. One tkm reflects one tonne hauled over one kilometre.
2. Forecast year begins in 2008.

Source: BITRE estimates (http://www.bitre.gov.au/publications/2010/files/report_121.pdf)

Resource Sector Road Use – Key Challenges

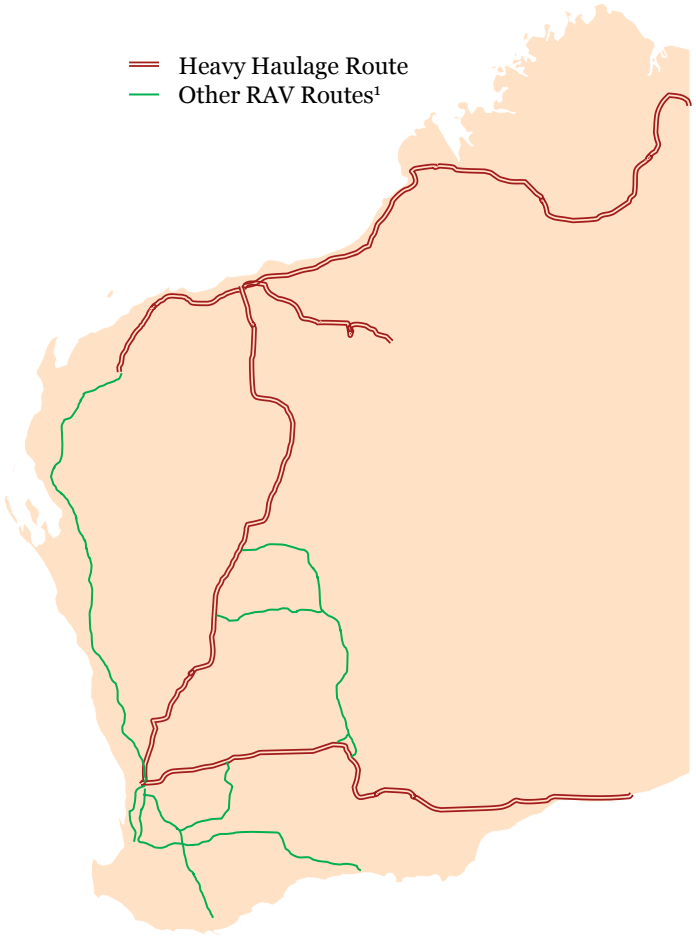
Drivers of Resource Sector Road Use

- Transport of mine output
- Transport of Supplies (Primarily Fuel and Spares)
- Transport of Workers
- Transport of Heavy Equipment

Interviews for the State Growth Outlook indicated that transport of heavy equipment and construction materials by road was a challenging issue for mining and energy companies, Main Roads and the Department of Transport.

Oversize/overmass loads require permits in order to travel on public roads. The demand for permits has been increasing rapidly, and is expected to increase further with increases in the scale of mining operations and increases in the average size of mining equipment and construction modules.

Oversize/Overmass Load Corridors



1. RAV is defined as Restricted Access Vehicle

Source: Main Roads (HVO); Department of Transport

Oversize/overmass loads present a challenge to the State's road network.

Oversize and/or oversize vehicles frequently weigh up to 1000 tonnes and are often in excess of 8 metres high and wide.

Changes in the design of mining equipment are leading to increasingly large loads being transported. The increasing scale of mining operations is creating a need for more frequent oversize loads.

The Great Northern Highway is the most common route for oversize/overmass loads travelling to the Pilbara.

There is also scope to use Victoria Highway and the Great Eastern Highway for some projects and/or special requirements.

The Department of Transport and Main Roads are working to improve the quality of roads and the permit process.

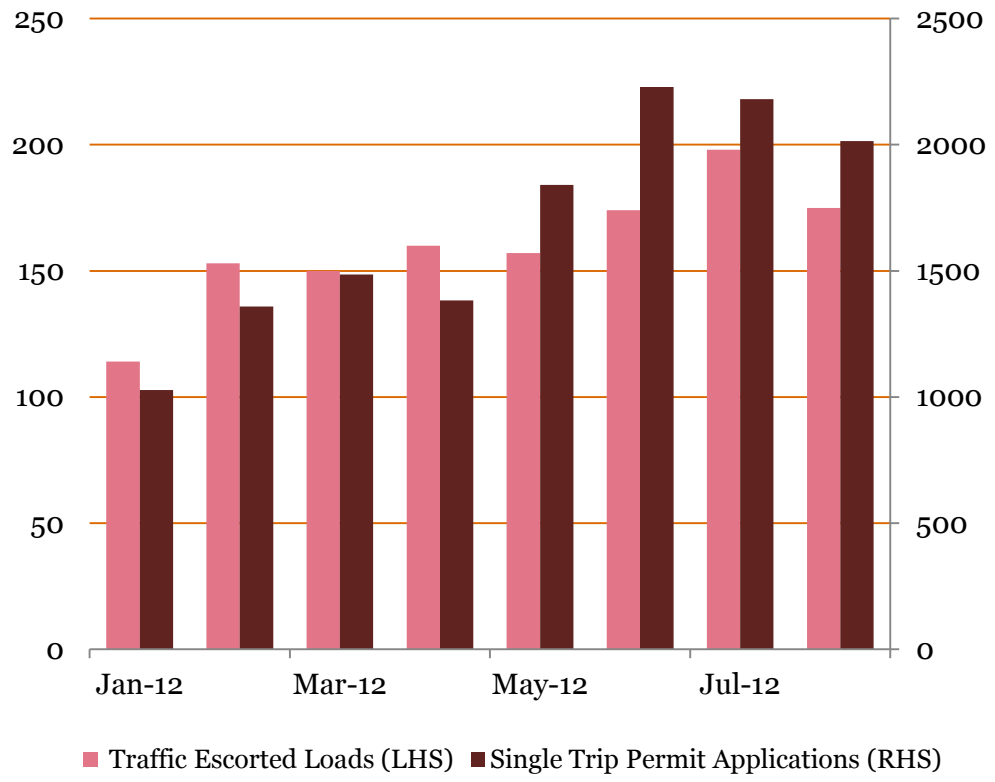
Critical issues include widening of roads; removing structural blocks to high loads (for example adjusting bridge designs and sinking power lines); and upgrading Onslow Road, off the North-West Coastal Highway, which is used to serve many Oil and Gas projects.

Government is currently considering the Regional Freight Transport Network Plan, which includes a review of investment priorities across the State's public road network.

Oversize/Overmass Permits

Oversize Overmass Trips in WA

2012 (# of escorts LHS; permit applications RHS)



Oversize/overmass permits can be granted either for single trips or on a periodic basis.

Single use permits are typically used for construction activity. Periodic permits are often used for routine tasks, such as moving heavy equipment between mining sites and Perth when maintenance is required.

Main Roads has experienced rapid growth in applications for permits.

Rapid growth in mining and energy activity has led to a corresponding increase in heavy vehicle traffic. This has led to the establishment of a "one stop shop" within Main Roads that can handle permit applications taking into account the requirements of Main Roads, WA Police and utility service providers.

Source: Main Roads HVO September 2012

Roads – Key Themes for Future Investment

Pilbara

Connectivity

- The majority of minerals and energy growth will be within the Pilbara. While the main arterial connections are built, expansion plans will require an emphasis on the issue of connectivity within the Pilbara.
- An additional focus area will be the management of oversize-overmass vehicles and along key routes between Perth and the Pilbara, and between Port Hedland Port and project sites.

Kimberley

Quality

- Minerals and Energy demand growth in the Kimberley region is primarily to support offshore energy projects. The support services to support these projects will drive freight growth.
- The Kimberley's geography and weather present reliability as a major challenge. A key investment theme is therefore increasing the availability of roads and reducing susceptibility to flooding.

South West

Community

- The South West will continue to support the vast majority of WA's population.
- Along with population growth, and corresponding passenger and freight traffic, mining and energy developments in the South West add heavy vehicles to the roadways.
- Safety and community considerations will drive an emphasis on separating heavy vehicles from residential areas and passenger vehicles, for example through bypasses and dual carriageways.

Other

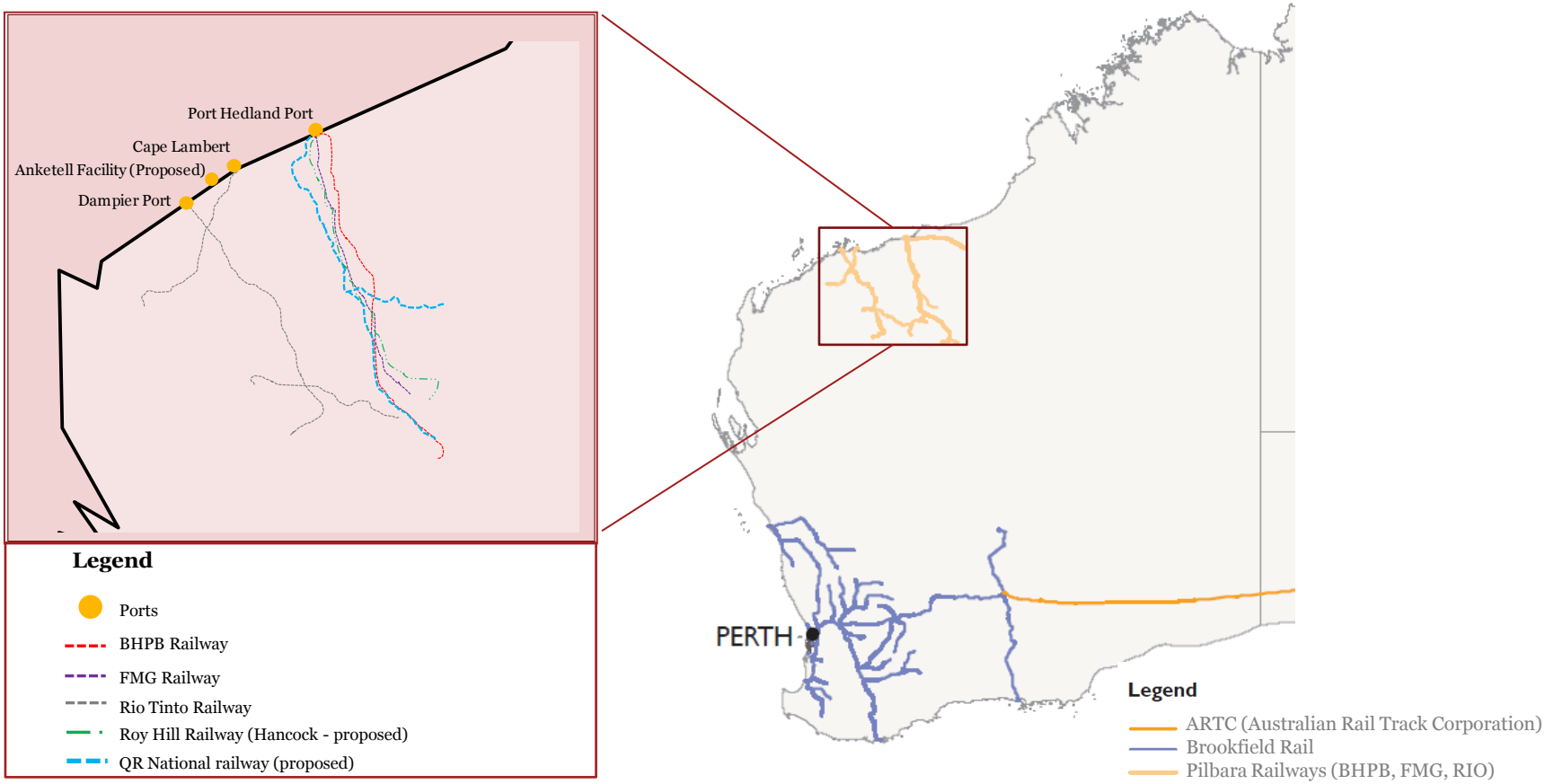
Renewal and Key Corridor planning

- In the Wheatbelt, Goldfields-Esperance and Great Southern road traffic growth will be more incremental. Key challenges will relate to managing this growth and the need for significant renewal of ageing road networks.
- Planning for growth in key access corridors around major Ports is a pressing issue given the overlap between freight and residential road networks.

Source: Department of Transport; State Growth Outlook Analysis

WA's Rail Network

The majority of WA's rail network is managed by Brookfield Rail with the exception of privately-owned Pilbara railways.



Source: BITRE; Brookfield Rail Website

Rail – Key Themes for Future Investment

South West	• In the South West region, much of the growth will be driven by alumina, coal and industrial downstream processing exports destined for the ports of Bunbury and Kwinana. • Future growth on the Collie to Bunbury rail line may require capacity upgrades. • Demand for rail from the Yilgarn iron ore region is expected to result in some tonnages directed to the Port of Fremantle's Outer Harbour at Kwinana.
Goldfields - Esperance	• Iron ore demand is forecast to increase significantly from approximately 20% of total rail demand to more than 40% of total demand by 2030. • Growth will be concentrated on the interstate mainline east of Koolyanobbing and the line from Kalgoorlie to Esperance, originating from the emerging Yilgarn province. • Future growth on the Leonora to Esperance Line will necessitate capacity upgrades.
Mid West	• Greater capacity is likely to be required in the Brookfield network in the Mid-West. • Coordinated corridor planning is a key issue. Interoperability between the existing rail network and the proposed Oakajee Mid West Development Project appears to be a significant opportunity.
Pilbara	• The potential for new rail lines implies the need for careful corridor planning to ensure that appropriate land is reserved, and that any new rail lines can efficiently interface with ports. • Increased rail traffic may necessitate grade separations at heavily trafficked level crossings to mitigate conflicts with the region's road network.

Source: Department of Transport; State Growth Outlook Analysis

WA's Rail Network

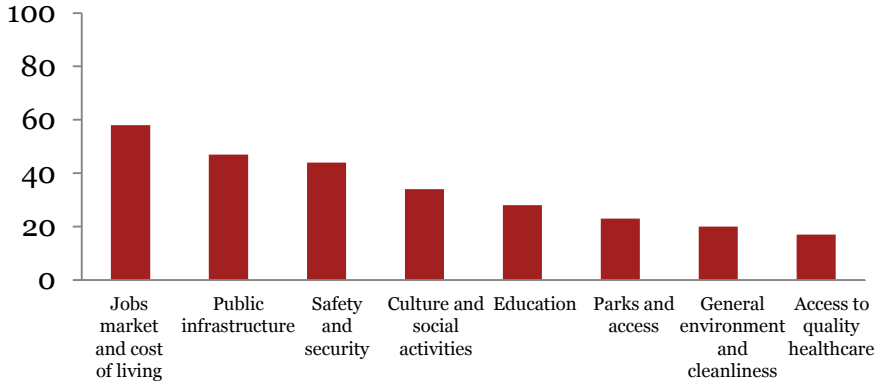
Existing Rail Lines	Usage Rights	Destination/link	Length (km)	Comments
BHP Billiton Pilbara Rail	Private	Port Hedland - Newman - Yarrie	634	Further expansions are expected.
Rio Tinto Pilbara Rail	Private	Dampier Port, Cape Lambert	1400	Rio Tinto operates the first fully autonomous Australian iron ore private network.
FMG Pilbara Rail	Private	Port Hedland - Cloudbreak	250	Further expansions are expected.
Brookfield Rail	Public	Mix of narrow, standard and dual gauge networks from the Mid-West to Esperance (See map for more details).	>5000	Brookfield has completed upgrades on the Kalgoorlie to Esperance line and is continuing with upgrades to the grain network.
ARTC	Public	Kalgoorlie-Sydney	900	-

Proposed Rail Lines	Usage Rights	Destination/link	Length (km)	Comments
Roy Hill Pilbara Rail	Private	Port Hedland – Roy Hill	342	
QR Pilbara Independent Rail	Public	Port Hedland – Central Pilbara	-	Atlas, QR National and Brockman Resources currently performing feasibility studies.
API / Aquila	Private	Anketell port – West Pilbara Iron Ore Project.	282	Potential to team up with FMGs Solomon line to Anketell Port.
Oakajee Port / Geraldton Port lines	Public	Oakajee Port – Mid West iron ore	570	Brookfield Rail has completed a rebuild of approx. 190km of rail infrastructure from Tilley to Geraldton. A new Port at Oakajee would be accompanied by a new rail link from key iron ore developments.

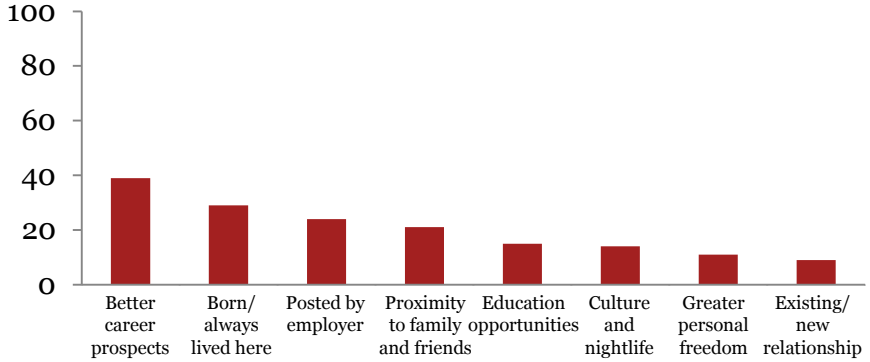
Source: Company Websites; State Growth Outlook Analysis; PwC Analysis

Liveability Factors

Top 3 factors making a city an attractive place to live and work (% who rated in top 3)



Top 3 motivations in coming to your city
(% who rated in top 3)



Perth is competing for internationally mobile, highly skilled minerals and energy workers. These workers are able to choose from a wide range of international resource hubs.

Many of WA's largest employers are international mining and energy companies who seek to attract and retain talented staff from around the world. The attractiveness of Perth as a city in which to live and work is a key determinant of the sector's ability to grow.

Career factors are the major motivator to ensuring a city is an attractive place to live in and/or move to. Safety, culture, education and public infrastructure also play a role.

While Perth is rated in the top 10 cities in the Economist's Liveability Report, it trails the top city (Melbourne) in the Culture & Environment category, and scores below the maximum for stability.

The challenge for Perth to remain in the Top 10 is to improve on the culture and environment dimension, for example, by increasing the number and variety of cultural activities and range of hospitality. The incidence of crime also presents an opportunity for improvement.

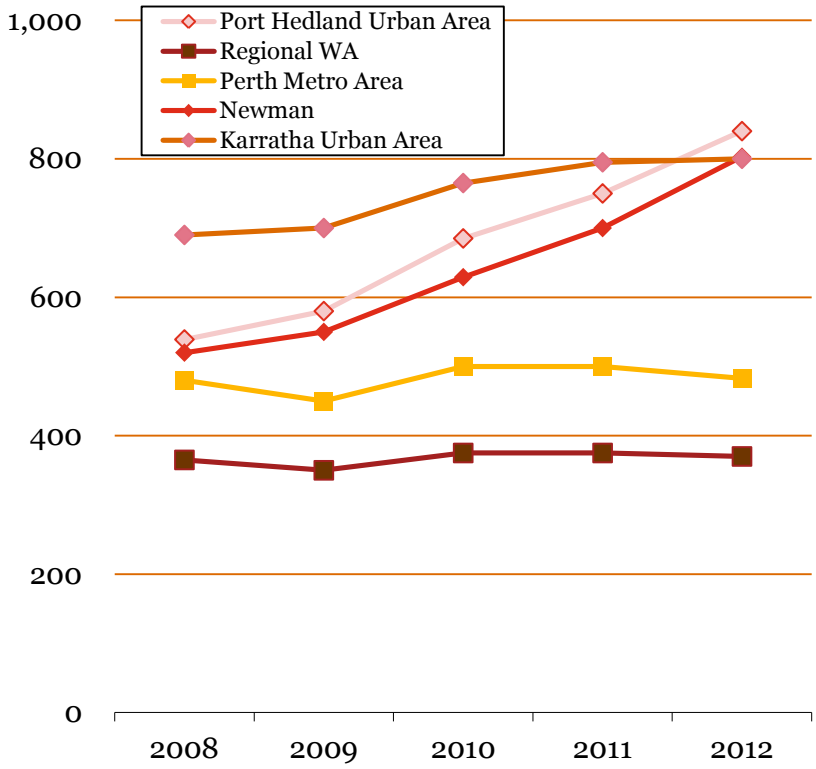
1. Survey results based on 575 urban professional respondents around the world. Asia-Pacific (30%), North America (30%), Western Europe, Rest of the world (10%).

Source: The Economist, Economist Intelligence Unit, *Liveable cities*, Nov 2010; *Global Liveability Report* 2012 and *Global Liveability Report* 2011.

Accommodation Costs In The Pilbara

Median House Prices 2008-2012

$000s



The ability to attract and retain a residential workforce in regional WA depends in part on the cost of living and amenity in key regional centres.

The selection of a workforce model (residential vs fly-in, fly-out) depends in large part on the preferences of workers and the costs of housing a residential workforce.

A mismatch between demand and supply of land has resulted in Pilbara property prices and rents increasing significantly.

Housing prices in the Pilbara are significantly higher than Perth. This pattern is replicated in rental prices, where average weekly rent for a one bedroom house exceeds $1200 in Port Hedland and Karratha, compared to around $350 in Perth.

Source: REIWA Regional Town and Centre profiles

Liveability of the Pilbara

Community Infrastructure – Key Objectives (Pilbara Planning and Infrastructure Framework)

Area	Objectives
General	Provide a comprehensive range of accessible community, cultural, and recreational facilities and services commensurate with growing resident and fly-in fly-out population levels and taking into account the region's remoteness and the distance between its settlements.
Health	Provide a comprehensive range of accessible health services and support facilities.
Education	Provide a comprehensive range of accessible education services and support facilities.
Recreation	Provide active and passive public open space and built facilities for formal and informal sport and recreation to enable community activity and healthier life styles.
Entertainment and Culture	Provide a comprehensive range of entertainment and cultural facilities throughout the region.

Community infrastructure is an important component of the liveability of the Pilbara.

The Pilbara Planning and Infrastructure Framework identifies key priorities in the areas of health, education, recreation and entertainment and culture.

The provision of a full range of community infrastructure in the Pilbara is challenging given the population of key towns, the geographic dispersion of the Pilbara's population and the region's remoteness.

Source: Pilbara Planning and Infrastructure Framework (January 2012), Department of Planning

6.3 Implications and Opportunities

6.3.1 Economic infrastructure

6.3.2 Social infrastructure

There is a bottleneck at Perth Airport during peak hours. Current traffic patterns reflect shift patterns designed around best practices in safety, fatigue management and operational efficiency. For this reason, flying outside of current peak hours is expensive for resource companies.

Perth Airport regularly reaches capacity during peak weekday morning and afternoon periods. These peaks reflect flight times preferred by the minerals and energy sector, based on target shift patterns.

Flying outside of peak hours is costly for resource companies, as it requires them to move away from preferred shift patterns, increasing safety and fatigue management challenges, as well as increasing operational costs.

Dealing with the peak capacity problem at Perth Airport requires shifting some traffic outside of the peak, or capacity expansion through improving efficiency of existing infrastructure or through an additional runway.

There is no easy, costless solution to the current bottleneck. Additional infrastructure at Perth Airport would be costly, and take several years to construct. Shifting flight times, as explained above, is also expensive.

Bulk mineral export facilities are operating at capacity. There is not yet a clear pathway to delivering new port facilities at Anketell, Oakajee and Esperance. These developments are required to facilitate resource developments in the Pilbara, Yilgarn and Mid West.

While there is capacity to increase vessel movements at WA's bulk ports, at present bulk export terminals are fully utilised.

Additional capacity is required. While some projects are underway, others (particularly for multiple users) have yet to clearly identify detailed plans for funding and approval.

Production growth plans rely on successfully executing infrastructure plans.

Production growth plans identified within this study rely on the availability of suitable infrastructure. Without those enabling investments, many projects will not be able to proceed as planned.

The Regional Freight Transport Network Plan will evaluate investments in key corridors to address the increasing number of oversize loads. Improved port facilities in the Pilbara are essential to facilitate a move from road transport to coastal shipping for some loads.

The Department of Transport has engaged in a detailed process to identify future freight demand and to contrast this demand with the current capability of public road and rail networks. This allows a prioritisation of investment into initiatives that address the most pressing challenges for the freight network. The plan is currently being considered by Government.

The movement of heavy equipment and construction supplies by road between Perth and the Pilbara presents increasing challenges for the safety and maintenance of the road network. Improved port facilities in the Pilbara would assist to remove some of this traffic from the road network by encouraging coastal shipping between Fremantle and the Pilbara.

Continued growth in exports will require additional rail capacity, and the protection of rail corridors for future growth.

There will be a need for increased rail capacity throughout the State. Some of this will come in the form of new rail lines, and some by expanding the capacity of existing lines through additional tracks, passing loops, level crossings and signalling upgrades.

A common feature of rail capacity expansions is the need for additional land, including access to ports. Preserving growth options in key corridors should therefore be a focus of the State's planning.

Perth is competing for internationally mobile, highly skilled minerals and energy workers. These workers are able to choose from a wide range of international resource hubs.

Many of WA's largest employers are international mining and energy companies who seek to attract and retain talented staff from around the world. The attractiveness of Perth as a city in which to live and work is a key determinant of the sector's ability to grow.

While Perth scores well on many liveability factors, a focus should remain on culture, safety and retaining Perth's unique strengths.

Perth is routinely rated amongst the world's most liveable cities. Against Australian and international peers, Perth struggles most with ratings relating to culture, hospitality and perceptions of safety.

To retain its strong ranking, Perth should retain a focus on expanding the quality and range of cultural activities and hospitality on offer.

Housing affordability and town amenity are critical enablers to maintaining a residential operational workforce. Housing costs in mining communities continue to be significantly higher than Perth.

A larger residential workforce in mining regions requires both that the regions are able to support increased population, and that the workforce is willing to relocate.

At present a major barrier to the liveability of many mining communities is the shortage of housing, and consequential high costs of living.

The liveability of mining towns in terms of access to quality health and education services, town amenities and a diverse "full service" local economy is also a challenge.

Section Seven

Appendix

7.0 Appendix

7.1 Glossary

7.2 Methodology

7 Appendix – 7.1 Glossary

Use of Acronyms

Acronym	Original Phrase
ABS	Australian Bureau of Statistics
CME	Chamber of Minerals and Energy of Western Australia
CAGR	Compound Annual Growth Rate
FIFO	Fly-in-fly-out
IMO	Independent Market Operator
LNG	Liquefied Natural Gas
NWIS	North West Interconnected System
NWS	North West Shelf
SWIS	South West Interconnected System
WAPC	Western Australian Planning Commission

Overall Study Methodology

The objectives of the study were to:

- Develop a demand outlook for the key growth enablers: people; energy; water; social infrastructure; and hard infrastructure capacity and identify potential demand/supply gaps;
- Provide a basis for identifying potential implications arising from current growth plans; and
- Provide valuable input into industry and government planning and to better position industry and government to capture opportunities from WA's growth.

Demand for the key growth enablers is expected to be driven by planned minerals and energy sector investments. The demand side data was sourced directly from the participating companies and focused on labour, energy, water, social infrastructure and hard infrastructure capacity requirements for each of their planned and relevant current projects through to 2025.

To supplement publicly available information on non-surveyed projects, the data points were then used to infer the demands for the non-surveyed projects to develop outlooks for all current planned projects for the State as of June 2012.

Only projects that had reached the stage of a preliminary feasibility study (PFS) were included in the study. For this reason, the majority of projects identified intend to enter construction within the next five years, and there are relatively few projects entering construction in the later part of the survey period. There is the potential for new projects, which are not currently at PFS stage, to enter construction by 2025.

Supply side information was sourced from relevant government agencies and private industry. Analysis was then conducted on the quantum of key growth outputs for both supply and demand and also on a more granular level where required. The final study output examined the supply and demand outlook through 2023 and the identification of any gaps.

Five reference groups were consulted throughout the project to: validate data quality; identify implications and opportunities; and to ensure alignment with objectives. These reference groups (CME People Strategies Committee, CME Energy Reference Group, CME Water Issues Group, CME Infrastructure Committee and a Project Reference Group) comprised industry and government representatives, ensuring adequate representation of key stakeholders.

Details of the methodology are provided in the following pages.

Data Survey (1 of 9) – Project Data Sheet

Project Data Sheet

Project Name	Insert project name here
Principal Commodity	-
Project Status	-
Expected Capex A$	-

Production Data

Material	Description	Units		2012	2013	2014	2015
Annual Production	Total material mined / extracted	**Please select**					
	Please specify product one (e.g. iron ore, gold, oil, condensate, gas etc.)	**Please select**					
	Please specify product one (e.g. iron ore, gold, oil, condensate, gas etc.)	**Please select**					
	Please specify product one (e.g. iron ore, gold, oil, condensate, gas etc.)	**Please select**					
	Please specify product one (e.g. iron ore, gold, oil, condensate, gas etc.)	**Please select**					

Note: All data points collected out to 2025 (where applicable).

Source: State Growth Outlook

Data Survey (2 of 9) – People Data – Construction Workforce

People Data

Construction Workforce

Resource	Description	Units		2012	2013	2014	2015
Total Construction Workers (Direct & Contractors)	Total Workers (Direct and Contract)	**Headcount**					
	Managers & Supervisors (if available) e.g. Site Manager, Superintendents, Foreman,						
	Professionals (if available) e.g. Engineers (Mining, Civil, Chemical, Process,						
	Associate Professionals (if available) e.g. Safety Advisers, Ventilation Officers,						
	Tradespersons & Maintenance (if available) e.g. Boilermaker, Auto Electrician, Welder, Fitter,						
	Operators (if available) e.g. Mobile Plant Operators						
	Labourers (if available)						
	Apprentices & Trainees (if available) e.g. Trades Apprentices, Trainee - mine and process operators						
Direct Construction Workers	Local Resident	**Headcount**					
	FIFO Shift Pattern One		Please select shift pattern				
	FIFO Shift Pattern Two (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Three (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Four (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Five (if applicable)		Please select shift pattern				
Contract Construction Workers (where known)	Local Resident	**Headcount**					
	FIFO Shift Pattern One		Please select shift pattern				
	FIFO Shift Pattern Two (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Three (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Four (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Five (if applicable)		Please select shift pattern				
Source of FIFO Construction Employees	Gascoyne	**% of FIFO**					
	Goldfields - Esperance						
	Great Southern/South West						
	Kimberley						
	Mid West						
	Perth/Peel						
	Pilbara						
	Wheatbelt						
	New South Wales						
	Victoria						
	South Australia						
	Queensland						
	Other Interstate (Please Specify)						
	International (please specify countries if known)						

Note: All data points collected out to 2025 (where applicable).

Source: State Growth Outlook

Data Survey (3 of 9) – People Data – Operations Workforce and General

Operations Workforce							
Resource	**Description**	**Units**		**2012**	**2013**	**2014**	**2015**
Total Operations Workers (Direct & Contractors)	Total Workers (Direct and Contract)	**Headcount**					
	Managers & Supervisors (if available) e.g. Site Manager, Superintendents, Foreman,						
	Professionals (if available) e.g. Engineers (Mining, Civil, Chemical, Process,						
	Associate Professionals (if available) e.g. Safety Advisers, Ventilation Officers,						
	Tradespersons & Maintenance (if available) e.g. Boilermaker, Auto Electrician, Welder, Fitter,						
	Operators (if available) e.g. Mobile Plant Operators						
	Labourers (if available)						
	Apprentices & Trainees (if available) e.g. Trades Apprentices, Trainee - mine and process operators						
Direct Operations WorkersWorkers	Local Resident	**Headcount**					
	FIFO Shift Pattern One		Please select shift pattern				
	FIFO Shift Pattern Two (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Three (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Four (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Five (if applicable)		Please select shift pattern				
Contract Operations Workers (where known)	Local Resident	**Headcount**					
	FIFO Shift Pattern One		Please select shift pattern				
	FIFO Shift Pattern Two (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Three (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Four (if applicable)		Please select shift pattern				
	FIFO Shift Pattern Five (if applicable)		Please select shift pattern				
Source of FIFO Operations Employees	Gascoyne	**% of FIFO**					
	Goldfields - Esperance						
	Great Southern/South West						
	Kimberley						
	Mid West						
	Perth/Peel						
	Pilbara						
	Wheatbelt						
	New South Wales						
	Victoria						
	South Australia						
	Queensland						
	Other Interstate (Please Specify)						
	International (please specify countries if known)						

General							
Resource	**Description**	**Units**		**2012**	**2013**	**2014**	**2015**
Company sponsored work visas	How many workers do you expect to bring into Australia on company sponsored visas in each year to support this project?	**Headcount**					

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (4 of 9) – Water Data

Water Data							
Resource	Description	Units		2012	2013	2014	2015
Sources							
Scheme Water/Third party water	Gross volume	**ML/a**					
Self Extracted Surface Water	Gross volume	**ML/a**					
Self Extracted Groundwater	Gross volume	**ML/a**					
Dewatering	Gross volume	**ML/a**					
Saline/Hyper-saline Water	Gross volume	**ML/a**					
Other Source (please specify)	Gross volume	**ML/a**					
Usage							
Total Water Usage	End use of water (if known)	**%**	Consumption/used in processing				
			Aquifer Reinjection				
			Discharge to Rivers/creeks				
			Supply to Third Parties				
			Other Consumptive				
			Other Non-Consumptive				

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (5 of 9) – Energy Data – Electricity

Energy Data							
Resource	Description	Units		2012	2013	2014	2015
Self Generated Electricity	Total Self Generated Electricity	MWh/a	Expected				
	Total Self Generated Electricity Sales	MWh/a	Sold to grid (eg. SWIS, Horizon, etc)				
			Sold directly to other third party				
	Source of Self Generated Electricity (if known)	%	Natural Gas				
			Diesel				
			Solar				
			Wind				
			Geothermal				
			Coal/Coke				
			Other (e.g. biomass)				
Purchased (grid) Electricity	Total Demand for Purchased Electricity	MWh/a	Grid Purchase (eg. SWIS, Horizon, etc)				
			Third party purchase				
	Source of Purchased Electricity (if known)	%	Natural Gas				
			Coal/Coke				
			Diesel				
			Solar				
			Wind				
			Geothermal				
			Other (e.g. biomass)				

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (6 of 9) – Energy Data – Other Energy

Natural Gas	Consumption from Distributed Supply	**GJ/a**					
	Purpose of Use	**%**	Mobile Plant				
			Electricity Generation				
			Industrial Process				
Diesel	Consumption	**ML/a**					
	Purpose of Use	**%**	Mobile Plant (incl. rail)				
			Electricity Generation				
			Industrial Process				
Coal	Consumption	**GJ/a**					
	Purpose of Use	**%**	Mobile Plant				
			Electricity Generation				
			Industrial Process				
Other Sources	*Please Specify Source in Comment Section*	**GJ/a**					
	Purpose of Use	**%**	Mobile Plant				
			Electricity Generation				
			Industrial Process				

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (7 of 9) – Port Data

Port Data							
Resource	Description	Units		2012	2013	2014	2015
Outbound freight	What level of outbound freight will be transported via a port each year?	T/a					
	Of this, what proportion will be transported through a common-access facility? (Please specify primary port where possible)	%	Please Select Port				
Inbound freight	What level of inbound freight will be landed by sea to support the project each year? (Port One)	T/a	Please Select Port				
	What level of inbound freight will be landed by sea to support the project each year? (Port Two)	T/a	Please Select Port				
	What level of inbound freight will be landed by sea to support the project each year? (Port Three)	T/a	Please Select Port				
	What level of inbound freight will be landed by sea to support the project each year? (Port Four)	T/a	Please Select Port				

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (8 of 9) – Air Transport Data

Air Transport Data							
Resource	Description	Units		2012	2013	2014	2015
Inbound Flights (to site)	What airfield do FIFO workers arrive at?		Please select Airfield				
	How many inbound flights do you charter per annum? (Please select airfield of departure - Case One)	Flights per annum	Please select Airfield				
	How many inbound flights do you charter per annum? (Please select airfield of departure - Case Two)	Flights per annum	Please select Airfield				
	How many inbound flights do you charter per annum? (Please select airfield of departure - Case Three)	Flights per annum	Please select Airfield				
	How many passenger slots are required on Regular Public Transport (RPT) flights from Perth each year?	Headcount per annum					
	How many passenger slots are required on Regular Public Transport (RPT) flights from origins other than Perth each year?	Headcount per annum					
Outbound Flights (frome site)	What airfield do FIFO workers depart from?		Please select Airfield				
	How many outbound flights do you charter per annum? (Please select destination airfield - Case One)	Flights per annum	Please select Airfield				
	How many outbound flights do you charter per annum? (Please select destination airfield - Case Two)	Flights per annum	Please select Airfield				
	How many outbound flights do you charter per annum? (Please select destination airfield - Case Three)	Flights per annum	Please select Airfield				
	How many passenger slots are required on Regular Public Transport (RPT) flights to Perth each year?	Headcount per annum					
	How many passenger slots are required on Regular Public Transport (RPT) flights to other destinations each year?	Headcount per annum					

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Data Survey (9 of 9) – Land Transport Data

Land Transport Data							
Construction							
Resource	**Description**	**Units**		**2012**	**2013**	**2014**	**2015**
Road based freight - Construction	What level of construction-related freight will you transport primarily via road each year?	**T/a**					
Oversize permits - Construction	How many construction-related loads do you expect to require an Oversize permit each year?	**Permits per annum**					
Rail based freight - Construction	What level of construction related freight will you transport primarily via rail each year?	**T/a**					
Operations							
Resource	**Description**	**Units**		**2012**	**2013**	**2014**	**2015**
Road based freight - Operations	What level of operational freight will you transport primarily via road each year?	**T/a**					
Oversize permits - Operations	How many operations-related loads do you expect to require an Oversize permit each year?	**Permits per annum**					
Rail based freight - Operations	What level of operational freight will you transport primarily via rail each year?	**T/a**					

Note: All data points collected out to 2020 (where applicable).

Source: State Growth Outlook

Definition of Regions

The eight key regions are:

- Kimberly
- Pilbara
- Gascoyne
- Midwest
- Wheatbelt
- Goldfields-Esperance
- Perth/Peel (combined)
- South West/Great Southern (combined)

Source: State Growth Outlook

Model Design Principles

An excel model was used to aggregate the raw data and provide a regional outlook for each of the growth enablers. The model was built based on the following principles:

- Incremental analysis: The model analysed the incremental changes in supply and demand, rather than absolute values, to eliminate potential errors arising from establishing baseline data. The demand outlook also includes projects that are expected to ramp/shut down during the period – it is adjusted based on an overlay of published end of life of mine for major existing operations in the State.
- Internal project economics accepted: Technical solutions to issues such as power supply (make vs. buy) and labour sourcing (FIFO vs. residential) will be documented as per current project assumptions, on the basis that the project owners have made rational decisions based on project economics i.e. the focus is on the 'business as usual' case.
- Time series data: Data was captured in the form of a time series, the time series has a 12 month resolution up to 2023.
- Probability weighted outlook: History has shown that not all announced projects will be realised and in order to account for this, an individual probability was applied to each project in the pool.

An individual probability weighting was determined for each project, with the weighted average realisation for all projects based on historic project realisation rate.

The project probability weighting was based on 3 sets of factors which affect project realisation:

- External factors: The consensus one-year growth forecast of the relevant commodity price;
- Company specific factors: The capital expenditure of the project relative to the market capitalisation of the company, and whether the company has other projects in operation; and
- Project specific factors: The current status of the project and time to construction.

Note: projects under construction or in operation were assigned a probability of 1.

The aggregate probability-weighting was normalised to be in line with historic outcomes. (From 2003-2008, ~75%[1] of DOIR (now DMP) announced projects have either been developed or are currently being commissioned.)

1. Based on analysis of Prospect Data, *Prospect Magazine*, DMP and DSD 2003-2008

Non-surveyed Data (1 of 2)

Publicly available information, taken from project feasibility studies, public environmental reviews and other company announcements were used to populate the required data points for projects not directly surveyed. When this information was not available, a multiplier, based on the commodity and region, was developed for each data point to infer a complete data capture template for every project.

The inferring methodology is as follows:

- ***Labour multipliers:*** It was assumed that a commodity, regardless of region, would demand the same amount of labour per unit of production. For each commodity, a total labour demand multiplier per unit production was developed by dividing the total labour headcount by total production unit levels for each commodity for both construction and operation. It was assumed that the split between FIFO workers and local resident workers for the inferred projects would be determined by the region in which the project was located, as opposed to the commodity of the project. For each region, an average percentage of the workforce that was sourced locally was determined, with the remaining portion deemed FIFO (completed separately for construction and operation workforce). This region specific percentage was applied to each project workforce within a region to determine the inferred FIFO contingent. The source of FIFO was based on survey responses only.
- ***Energy multipliers:*** It was assumed that a commodity, regardless of region, will consume the same amount of electricity per unit of production. For each commodity (differentiating between hematite and magnetite for example), a total electricity demand per unit production multiplier was developed by dividing the total electricity demand (self generated and purchased) consumption by production levels for each commodity. This provided the total electricity demand per unit production for each commodity. It was assumed that the source of demand, either scheme or self generated, would be determined by the region (and associated infrastructure) in which the project was located, as opposed to the commodity of the project. For each region, an average percentage of the electricity demand met through self generation was determined, with the remaining portion deemed to be met by purchased supply. The fuel source for the self generated electricity was also determined by the project region. This was achieved by averaging the total energy for self generation consumed in a region and dividing by the relative amount that was fuelled by natural gas and that which was fuelled through diesel or coal/coke. The same multiplier methodology was used to determine gas and diesel requirements for industrial use and mobile plant.

Non-surveyed Data (2 of 2)

Multipliers continued:

- ***Water multipliers:*** It was assumed that a commodity, regardless of region, will consume the same amount of water per unit or production. For each commodity, an 'intensity of use' multiplier was developed by dividing the total water consumption by production levels for each commodity, to give the total water demand per unit production of each commodity. It was also assumed that the relative portion of this demand that would be met from self extracted water, surface water and scheme would be determined by the project region. A region specific multiplier was developed for each region that was used to apportion a percentage of the total water demand given by the intensity of use multiplier to each of the water sources: scheme; self extracted (including dewatering) and surface water.

Agencies Consulted on Supply/Planning Outlook

Informative supply side/planning discussions were conducted with the following groups, providing data where appropriate:

- Australian Bureau of Statistics
- Department of Local Government
- Department of Mines and Petroleum
- Department of Planning
- Department of Regional Development and Lands (Pilbara Cities Office)
- Department of State Development
- Department of the Premier and Cabinet
- Department of Training and Workforce Development
- Department of Transport
- Department of Treasury (Strategic Projects)
- Department of Water
- Horizon Power
- Independent Market Operator
- Regional Development Council
- Verve Energy
- Water Corporation
- Western Power

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