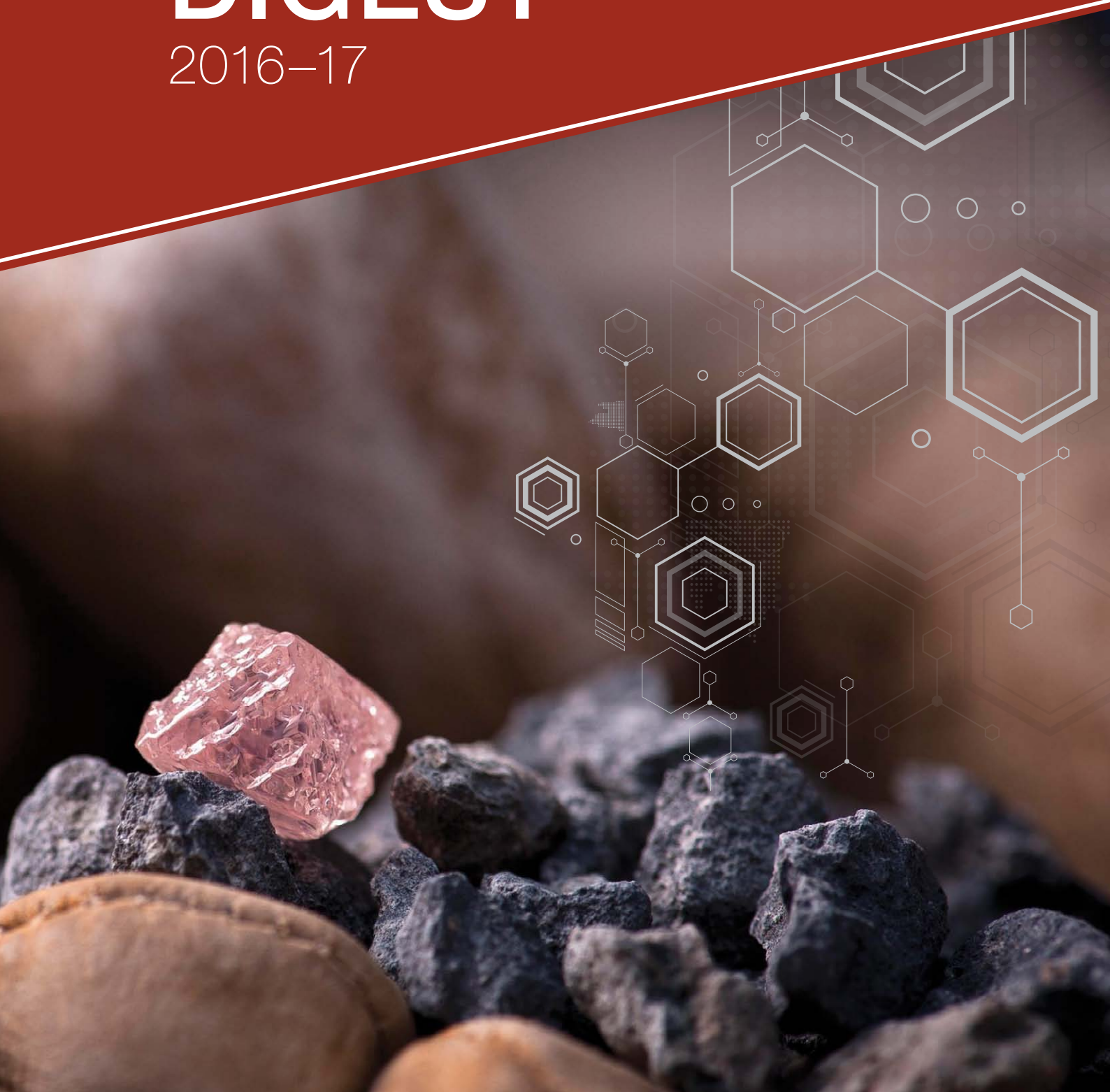
Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**

MINERAL AND PETROLEUM

STATISTICS DIGEST

2016–17



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Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**

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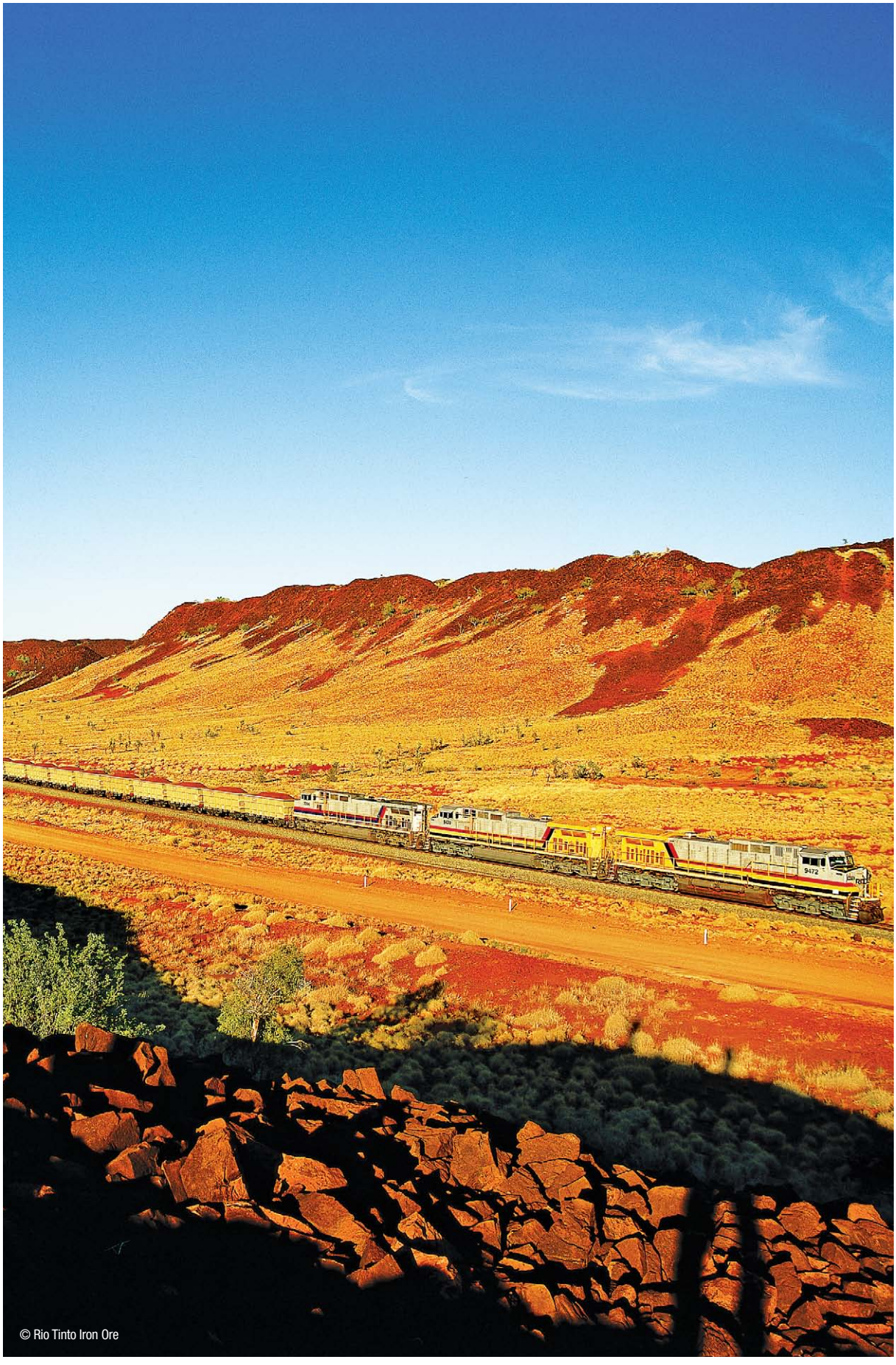

© Rio Tinto Iron Ore

FOREWORD

Throughout 2016–17, we saw volatility across many commodities with political and economic events contributing to the reshaping of these markets. Globally, movements in exchange rates and commodity prices were influenced by:

- decisions around US interest rates
- the election and early activities of the Trump administration
- escalating tensions in North Korea
- uncertainty over European elections.

Even local factors, such as weak inflation data and lower-than-expected retail sales, affected the strength of the Australian dollar.

What remains clear through these economic fluctuations is the global significance of Western Australia's mining and petroleum industry. We often talk about the huge size of Western Australia's mining sector and its significant contribution to our economy. We also explain the contribution it makes to Australia as a whole and how much national economic activity is generated from our (not so) little mining sector.

These statements were put into perspective in a recent report from a global market intelligence analyst (S&P Global) which generated a list of the world's top 50 mineral (iron ore, gold and base metals) mining projects by production value. Western Australia based projects featured heavily in this list.

The cumulative production value for the world's top 50 projects was estimated at more than US$124 billion for 2016, with Rio Tinto's Hamersley iron ore projects heading the list at almost US$11 billion. In value terms, Western Australian projects accounted for 32 per cent of the world's top 50, and a staggering 63 per cent of the top 10 global mining projects.

Western Australia hosts nine of the world's top 50 projects, including an astonishing six of the world's 10 highest valued mineral projects. No other nation – let alone a single State – can claim more than one of the world's top 10 projects.

Western Australia is certainly in an envious situation, with a mining industry on a scale nearly unmatched in the world and our LNG projects among the biggest on the planet.

David Smith
Director General
Department of Mines, Industry Regulation and Safety

Political and economic developments in the US, escalating tensions in North Korea and uncertainty over European elections caused fluctuations in exchange rates and commodity prices during 2016–17.

Locally, weak inflation data and lower than expected retail sales affected the strength of the Australian dollar, which was up slightly from an average of 73 US cents in 2015–16 to 75 US cents in 2016–17. Similarly, global commodity prices generally held up well. Some major commodities experienced strong price increases in the first half of the financial year which, coupled with strong production, helped Western Australia's mineral and petroleum industry to bounce back from 2015–16.

In 2016–17, Western Australia's mineral and petroleum industry reported sales of just under $105 billion, a return to exceeding the $100 billion dollar mark. The 19 per cent increase, up from $88.2 billion in 2015–16, was driven by better than expected iron ore prices, continued strength of the gold sector and growth in LNG volumes.

Mineral sector highlights

Mineral commodities dominated the State's resources sector, accounting for 82 per cent, or $86 billion, of total sales value. Iron ore was by far the most valuable commodity, accounting for 74 per cent of mineral sales and 61 per cent of overall sales.

Iron ore recorded sales valued at $63.7 billion in 2016–17, an increase of 31 per cent. This was the result of stronger than expected iron ore prices and a 6 per cent increase in the quantity of iron ore sold – a record 790 million tonnes.

Gold sales broke the 200 tonne mark for the first time since 2000–01 with 205 tonnes (6.6 million ounces) of gold sold in 2016–17. Increased volumes combined with strong gold prices to deliver a 7 per cent increase in the value of the sector, from $10.1 billion in 2015–16 to $10.8 billion in 2016–17.

Alumina and bauxite sales accounted for 6 per cent of all mineral sales. Sales volumes increased marginally year-on-year, attributable to the increase in bauxite exports more than an increase in alumina sales. This meant that the value of the industry increased 3 per cent to $5.1 billion in 2016–17.

Western Australia's nickel sector continued to struggle amid consistent low prices. A slight reprieve in global nickel prices was seen in the last half of the financial year, resulting in a 5 per cent increase in the overall average annual nickel price to $13,460 per tonne. However, a 10 per cent decline in nickel sales meant that the value of the nickel sector decreased 6 per cent to $2.1 billion in 2016–17.

The remaining minerals sales values comprised:

- base metal sales of $1.4 billion (down 0.5 per cent)
- coal sales of $338 million (up 0.6 per cent)
- cobalt sales of $238 million (up 36 per cent)
- diamond sales of $268 million (down 24 per cent)
- mineral sands sales of $554 million (up 0.15 per cent)
- salt sales of $292 million (down 13 per cent)
- spodumene sales of $607 million (up 133 per cent).

Petroleum sector highlights

The petroleum sector, which comprises crude oil, condensate, LNG, natural gas and LPG, accounted for 18 per cent of the total value of mineral and petroleum sales in Western Australia.

The sector was valued at $19.1 billion in 2016–17, an increase of 5 per cent from $18.1 billion in 2015–16.

The volume of LNG produced in Western Australia has increased 45 per cent during the past five years with production reaching a record 28.7 million tonnes in 2016–17. This followed the start–up of the Gorgon LNG project, as well as record production from the North West Shelf and Pluto LNG projects.

LNG was Western Australia's most valuable petroleum product, accounting for 12 per cent of the value of the State's mineral and petroleum sales in 2016–17. The value of LNG sales value rose from $10.8 billion in 2015–16 to $12.7 billion in 2016–17.

In 2016–17, crude oil volumes were down almost 30 per cent to 5.4 gigalitres, while condensate production decreased 11 per cent to six gigalitres. Based largely on the fall in volumes, the value of crude oil and condensate sales fell for the sixth consecutive year to $4.3 billion, a decrease of 18 per cent.

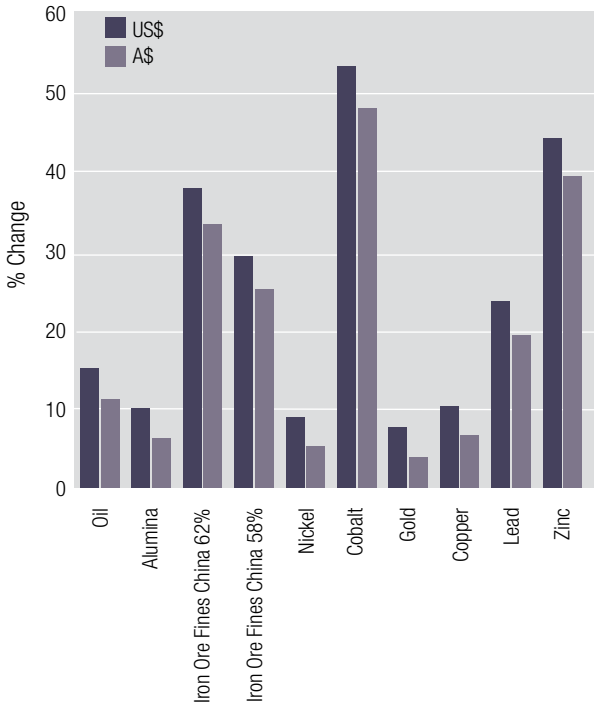


Figure 1 **Percentage price change between 2015–16 and 2016–17**
Source: LME, Kitco, Argus Metals, WATC and DMIRS

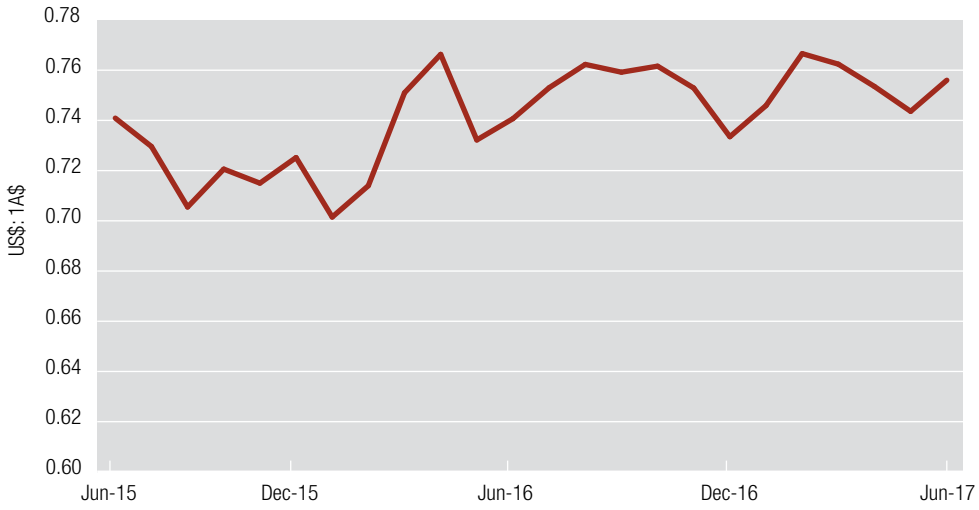


Figure 2 **Monthly average exchange rate**
Source: Reserve Bank of Australia

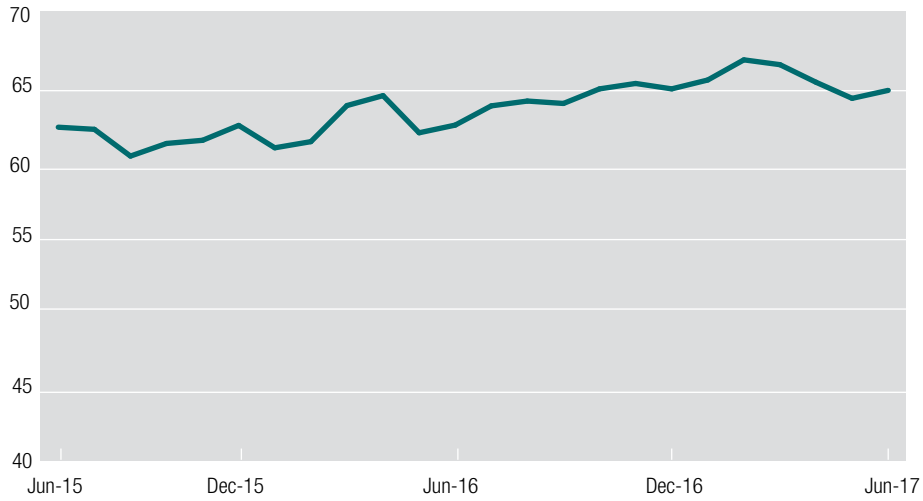


Figure 3 | **Trade-weighted index (units of foreign currency per A$)**
Source: Reserve Bank of Australia

'"Trade-weighted index" is the average value of A$ in relation to the currencies of Australia's major trading partners.

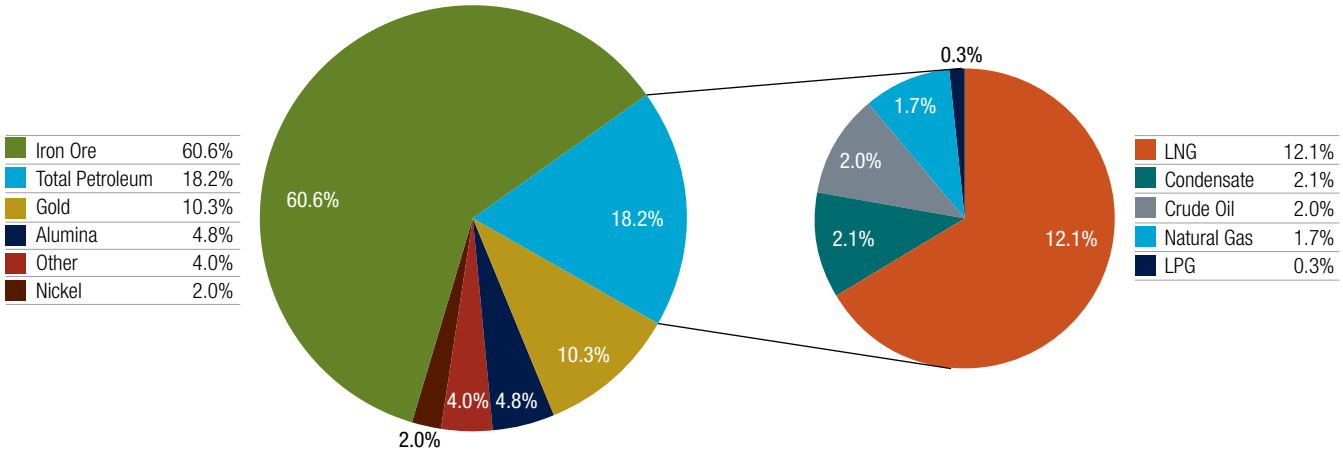


Figure 4 | **Financial year 2016-17 mineral and petroleum summary**
Total value $104.95 Billion
Source: DMIRS

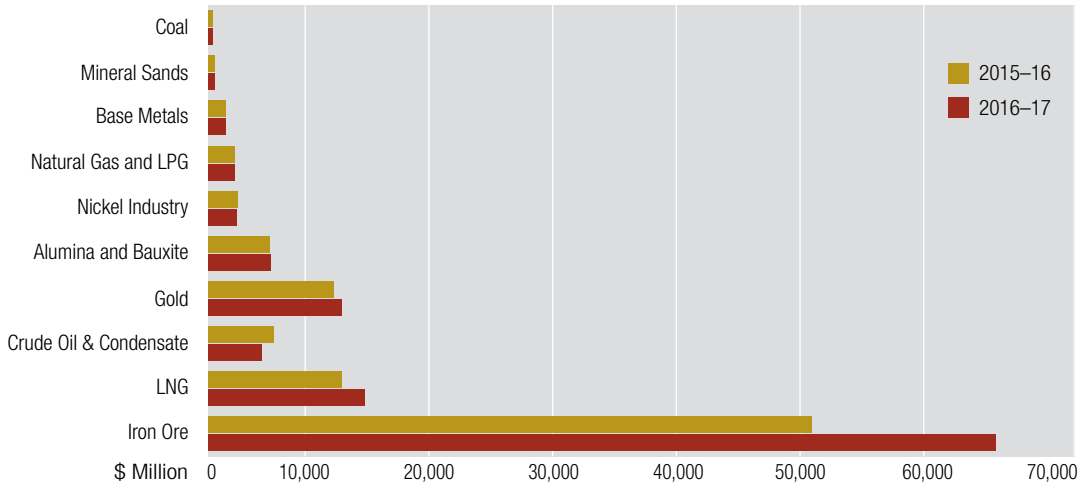


Figure 5 | **Major commodities by value**
Total value $104.95 Billion
Source: DMIRS

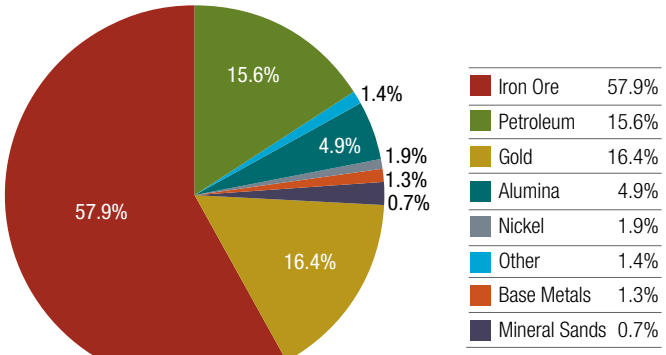


Figure 6 **WA mineral and petroleum exports 2016–17**
$108.2 Billion
Source: DMIRS and ABS

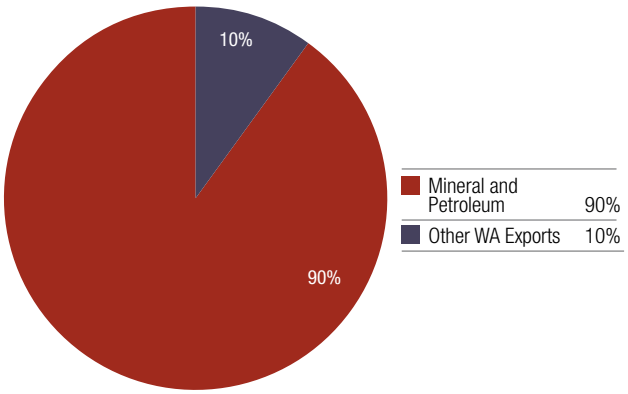


Figure 7 **WA merchandise exports 2016–17**
$120.63 Billion
Source: DMIRS and ABS
Note: Minerals and Petroleum includes $5.53 billion worth of gold and $332.1 million worth of Mineral Sands refined or processed in WA but produced in other States/Territories/overseas.

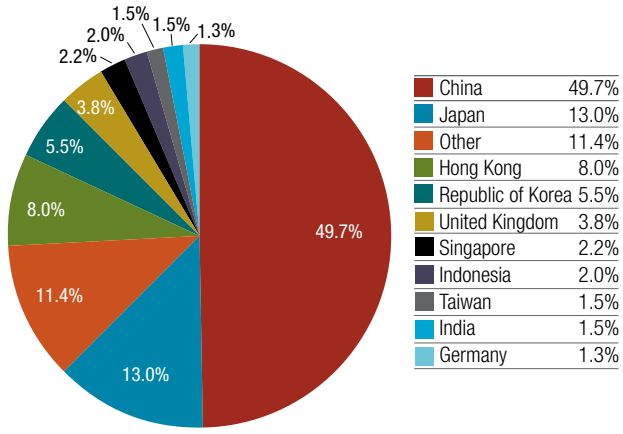


Figure 8 **WA merchandise exports by country 2016–17**
$120.63 Billion
Source: ABS

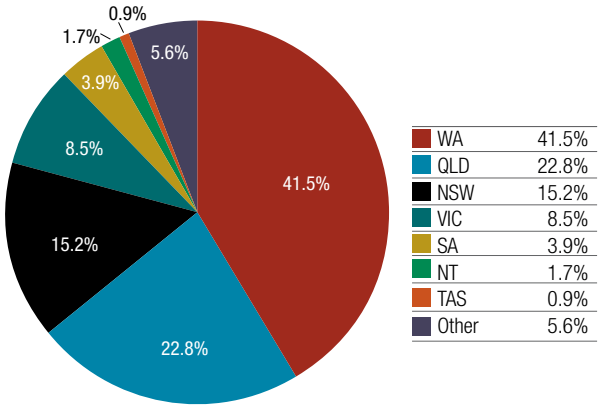
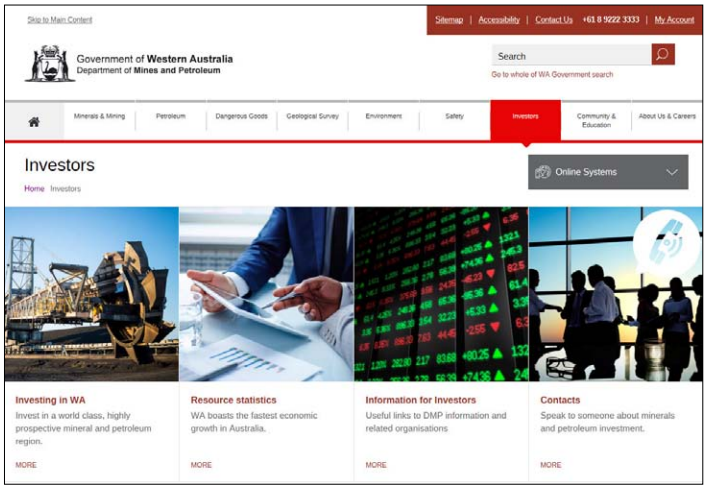


Figure 9 **Australian merchandise exports 2016–17 by state/territory**
$290.86 Billion
Source: ABS
Note: "Other" refers to exports where state of origin is not released by ABS or where merchandise is re-exported.

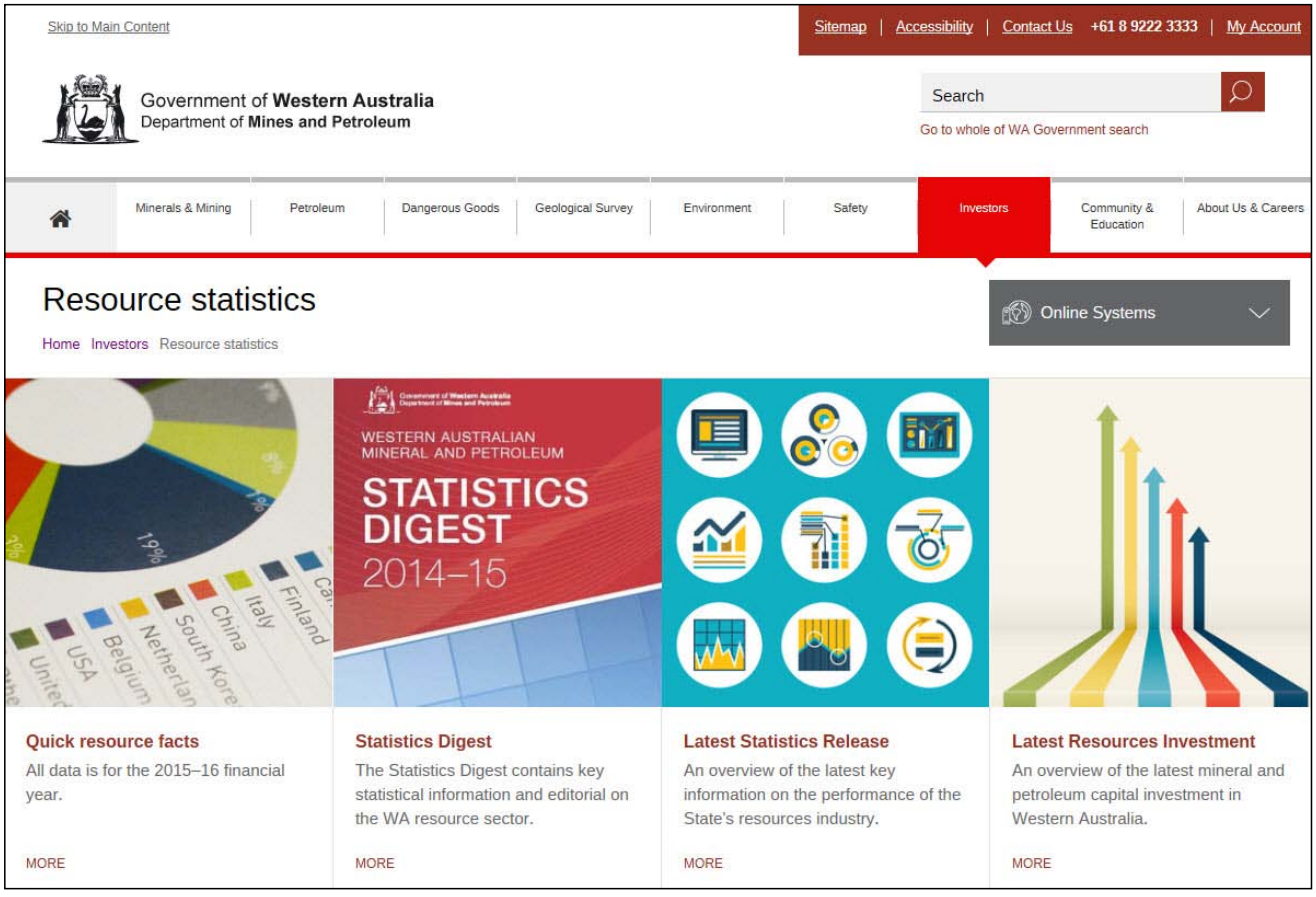
The department publishes detailed resource data, which is available on the website.

Three separate Excel files are available:

1. Major commodities – this file contains information about the scale and scope of Western Australia's mineral and petroleum industry, as well as detailed information about the State's major commodities, including sales value and volumes, prices, exports and production, compared to the rest of Australia.
2. Economic indicators – this file contains information about how the State's mining and petroleum industry contributes to the economy through exploration and investment, employment and royalty receipts.
3. Spatial and regional – this file contains information about mining and petroleum tenements and how the value of mineral and petroleum sales is distributed across the State.



Throughout this digest you will find references indicating where in the resource data files to find more detailed information about the topics discussed. These hints are identified by this symbol:



1.1 MINERAL TITLES

Tenement activity provides an indicator of the industry's activity and the scale of the various mining activities across the State.

In 2016–17, 42.5 million hectares of Western Australian land was covered by mining tenements – an increase of 13 per cent from 37.6 million hectares in 2015–16.

Exploration licences accounted for about 80 per cent of the area covered by mining tenements. The number of exploration licences increased 11 per cent over the year from 4529 tenements in 2015–16 to 5020 tenements in 2016–17.

Mining leases accounted for just 6 per cent (2.4 million hectares) of the total area. The number of mining leases fell 1 per cent from 5873 in 2015–16 to 5827 in 2016–17, although the area covered under these mining leases rose 1 per cent over the same period.

A new graph has been added to this year's publication to demonstrate the range of tenement activity over the year. The graph identifies three aspects of activity:

- applied for – the number of applications received by the department for mining tenements
- granted – the number of tenements that the department has approved
- died – the number of dead tenements that occurred (dead tenements occur when a former holder no longer has exploration or mining rights over the area of land, either because the time period of the tenement has expired, or the tenement has been surrendered or forfeited).

The spatial and regional data file provides historic information about the number and type of mineral titles.

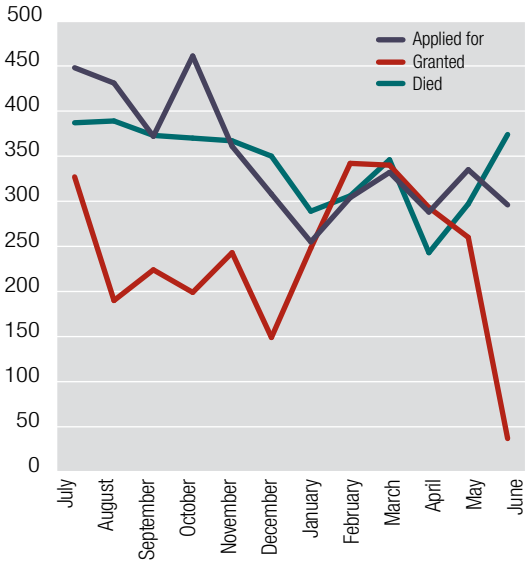


Figure 10 | **Tenement activity 2016–17**
Source: DMIRS

1.2 PETROLEUM TITLES

State petroleum titles are administered under three Acts:

1. The *Petroleum (Submerged Lands) Act 1982,* which generally applies to the State's territorial sea to the three-nautical-mile mark, including the territorial sea around State islands.
2. The *Petroleum and Geothermal Energy Resources Act 1967,* which generally covers all onshore areas of the State, including its islands. Most areas under petroleum titles are covered under this Act.
3. The *Petroleum Pipelines Act 1969,* which applies to petroleum pipelines on land within the State.

As at 20 July 2017, the area covered by petroleum titles regulated by Western Australian State legislation was 76,766 square kilometres – about 3 per cent of Western Australia's land area. The area covered by petroleum titles was significantly lower (down 58 per cent) compared with 2015–16 (181,963 square kilometres), which reflects the prevailing low oil price and the apparent limited availability of investment capital for high risk petroleum exploration.

1.3 EXPLORATION

The economic indicators resources data file contains detailed ABS exploration expenditure data, including:

- historic and current expenditure on mineral exploration in Western Australia and the rest of Australia
- a breakdown of the State's exploration spend by commodity compared with the rest of Australia
- historic and current exploration drilling and expenditure on new and existing mineral deposits
- historic and current expenditure on petroleum exploration in Western Australia compared with the rest of Australia.

1.3.1 Minerals exploration

Australia's mineral exploration expenditure was $1.6 billion in 2016–17, up from $1.4 billion in 2015–16. Western Australia contributed more than $1 billion of this spend with the gold and iron ore sectors attracting the largest share. Gold exploration expenditure in Western Australia increased significantly from $385.9 million in 2015–16 to $509.5 million in 2016–17. Iron ore exploration also increased, but only marginally to $281.6 million.

Globally, exploration budgets have been declining since 2012 with the mix between greenfield and brownfield exploration shifting towards the latter. In terms of expenditure, the mix of Australian exploration has remained static over the past five years, roughly weighted 70:30 towards brownfield exploration.

The department received 2232 mineral exploration Programme of Work (PoW) applications in 2016–17 with a noticeable increase in applications received in the second half of the financial year. This may reflect improved commodity prices during that period. Mineral exploration applications made up about 30 per cent of all applications received by the department during 2016–17.

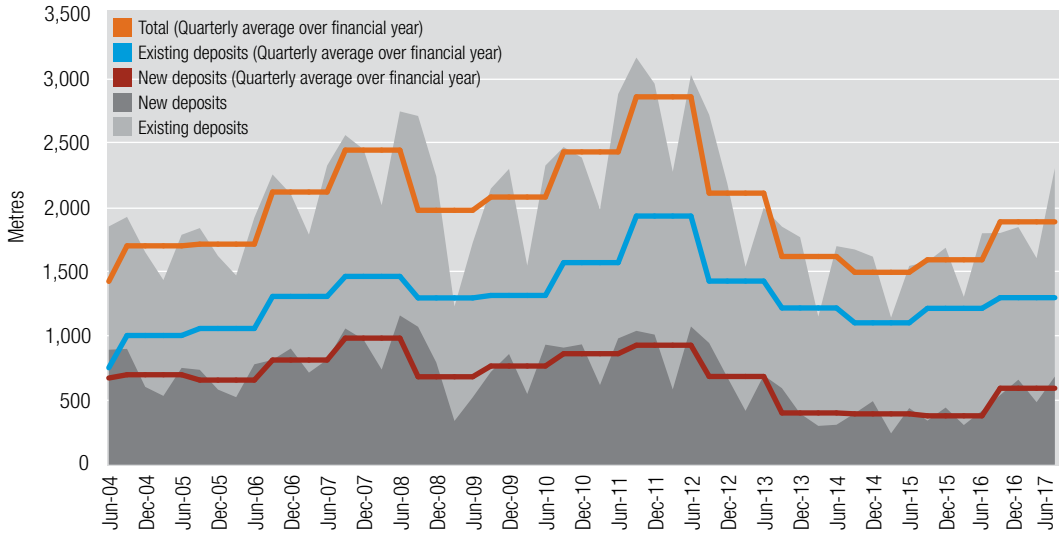


Figure 11 | **Australia-wide drill metres – new and existing deposits**
Source: ABS

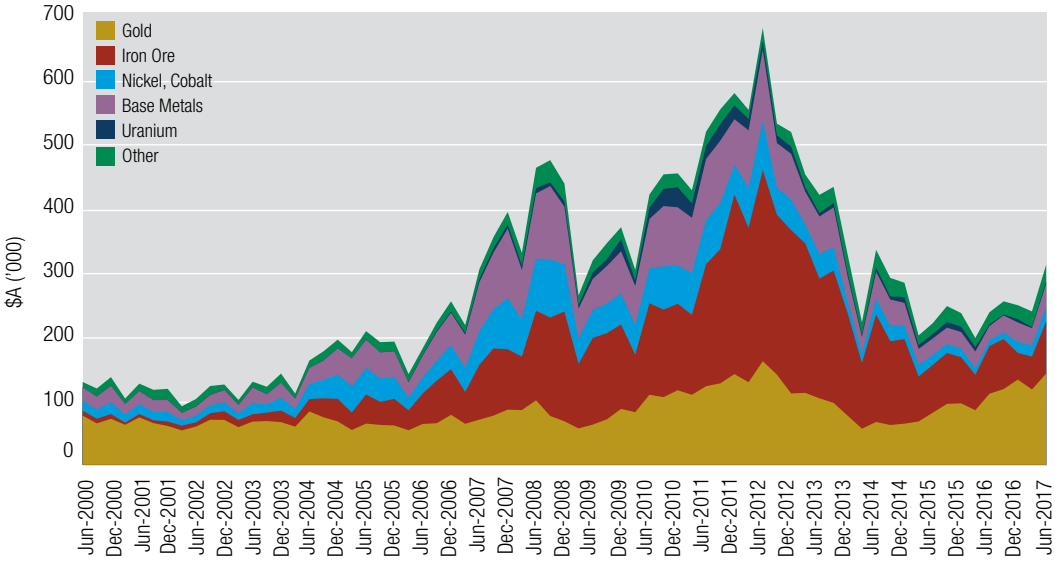


Figure 12 | **WA mineral exploration spend by commodity**
Source: DMIRS and ABS

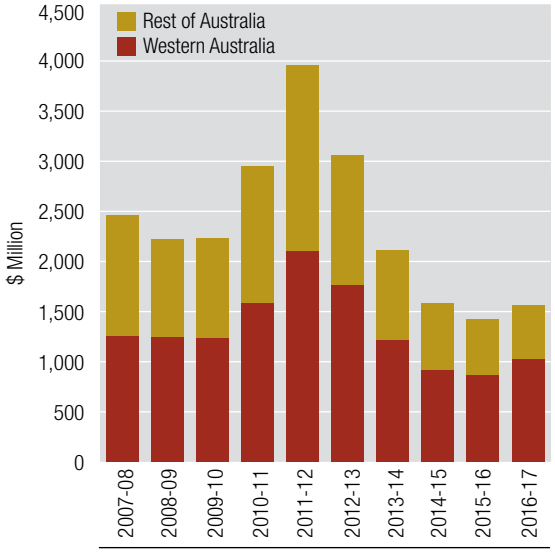


Figure 13 | **Mineral exploration expenditure**
Source: ABS

Notable events

- Pilbara Minerals increased the resource estimate at its Pilgangoora lithium-tantalum project following further drilling and the acquisition of the Lynas Find project. As of January 2017, the resource was 156.3 million tonnes containing 1.95 million tonnes of lithium oxide and 44.2 million pounds of tantalum pentoxide.
- Altura Mining increased reserve and resource estimates at its Pilgangoora lithium project by 40 per cent (to 30.1 million tonnes) and 32 per cent (to 40.3 million tonnes) respectively.
- Kidman Resources announced an initial resource for its Earl Grey lithium project of 128 million tonnes for 1.84 million tonnes of lithium oxide.
- Reserves at the Tropicana gold project increased 1.39 million tonnes to 60.1 million tonnes for 3.8 million ounces of gold, increasing the mine life to 2024.
- Blackham Resources released drilling results for the Matilda gold project, confirming the potential for open pit mining and support for an expansion of the Wiluna processing plant. The resource was also increased by 25 per cent to 63 million tonnes for 6.4 million ounces of gold.
- Gold explorer Kin Mining released several positive results from their Leonora project, recording grades of 622 grams per tonne, 177 grams per tonne and 51 grams per tonne.
- Exploration drilling also extended the mine life at Ramelius Resources' Vivien Gold mine to at least 2019.
- Uranium developer Vimy increased resources 17 per cent on the back of a good drilling campaign.
- Copper explorer Auris announced results that it claimed were consistent with the oxide zones found above the massive sulphides at nearby DeGrussa.

1.3.2 Petroleum exploration

National petroleum expenditure continued to decline, from $1.8 billion in 2015–16 to $1.4 billion in 2016–17.

Typically, Western Australia attracts about 70 per cent of Australia's petroleum exploration spend. However, this dropped to 47 per cent in 2016–17. The decrease in the State's share can be attributed to Quadrant's aggressive 2016 drilling campaign ending at some of its Western Australian prospects and ConocoPhillips starting a drilling campaign off the Northern Territory coast.

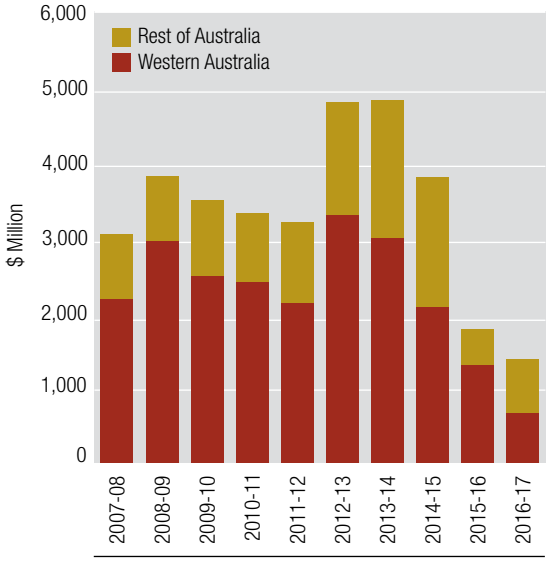


Figure 14 | **Petroleum exploration expenditure**
Source: ABS

Notable events

- Woodside announced that its focus would be on brownfield expansion of existing projects out to 2021. It then plans to unlock value from ventures such as Browse and Scarborough until 2026.
- AWE and Origin Energy spudded the onshore Waitsia-3 appraisal well in May which was drilled to 3700 metres over seven weeks. Waitsia-3 is the first of two appraisal wells planned for this year.

Further information on Western Australian petroleum exploration activity is available in the DMIRS publication *Petroleum in Western Australia*. It includes a comprehensive overview of the State's petroleum exploration activities and details about the award of petroleum exploration permits. It is available on the department's website. **www.dmirs.wa.gov.au.**

1.4 INVESTMENT ACTIVITY

The economic indicators resource data file contains historic and current ABS investment data released in catalogue *5625.0 – Private New Capital Expenditure and Expected Expenditure.* This data includes:

- mining investment within Australia, including Western Australia
- new capital investment for mining within Australia, including Western Australia.

1.4.1 Mining investment and new capital expenditure

Nationally, mining investment[1] has fallen from $95 billion in 2012–13 to $39 billion in 2016–17, a decrease of almost 60 per cent. The decline has been slightly less severe for Western Australia, with mining investment falling 54 per cent over the same period.

A total of $22 billion was invested in Western Australia's mining industry in 2016–17, representing more than 57 per cent of national expenditure.

Despite the lack of new investment in traditional iron ore and LNG projects, interest and investment in new sectors, such as lithium, is rising. For example, Pilbara Minerals is progressing the $234 million Pilgangoora lithium mine, Tawana Minerals has begun construction at the Bald Hill Lithium mine and Potash Australia is progressing the $175 million stage one of the Lake Wells project, although this is still at an early stage.

While not the huge investment projects seen during the peak commodity cycle, these investments will contribute valuable employment, exports and royalties for the State.

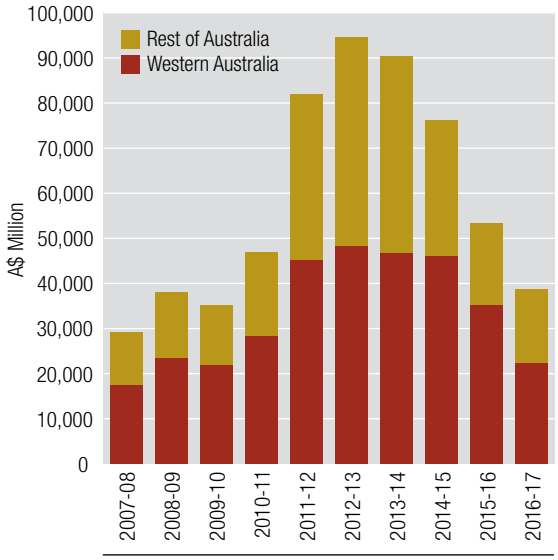


Figure 15 | **Mining investment**
Source: ABS

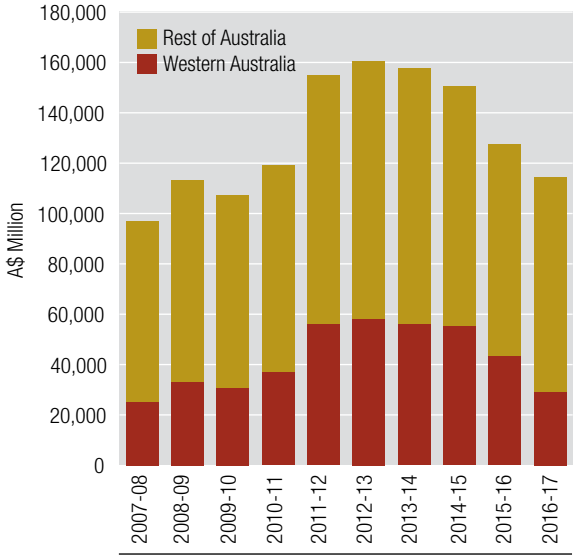


Figure 16 | **New capital expenditure**
Source: ABS

Other investment announcements over the period included:

- Rio Tinto on the cusp of approving the $2.2 billion Koodaideri iron ore project. If approved, the Koodaideri development will require an expected 1600 construction jobs and a further 600 operational staff.
- Through the Clean Energy Finance Corporation, the Commonwealth Government invested $20 million in Pilbara Minerals' Pilgangoora project.
- Fortescue Metals announced a proposal to develop the Eliwana Mine Project in the Pilbara. Average production is expected to be 30 million tonnes per annum with first ore expected in 2020.

[1] The ABS uses classifications specified in the 2006 edition of the Australian and New Zealand Standard Industrial Classification (ANZSIC). Under this standard, mining is broadly defined as the extraction of minerals occurring naturally as solids, such as coal and ores, and liquids such as crude petroleum and natural gas. Downstream mining activities, such as smelting of minerals or ores (other than preliminary smelting of gold) or refining, are classified as manufacturing activities under the ANZSIC. Products such as coke and alumina are also included in the ANZSIC manufacturing category. Therefore, the ABS figures do not capture all mining investment.

1.4.2 Major projects

The department collects information on mineral and petroleum projects to estimate actual and possible investment in Western Australia's resources industry[2]. Where possible, information is collated relating to expected capital expenditure, project timing and employment during the construction and operation phases.

Mineral and petroleum projects are categorised as follows:

- Projects under construction – those actually under construction at the time of updating the estimates of total capital expenditure.
- Committed projects – have company commitment, i.e. a final investment decision, but are waiting for approvals to proceed with construction.
- Planned projects – those undergoing advanced feasibility studies, i.e. definitive and bankable feasibility studies. For oil and gas projects, the planning phase typically involves detailed engineering design.
- Possible projects – those raising capital and not yet as advanced as those projects conducting definitive and bankable feasibility studies.

As of September 2017, Western Australia had resource projects in the pipeline valued at an estimated $148 billion, down slightly from the March 2017 estimate of $152 billion.

Some new projects have been announced, including:

- St Barbara's Gwalia gold mine extension ($100 million)
- Tawana and Alliance Mineral Assets' Bald Hill lithium/tantalum project ($42 million)
- Talison Lithium's Greenbushes lithium mine expansion ($320 million)
- Northern Minerals' Browns Range rare earth pilot project ($56 million)
- APA Group's Yamarna Gas Pipeline and power station ($180 million).

The value of projects under construction, or in the committed stage of development, was an estimated $99 billion, down slightly from $100 billion in March this year. The number of planned or possible projects also declined from $52 billion to $49 billion between March and September. This is attributable to several projects being completed, progressed or placed on hold due to prevailing market conditions.

Following the expected start-up of Chevron's Wheatstone project in the near future, Shell's Prelude FLNG project and Inpex's Ichthys LNG will be the last two of Western Australia's wave of new LNG supply projects to come online. Both are expected to start production in 2018, and they will drive Australia closer to Qatar as the world's largest LNG exporter. The completion of major projects such as these will see the value of investment in State's major projects decline substantially.

TABLE 1. WA major projects

Sector	Commodity	CAPEX (A$ million)[3]	
		Committed/ under construction	Planned/ possible
Minerals	Gold	968	459
	Iron ore	482	11,669
	Nickel, copper and zinc	153	5,052
	Lithium	716	150
	Other minerals and infrastructure	500	12,384
	Sub-total Minerals	**2,819**	**29,714**
Petroleum	Crude oil and condensate	2,519	
	Gas	2,652	
	LNG	90,744	19,500
	Pipelines and infrastructure	180	
	Sub-total Petroleum	**96,095**	**19,500**
Total forecast investment		**98,914**	**49,214**

Source: DMIRS

[2] Information is obtained from various sources including the Office of the Chief Economist's list of major mineral and energy projects, EnergyQuest, REPS' Major WA Projects Listing, online company research consultancy systems, media announcements and company websites.

[3] A summary of total capital expenditure by commodity is provided. However, it should be noted that investment in several projects is publicly reported in US dollar terms and the data may vary over time in line with movements in the US$/A$ exchange rate.

1.5 PRINCIPAL MINING PROJECTS

Western Australia's mining industry consists of 116 predominantly higher-value and export-oriented mining projects, as well as hundreds of quarries and small mines producing clays, construction materials (aggregate, gravel, rock and sand), dimension stone, gypsum, limestone, limesand, spongolite, gems and semi-precious stones[4].

In total, more than 50 different minerals are produced and several major mineral processing operations produce alumina, nickel matte, titanium dioxide, silicon metal and refined gold.

A list of the principal mining projects and key basic raw materials producers is available on the department's website.

1.6 EMPLOYMENT

The economic indicators resources data file provides detailed employment data, including:

- current and previous period employment data in the mineral industry
- current and previous period employment data in the petroleum industry
- a breakdown of employment by commodity for the mineral industry
- calendar year employment by commodity data for the mineral industry since 2001
- financial year employment by commodity data for the mineral industry since 2001–02
- employment data for the mineral and exploration industries by commodity on a monthly basis since 2001
- historic calendar year employment data (by commodity) for 1987–2000.

1.6.1 Mining

Western Australia's mining industry directly employed an average of 108,769 people during 2016–17, up from 104,553 the previous year. This figure included people employed in mineral exploration, mine site infrastructure construction, mineral processing, mine site surveying, transport and catering – essentially those people operating on site[5].

In the reporting period, direct employment remained high relative to just 10 years ago, when the average number of people employed was 62,117 (an increase of more than 75 per cent).

The iron ore sector remained the State's largest employment sector, accounting for 50 per cent, or an average of 52,869 people. Gold and alumina were the next largest employers with 27,124 and 6645 people.

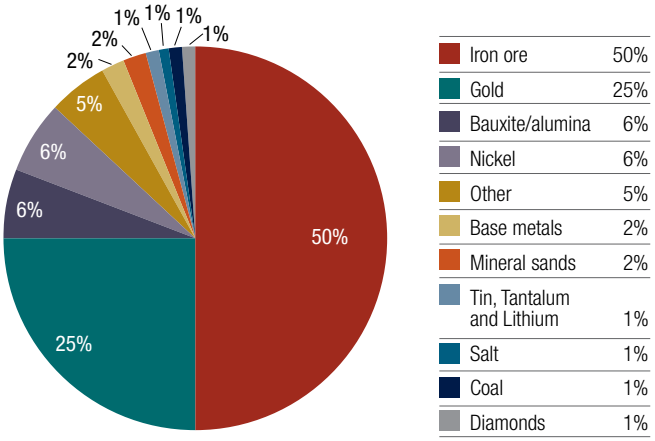


Figure 17 **WA minerals direct employment by mineral commodity 2016–17**
Source: DMIRS

[4] The State's principal mining projects are those that produce commodities valued at more than $5 million per annum or, in the case of gold producers, more than 2500 ounces of gold. Projects on private land, for which production values are not required to be reported, are also classified as principal projects where employee numbers are greater than 50.

[5] DMIRS collects mining employment data from monthly accident reports, which all operating mines, as well as companies undertaking exploration activities on exploration and mining leases, are required to submit. The data identifies the number of direct employees and contractors and includes sites under State Agreement Acts. It does not include personnel in administrative locations not on operating sites.

Employment data collected and published by the ABS is classified using ANZSIC and is not directly comparable to data collected by DMIRS.

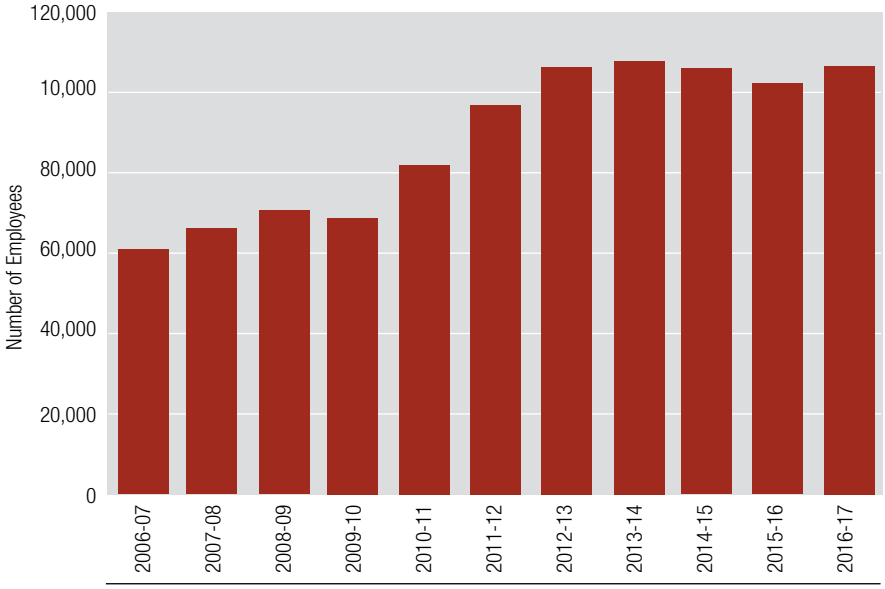


Figure 18 | **WA mining employment 2006–07 to 2016–17**
Source: DMIRS
Does not include petroleum data.

1.6.2 Petroleum

The average number of people employed by the State's onshore petroleum sector continued to decline, down from 1382 people in 2015–16 to 1203 people in 2016–17[6]. The data represents the average number of people employed at operating sites, including contractor employees.

Chevron's Gorgon project reported the biggest fall with numbers down 30 per cent.

1.7 ROYALTIES

Royalties for all minerals and petroleum produced on State land and in State waters are paid into the Government's Consolidated Revenue Fund. The State also receives about 65 per cent of the royalties from the petroleum produced by the North West Shelf Project, in the form of Commonwealth grants, in accordance with an agreement between the Western Australian and Australian Governments.

The Western Australian Government received royalty revenue from the State's mineral and petroleum producers totalling $5.7 billion in 2016–17, an increase of 24 per cent on 2015–16[7].

Iron ore provided the bulk of collections (80 per cent) for 2016–17 with strong prices and volume growth during the year, increasing receipts 33 per cent. The gold sector was the other positive contributor with receipts totalling $263 million for 2016–17, an increase of almost 10 per cent.

Petroleum royalty receipts were significantly down for the year, declining almost 53 per cent from $7.2 million in 2015–16 to $3.4 million in 2016–17. The State also received $573 million in grants for the North West Shelf project, which accounted for 10 per cent of total royalty revenue.

The decline in petroleum royalties, compared to the increase in petroleum sales value, is attributed to the different reporting periods. Royalty receipts are offset from sales value figures by one quarter, ie. they include the June, September, December 2016 quarters and the March 2017 quarter.

The economic indicators resources data file contains:

- a breakdown of royalty receipts per commodity for the most recent calendar and financial year
- historic royalty receipts and North West Shelf grants from 1984–present.

[6] These figures only include employment in onshore facilities and pipelines covered under the *Petroleum Pipelines Act 1969, Petroleum (Submerged Lands) Act 1982* and *Petroleum Geothermal Energy Resources Act 1967*.

[7] Included in the State's royalty receipts for iron ore is an additional lease rental amount, which is currently applied under iron ore State Agreement Acts and the Mining Act. The rate is 25 cents per tonne. In the case of some older Agreement Acts, the rate is 25 cents per imperial ton. The additional lease rental applies to iron ore obtained from a mining lease following 15 years from the date the iron ore was first obtained from the mining tenement, by the lessee.

TABLE 2. Royalty receipts and North West Shelf grants 2015–16 and 2016–17				
Commodity	**2015–16 Total A$**	**2016–17 Total A$**	**2016–17 growth A$**	**%**
Alumina	84,324,000	81,082,361	-3,241,639	-3.8%
Copper, Lead & Zinc	59,238,000	59,915,818	677,818	1.1%
Diamonds	18,324,000	13,019,655	-5,304,345	-28.9%
Gold	239,554,000	262,873,805	23,319,805	9.7%
Mineral sands	16,818,000	14,317,157	-2,500,843	-14.9%
Iron ore	3,472,766,000	4,619,550,947	1,146,784,947	33.0%
Nickel	54,093,000	49,169,483	-4,923,517	-9.1%
Petroleum *	7,239,000	3,431,830	-3,807,170	-52.6%
Other	69,692,000	68,541,296	-1,150,704	-1.7%
Total royalty receipts	**4,022,048,000**	**5,171,902,351**	**1,149,854,351**	**28.6%**
North West Shelf Grants	**615,475,000**	**573,000,324**	**-42,474,676**	**-6.9%**
Total revenue	**4,637,523,000**	**5,744,902,675**	**1,107,379,675**	**23.9%**

Note: All royalty revenue shown above is paid into the State's Consolidated Revenue Fund. Added to the table, shown separately, is the State's share of the North West Shelf project royalty payments to the Commonwealth (which are provided as a grant from the Commonwealth to the State).

Note 2: Regulation 86A of the Mining Regulations 1981 requires that royalties be paid within 30 days following the end of a quarter. As a result, the cash receipts are necessarily offset by one quarter, i.e. the 2016-17 financial year royalty receipts reflect the 2016 June, September and December quarters, and the 2017 March quarter.

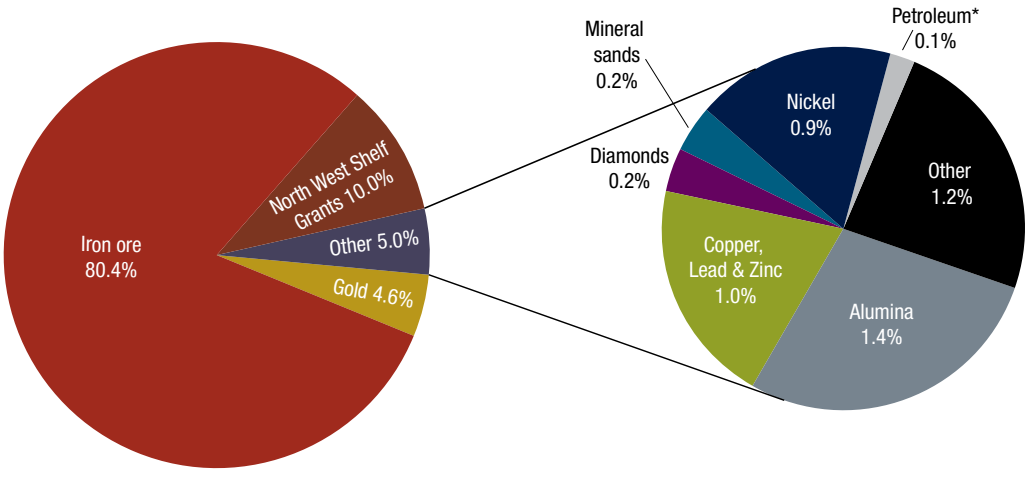


Figure 19 **Royalty receipts and North West Shelf grants 2016–17**
$5.74 Billion
Source: DMIRS and WA Treasury

* Includes the Commonwealth's share of royalties collected under the Western Australian *Petroleum (Submerged Lands) Act 1982*.

2.1 IRON ORE

Pricing

The average annual iron ore price improved for the first time since 2013–14, averaging US$69.48 per tonne in 2016–17. The 38 per cent year-on-year increase can be attributed to improved steel demand following increased infrastructure and property development in China, as well as market speculation about possible infrastructure spending in the United States.

A spike in the price of coking coal (as a result of Cyclone Debbie in Queensland) also drove demand for high grade iron ore. There was an increase in the price spread between the 62 per cent iron content ore and 58 per cent iron content ore products throughout the year, which started at about US$9.61 per tonne in July 2016 and increased to US$13.10 per tonne in February 2017.

Steel mills attempted to reduce their production costs by improving the efficiency of the steel-making process by using less coking coal and higher grade iron ore. It is estimated that for every 1 per cent increase in the grade of iron ore, the amount of coking coal required is reduced by about 2 per cent.

The strong 62 per cent iron content price, which began its climb in November 2016, continued through the first three months of 2017 to reach a monthly average of more than US$87 per tonne. The price dropped to an average of US$57 per tonne in June 2017. Rising stockpiles in China (a record 136 million tonnes in May), substitution of scrap metal and increased seaborne supply (exports from Port Hedland were 12 per cent higher year-in-year for May) contributed to the fall.

Iron ore price spread

While the benchmark iron ore price is for 62 per cent iron content ore, the grade of iron ore used in steelmaking usually ranges between 58 to 65 per cent iron content. Premiums and discounts are applied to the price paid for higher and lower grade ores.

A growing gap between the price received for low and high-grade ores has recently emerged. In April–May 2017, the price for 58 per cent iron content fines was 27 per cent lower than the 62 per cent price, compared to 19 per cent a year earlier. The difference has averaged 14 per cent since 2012.

While the gap has recently narrowed again, it is still larger than the historical average. Western Australia typically hosts high-quality iron ore reserves (close to the 62 per cent benchmark). However, there are a number of producers operating lower grade mines, which may be exposed to persistently lower prices for low-grade ore.

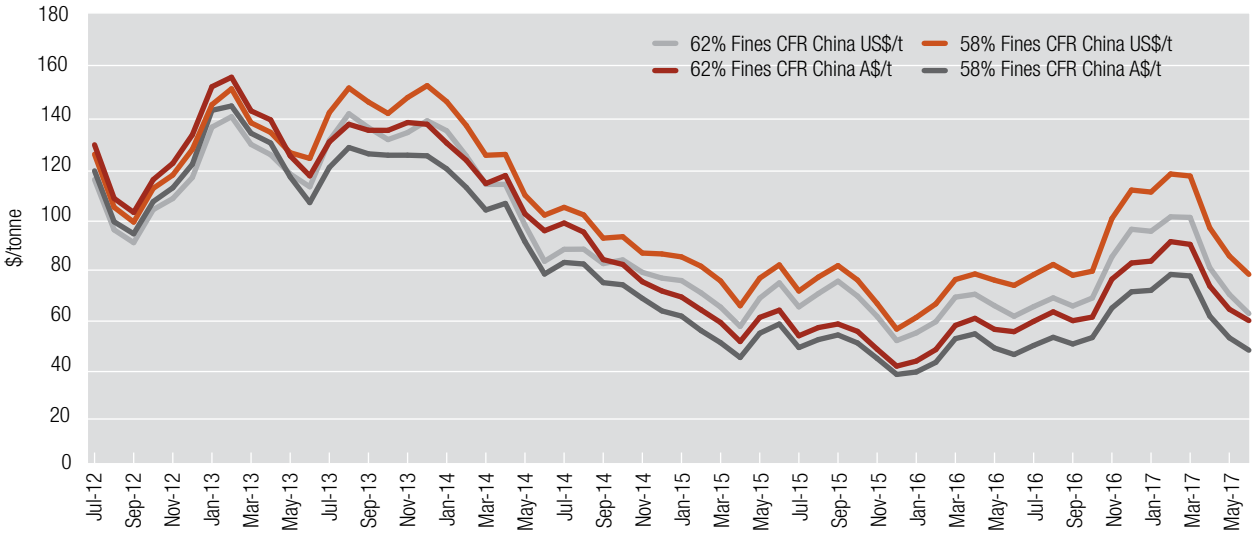


Figure 20 | **Iron ore price**
Source: Argus Metals

Quantity and value

Western Australia accounts for 99 per cent of Australia's iron ore production with fewer than 12 million tonnes being produced across the rest of Australia.

Western Australia's iron ore sales reached a record 790 million tonnes in 2016–17, an increase of almost 6 per cent on 2015–16. Rio Tinto, Roy Hill and BHP increased output, following the ramp-up of new and expanded mines and productivity improvements, which contributed to the increase in sales volumes.

A particularly severe monsoon season in February and March affected mining and rail operations across the Pilbara. However, the disruptions were not enough to impact overall sales numbers. This was largely due to the very strong December quarter in which sales volumes reached more than 200 million tonnes.

Increased sales volumes combined with the stronger prices to deliver a 31 per cent increase in the value or iron ore sales from $48.8 billion in 2015–16 to $63.7 billion in 2016–17.

Iron ore accounted for 61 per cent of all mineral and petroleum sales, 74 per cent of mineral sales and about 80 per cent of Western Australia's royalty revenue, making the sector a substantial contributor to the State's prosperity.

China remained the State's largest iron ore customer, accounting for more than 82 per cent ($51 billion) of iron ore exports. Japan and South Korea were the next two largest markets, accounting for $5 billion (9 per cent) and $4 billion (6 per cent) respectively.

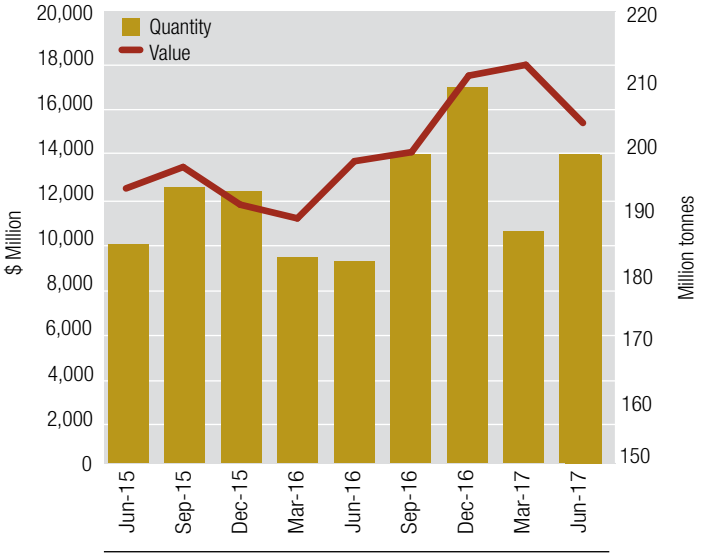


Figure 21 **Iron ore quantity and value by quarter**
Source: DMIRS

Notable events

- Atlas Iron advised that the Abydos and Wodgina mines would be depleted by the end of 2017. It planned to ramp up output at Mount Webber and develop Corunna Downs to make up the shortfall in production, but has since deferred the Corunna Downs development due to market conditions.
- BC Iron announced it had received approval for mining below the water table at Iron Valley, giving access to the project's entire ore reserves and significantly extending the mine life.
- Mount Gibson Iron applied for environmental approval to rebuild the sea wall and dewater the pit at Koolan Island. Total redevelopment and capital costs are estimated at US$68 million, with the resumption of production targeted for the September 2018 quarter. Koolan is expected to produce more than 12 million tonnes per annum with a mine life of three-and-a-half years. Mount Gibson also received approval to begin work on its Iron Hill mine, which is expected to produce 400,000 to 500,000 tonnes of iron ore per year.
- Cliffs Natural Resources received environmental approval for a 9 million tonnes per annum expansion of Koolyanobbing.
- A $13.6 million upgrade of an iron ore shipping berth at the Port of Geraldton was completed.
- The Western Australian Government's magnetite financial assistance program continued to support the Sino and Karara projects. The program, which provides eligible producers with a 50 per cent royalty rebate, operates through to April 2018.

The major commodities resources data file contains:

- quarterly production and sales value figures for iron ore in Western Australia
- historic annual average price of iron ore and recent monthly prices
- value of iron ore exports from Western Australia by destination
- annual historic iron ore production in Western Australia compared with the rest of Australia
- annual historic calendar year iron ore imports and crude steel production in China since 1980 and a detailed breakdown of iron ore imports to China, including Australia's contribution
- annual historic financial year iron ore imports and crude steel production in China since 1990–91 and a detailed breakdown of iron ore imports to China, including Australia's contribution.

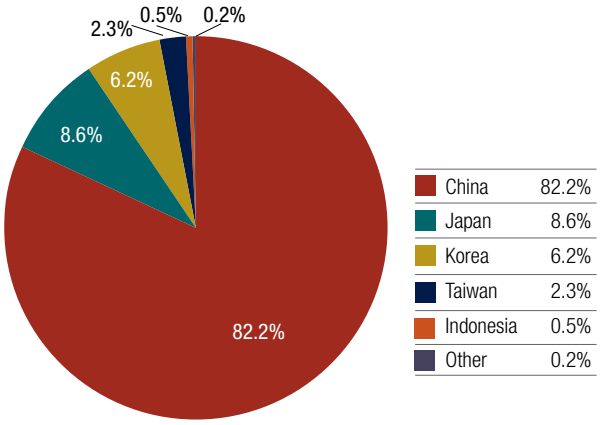


Figure 22 **Iron ore exports**
$62.4 Billion
Source: ABS

Figure 23 **Iron ore exploration expenditure 2016–17**
Total Australian spend $291.3 million
Source: ABS

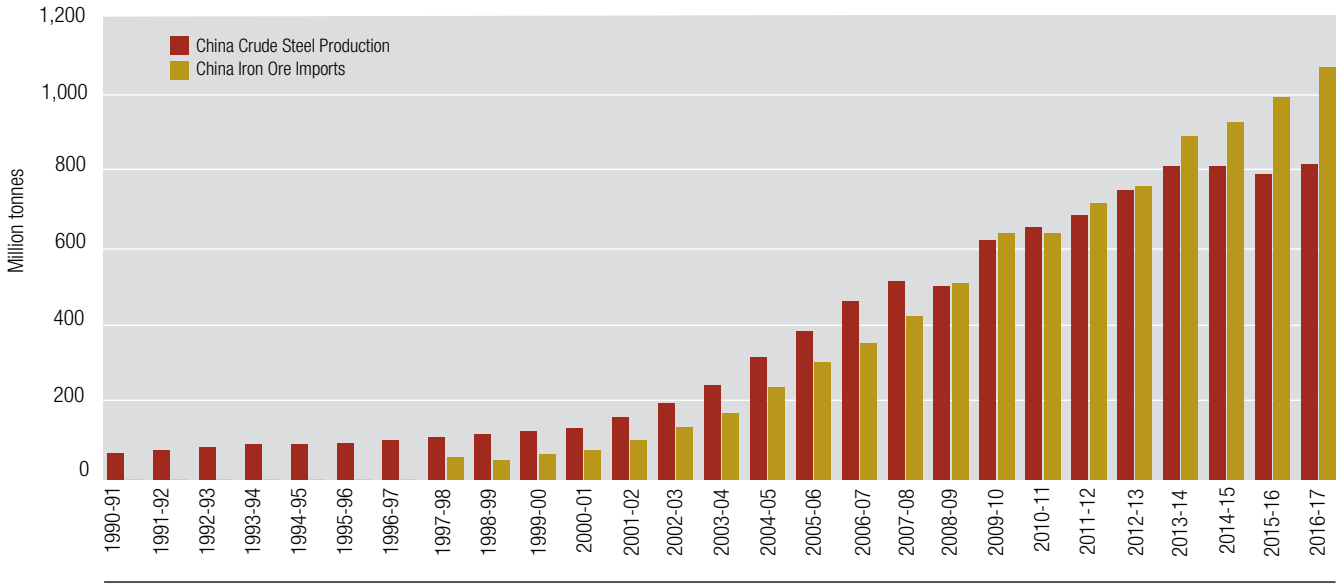


Figure 24 **China's crude steel production and iron ore imports**
Source: World Steel Association

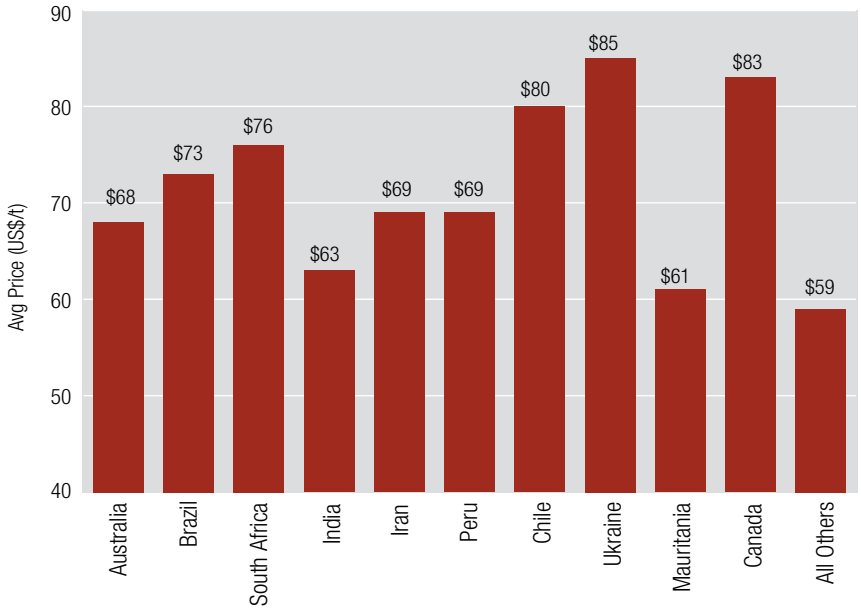


Figure 25 **China's average iron ore import price by country 2016–17**
Source: TEX Report

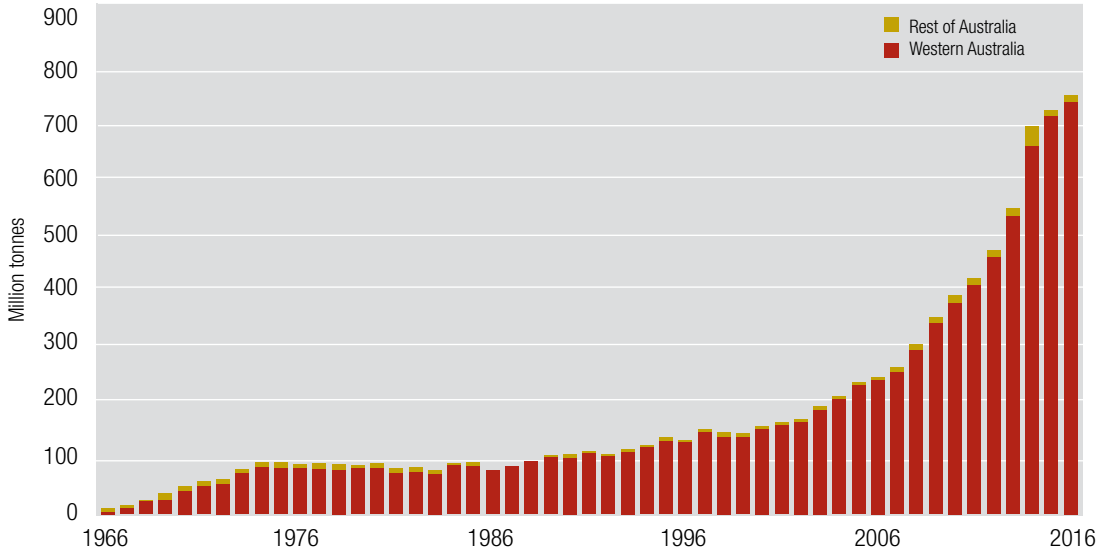


Figure 26 **WA iron ore production v rest of Australia**
Source: DMIRS and DIIS

2.2 PETROLEUM

In 2016–17, the value of petroleum products produced in State areas, onshore and offshore, and in adjacent Commonwealth offshore areas totalled $19.1 billion, up 5 per cent from $18.2 billion in 2015–16[8].

Petroleum production accounted for 18 per cent of the value of mineral and petroleum sales for Western Australia, making the petroleum sector the second most valuable after iron ore.

Japan remained the primary export destination for petroleum, taking 51 per cent, or $8.6 billion, of Western Australia's petroleum production. China and Singapore followed with 11 per cent and 10 per cent of petroleum exports respectively.

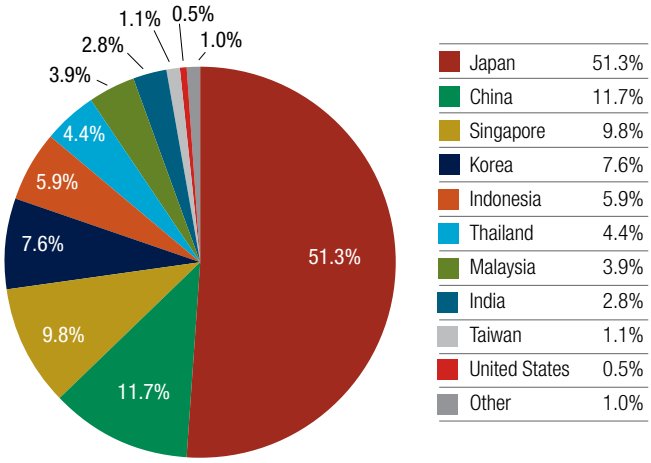


Figure 27 **Petroleum exports $16.9 Billion**
Source: DMIRS and ABS

[8] In early 2016, changes in information-sharing between the Australian and Western Australian Governments resulted in the department losing access to data relating to Western Australian offshore petroleum fields administered by the Commonwealth. Although DMIRS is working to regain access to this data, it was not available for this release.

The major commodities resources data file contains more detailed information, including:

- quarterly quantity and value figures for crude oil and condensate
- quarterly quantity and value figures for natural gas, LNG and LPG (butane and propane)
- historic annual average Tapis crude oil prices and recent monthly prices
- value of exports of petroleum products from Western Australia by destination
- annual historic crude oil and condensate production in Western Australia compared with the rest of Australia
- production and domestic consumption of natural gas in Western Australia compared with the east coast of Australia
- global trade in LNG, including Western Australia and Australia's position within the global market
- proven global oil reserves, by country and OPEC affiliation.

2.2.1 Liquefied natural gas (LNG)

Pricing

In 2016–17, global LNG prices remained low relative to the historical average, most likely affected by an oversupply of the spot market and the lower oil price, which has affected oil-linked LNG contracts.

Movements in annual average contract prices with the State's major LNG trading partners were mixed. The average annual price fell 7 per cent to US$7.10 per GJ for LNG delivered to Japan and 8 per cent to US$7.04 per GJ for LNG delivered to South Korea. Average annual prices were stable for LNG delivered to Taiwan at US$6.74 per GJ and up 13 per cent to US$6.42 per GJ for LNG delivered to mainland China. Overall, the price received by Western Australian producers was down compared to 2015–16.

While annual average prices were down across many parts of the world, there was a consistent improvement in monthly average prices. For example, the average monthly LNG import price to Japan increased 31 per cent from an average of US$6.02 in July 2016 to an average of US$7.90 in June 2017. These movements can be seen in the table below.

TABLE 3. Monthly average LNG price

	Japan	Taiwan	US	Sth Korea	China	Henry Hub
Monthly average LNG price	US$/GJ	US$/GJ	US$/GJ	US$/GJ	US$/GJ	US$/GJ
July 2016	$6.02	$6.13	$2.93	$5.57	$5.17	$2.69
June 2017	$7.90	$6.81	$3.27	$7.45	$6.81	$2.88
Growth	31%	11%	12%	34%	32%	7%

This price growth was comparable to the benchmark US Henry Hub natural gas price – a 7 per cent increase in the monthly average price between July 2016 and June 2017.

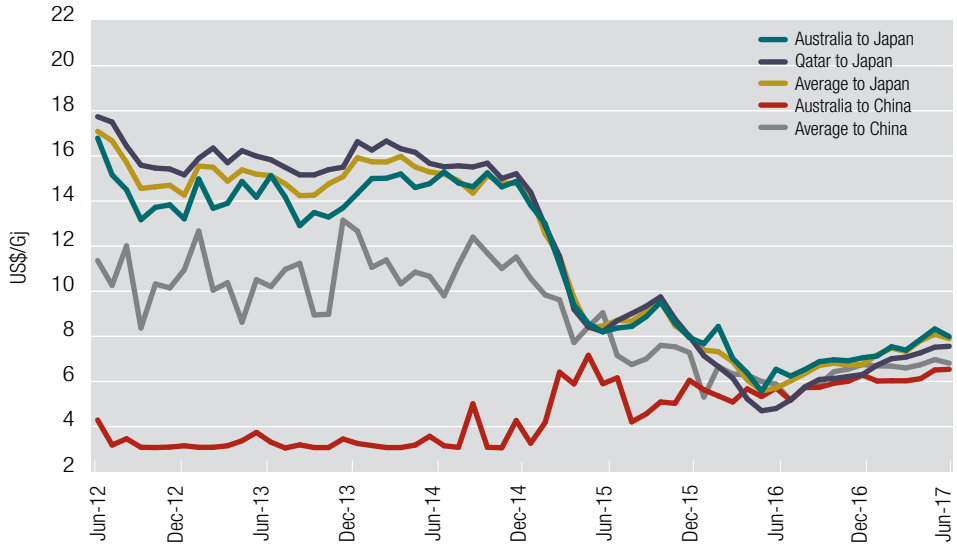


Figure 28 | **LNG import prices**
Source: EnergyQuest

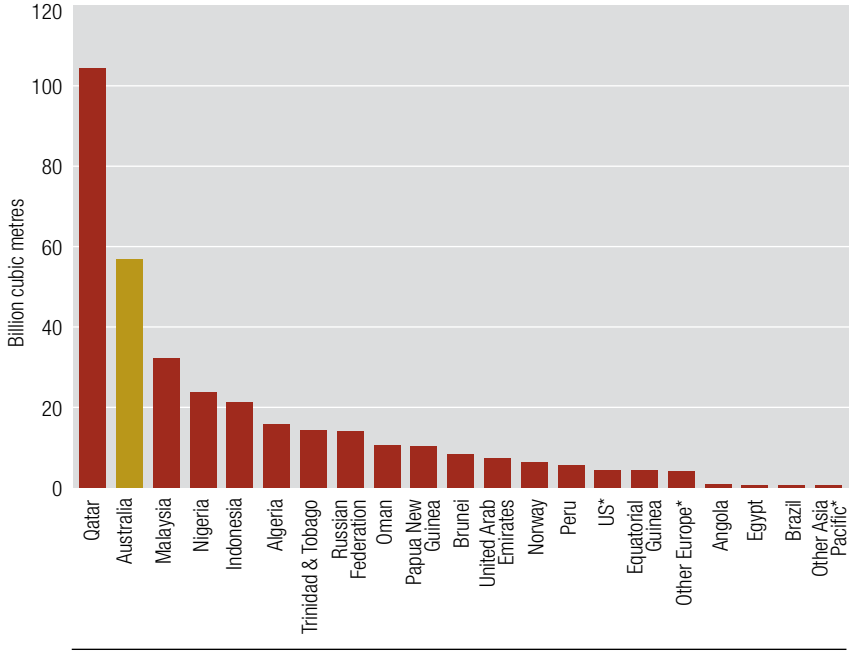


Figure 29 | **Global LNG exports by country**
Source: BP World Energy Statistics 2017
**Note: Includes re-exports*

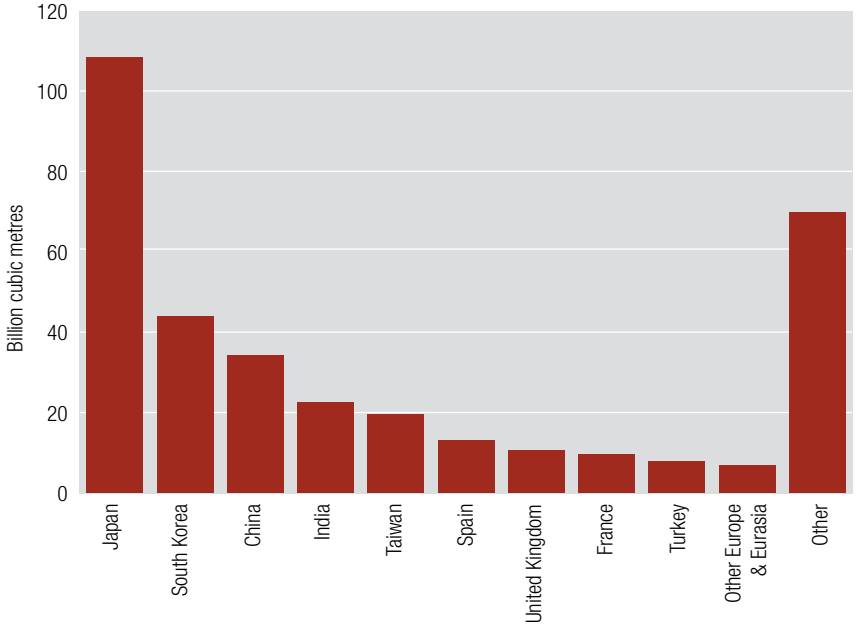


Figure 30 | **Global LNG imports by country**
Source: BP World Energy Statistics 2017

Quantity and value

The volume of LNG produced in Western Australia has increased 45 per cent in the past five years, with production reaching a record 28.7 million tonnes in 2016–17. This follows the start-up of the Gorgon LNG project, as well as record production from the North West Shelf and Pluto LNG project.

LNG was easily Western Australia's most valuable petroleum product in 2016–17, accounting for 12 per cent of the value of the State's mineral and petroleum sales. LNG sales rose from $10.8 billion in 2015–16 to $12.7 billion in 2016–17.

Although the volume of LNG sales increased 37 per cent year-on-year, the value of sales increased only 18 per cent. This result was influenced by the price received by Western Australian producers. For example, Japan and Korea accounted for 77 per cent of the State's LNG exports and the year-on-year fall in LNG delivered prices in those counties affected the overall sales value.

Notable events

- Production at the North West Shelf and Pluto projects was affected by adverse weather conditions in the March quarter. Following an electrical fault, North West Shelf operations were suspended between 15 and 28 April.
- At Gorgon, the third LNG train began production in March, three months ahead of schedule.
- Woodside announced it is considering processing gas from the Browse and Scarborough fields at onshore facilities at Burrup. Previous plans involved a floating facility, but the project was stalled in March 2016 after the company reviewed the economics of a floating facility.
- In June, Shell's Prelude gas platform, the world's largest, left South Korea for Western Australia, arriving in late July. It could take up to one year for commissioning and then Prelude is expected to produce 3.6 million tonnes of LNG and 1.3 million tonnes of condensate per year.
- Chevron's Wheatstone project completed the offshore platform hook-up and commissioning for Train 1 start-up.

More about WA LNG

Western Australia is rich in petroleum resources, with 92 per cent of Australia's conventional gas resources held in basins along the State's coastline.

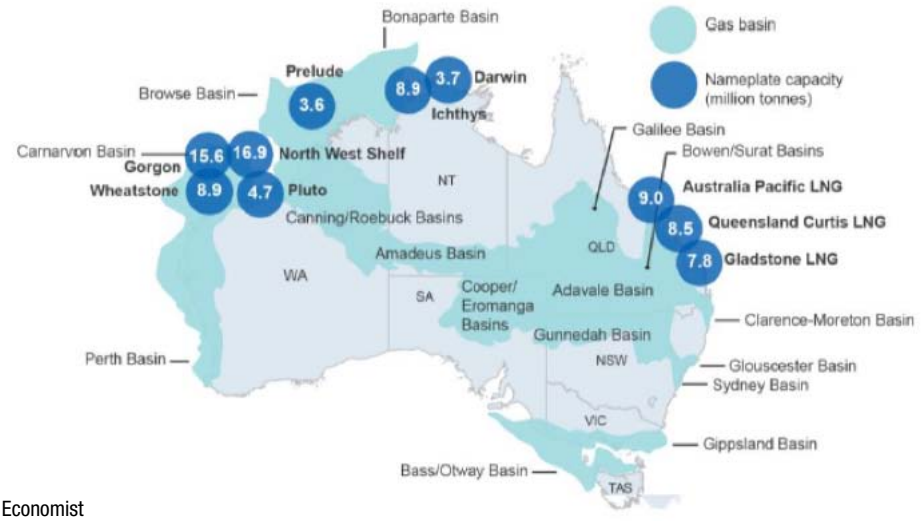
Western Australia's conventional gas reserves are calculated at 130 trillion cubic feet (tcf), while oil and natural gas liquid reserves are estimated at 1700 million barrels. In the Canning Basin alone, recoverable onshore shale gas resources are estimated between 70 and 150 tcf, with additional shale and tight gas resources in other onshore basins.

The North West Shelf, Australia's first LNG export project, began exporting gas in 1989. It was joined by the Pluto project in 2012 and the Gorgon project in 2016. There are two more projects under construction in Western Australia – Wheatstone and Prelude.

Combined, these projects will contribute an additional nameplate capacity of 12.5 million tonnes per annum (Mtpa) by 2018, bringing Western Australia up to a capacity of 48.7 Mtpa. It is estimated that Western Australia will produce about 56 per cent of all Australian LNG and be second only to Qatar in global LNG production, which currently has capacity to produce approximately 77 Mtpa.

Japan, Western Australia's the first customer for LNG exports, remains the largest consumer of Western Australian LNG. Western Australia also exports LNG to China, South Korea and Taiwan and will soon be supplying India.

Australia's LNG projects and gas basins



Source: Office of the Chief Economist

2.2.2 Crude oil and condensate

Pricing

Global oil prices have been influenced by two main counterbalancing events: the OPEC-led supply cuts[9], the increase in shale oil production by the US and removal of the US crude oil export ban.

Most OPEC oil is produced for export, whereas many non-OPEC countries, such as the US, produce oil primarily to meet domestic needs. Non-OPEC countries account for less than 25 per cent of the world's proven oil reserves, but produce 41 per cent of the world's oil. They also possess most of the world's capacity for refining crude oil into petroleum products, such as petrol and heating oil.

Some unusual production dynamics appeared in the global oil market during the first half of 2017. Shale oil production increased by 495,000 barrels per day (bpd), but this was offset by OPEC member supply cuts targeting 1.8 million barrels per day.

In the first six months of 2017, Brent crude oil spot prices averaged US$53 a barrel, while West Texas Intermediate (WTI) spot prices averaged US$50 a barrel. These average prices were about 40 per cent higher than in the corresponding period the previous year, when the market was characterised by excess global supply.

Despite price gains in the first four months of 2017, rising US oil output and speculation about persistent global oversupply coincided with a drop in prices at the start of the June quarter, bringing Brent spot prices below US$50 a barrel for the first time since November 2016.

The annual average oil price, based on a combination of Brent, WTI and Tapis, was US$50 per barrel in 2016–17, up 16 per cent from US$43 per barrel in 2015–16. This was the first increase in average prices since 2013–14.

Quantity and value

In the reporting period, Western Australian production was affected by severe weather related shutdowns, which contributed to lower production from the North-West Shelf and Pluto oil fields.

In 2016–17, crude oil volumes were down almost 30 per cent to 5.4 gigalitres, while condensate production decreased 10 per cent to 6 gigalitres. Western Australia's condensate production is a by-product of natural gas production from the North West Shelf fields.

Based largely on the fall in volumes, the value of crude oil and condensate sales fell for the sixth consecutive year to $4.3 billion, a decrease of 18 per cent.

Notable events

- OPEC's supply-cut agreement was expected to last six months, from January to June 2017. The agreement has now been extended to March 2018 and is expected to curb collective oil production by about 1.2 million bpd, while Russia and some other non-OPEC producers are cutting a further 600,000 bpd.

- Buru Energy undertook an asset swap with Mitsubishi Corp which gave Buru 100 per cent ownership of the onshore Ungani oilfield. Buru restarted production at Ungani in late June after it was halted in January 2016 for economic reasons.

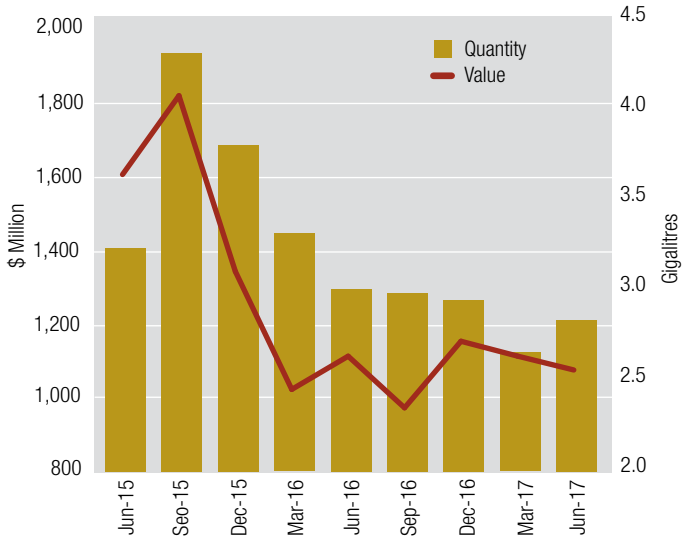


Figure 31 **Crude oil and condensate quantity and value by quarter**
Source: DMIRS

[9] OPEC is an inter-governmental organisation of oil-exporting developing nations that coordinates and unifies the petroleum policies of its member countries. OPEC's 14 member countries comprise Algeria, Angola, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela.

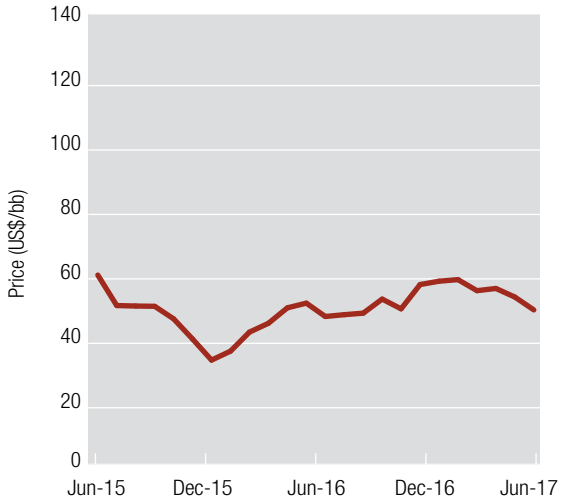


Figure 32 | **Tapis crude oil price**
Source: WA Treasury Corporation

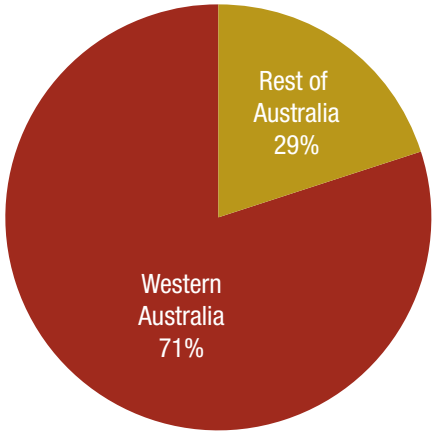


Figure 33 | **Crude oil and condensate production 2016**
Source: DMIRS and EnergyQuest

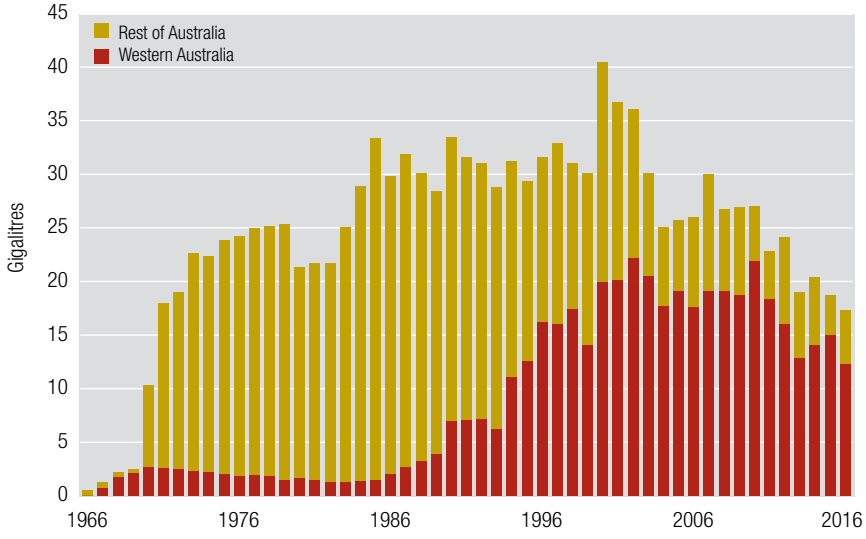


Figure 34 | **Crude oil and condensate production WA v rest of Australia**
Source: DMIRS and EnergyQuest

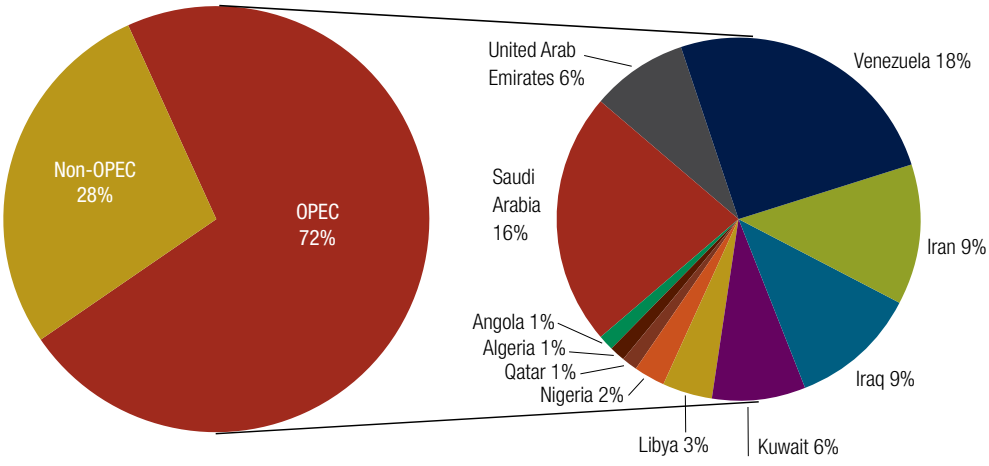


Figure 35 | **OPEC share of world crude oil reserves 2016**
Source: BP Statistical Review of World Energy 2017

2.2.3 Domestic natural gas supply

Pricing

In 2016–17, the average price of gas sold into the Dampier-to-Bunbury Natural Gas Pipeline (DBNGP) was $4.96 per gigajoule, representing a small increase from $4.92 in 2015–16.

Quantity and value

In 2016–17, the quantity of natural gas supplied into the domestic market decreased from 10.2 billion cubic metres to 9.7 billion cubic metres.

The value of domestic gas sales is based on the total sales value at the points of entry into the DBNGP, Parmelia pipeline and Goldfields pipeline. The value of domestic gas sales decreased from $1.9 billion in 2015–16 to $1.8 billion in 2015–16.

Notable events

- The first 150 terajoule per day tranche of gas flowed into the State's domestic system from the Gorgon LNG project (the total domestic gas capacity in Western Australia is about 1633 terajoules per day).

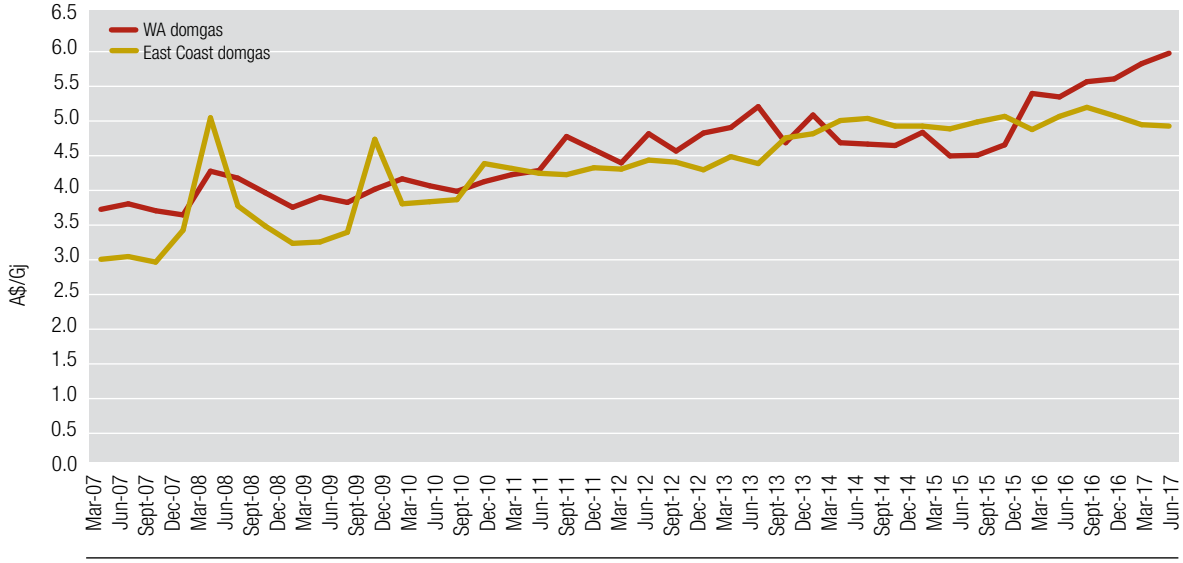


Figure 36 **Average quarterly natural gas price**
Source: EnergyQuest and DMIRS

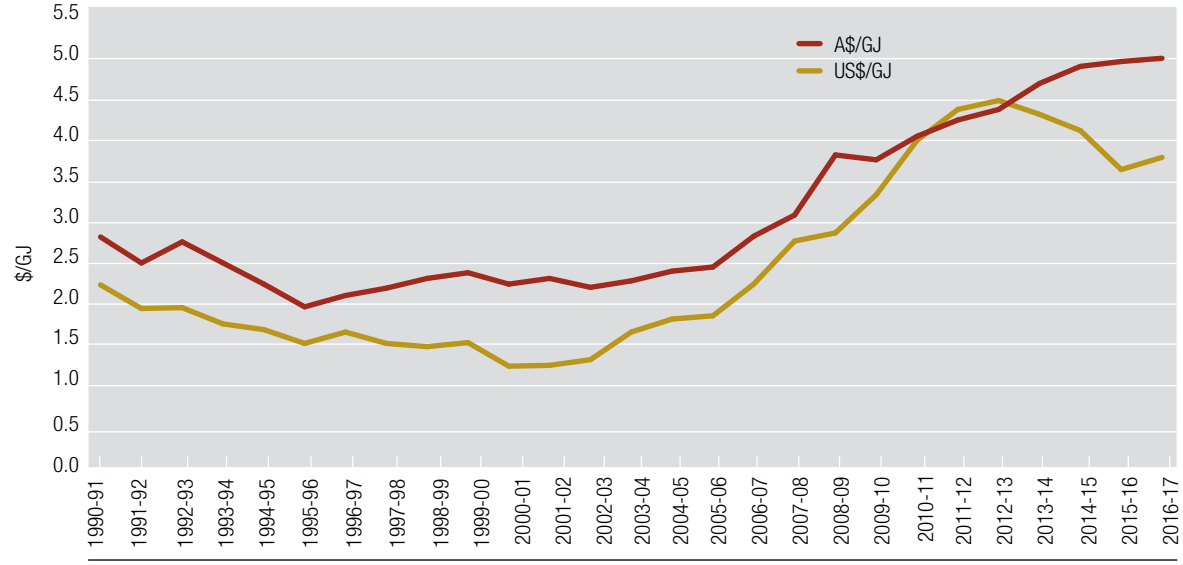


Figure 37 **Western Australian average domestic natural gas price**
Source: DMIRS
The value of Western Australian domestic gas sales is based on the summation of total domestic gas sale values as at the point of entry into the DBNGP or where applicable, the Parmelia and Goldfields pipeline.

2.3 GOLD

Pricing

Uncertainty associated with the Brexit vote in the United Kingdom and the US presidential election coincided with strong increases to the gold price in mid-2016. The average monthly gold price reached US$1341 per ounce in August 2017, the highest monthly average recorded since 2013.

Demonetisation moves in India (substantially decreasing demand from a major gold importer) and developments in the US (interest rate rises and speculation about massive infrastructure spending) coincided with a price fall towards the end of 2016, before stabilising over the remainder of the period.

The result was an 8 per cent increase in the average annual gold price to US$1257 per ounce for 2016–17. Movements in the exchange rate meant that the average Australian dollar price of gold increased only slightly from $1613 per ounce in 2015–16 to $1675 per ounce in 2016–17.

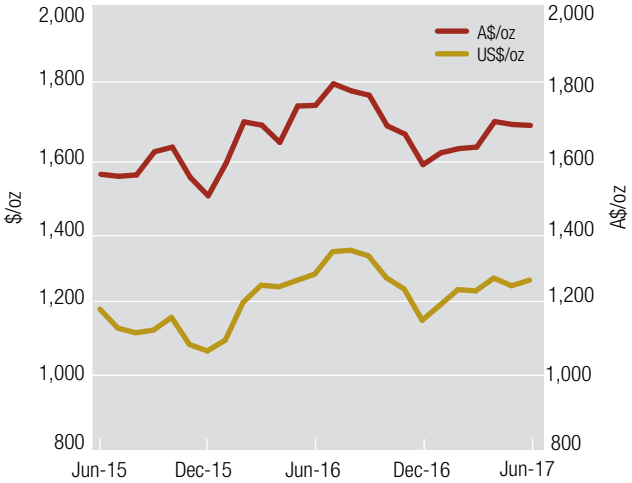


Figure 38 **Gold price**
Source: Perth Mint and Kitco

Quantity and value

Western Australia's gold sales broke through the 200 tonne barrier to reach 205 tonnes (6.6 million ounces) in 2016–17, the highest level since 1999–2000. A 4 per cent increase in year-on-year sales was achieved despite impacts to production at several mines, including record rainfall during January, which restricted operations at Newcrest's Telfer and Tanami mines.

The increase in volumes, combined with continued strength in the Australian dollar gold price, led to a 7 per cent increase in the value of the gold sector from $10.1 billion in 2015–16 to $10.8 billion in 2016–17[10]. The gold sector is Western Australia's second most valuable mineral commodity and accounts for about 70 per cent of Australia's total gold production.

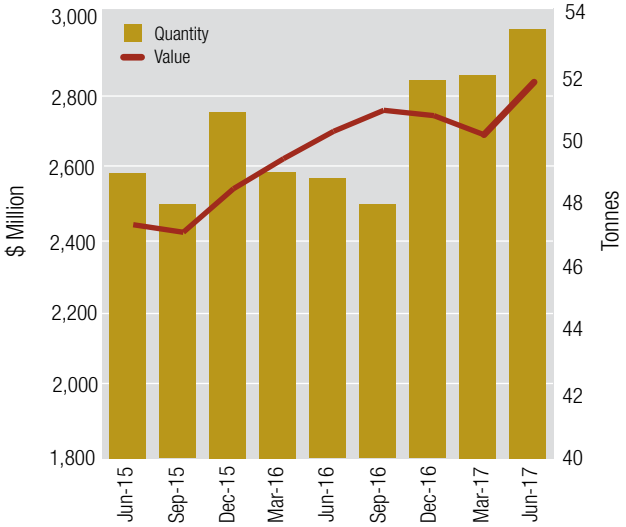


Figure 39 **Gold quantity and value by quarter**
Source: DMIRS

[10] The ABS releases Western Australian export trade data which shows a value for the export of gold that is significantly higher than the gold actually produced. This export data should be interpreted with some caution.

The Perth Mint operates Australia's only London Bullion Market Association accredited gold refinery. It refines gold produced in other Australian states and territories, as well as from surrounding countries. It also refines secondary gold, mainly from Asia. This refined gold is then exported from Western Australia.Therefore, the ABS export figure for Western Australia includes gold produced in other jurisdictions.

Ten gold projects accounted for 59 per cent of the State's total gold production:

- Newmont Australia's Boddington mine (12 per cent with 801,182 ounces)
- KCGM's Kalgoorlie Super Pit (12 per cent with 747,707 ounces)
- Newcrest's Telfer mine (6 per cent with 386,083 ounces)
- Gold Fields' St Ives mine (6 per cent with 366,207 ounces)
- AngloGold Ashanti's Tropicana mine (5 per cent with 299,770 ounces)
- Gold Fields' Granny Smith mine (4 per cent with 284,394 ounces)
- St Barbara Ltd's Gwalia operations (4 per cent with 260,828 ounces)
- Northern Star Resources' Jundee mine (3 per cent with 226,310 ounces)
- Regis Resources' Garden Wells operations (3 per cent with 221,134 ounces)
- AngloGold Ashanti's Sunrise Dam mine (3 per cent with 219,859 ounces)

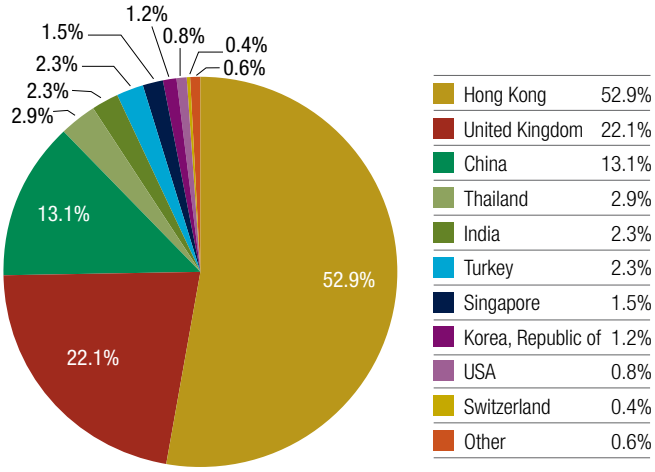


Figure 40 **Gold exports**
$17.7 Billion
Source: ABS and DMIRS estimate
Note: Includes gold refined/processed and exported from Western Australia, but produced from mining operations in other states, territories and overseas.

Notable events

- Western Australia remains the largest centre of gold exploration activity in Australia, attracting 74 per cent of national gold exploration expenditure. In 2016–17, gold exploration spend reached $509.5 million in Western Australia.
- Ramelius Resources' Vivien project and Saracen Mineral Holdings' Thunderbox project continued to ramp up. There were also significant boosts in output at several mid-tier operations, including Metals X's Higginsville project, Ramelius Resources' Mount Magnet project and Evolution Mining's Mungari project.
- Mergers and acquisitions were a theme:
    - The $350 million sale of a 50 per cent interest in the Gruyere project by Gold Road Resources to Gold Fields was completed.
    - RNC Minerals purchased Westgold's South Kalgoorlie operations for $80 million.
    - Shandong Tienye Group Bid Co's purchased Hanking Australia's Southern Cross operations for $330 million.
    - Red 5 purchased the Darlot mine from Gold Fields Limited and the King of the Hills mine from Saracen Minerals.
    - Dacian Gold started mining at the $197 million Mount Morgans project. First gold production is planned for March 2018.
    - Doray Minerals will close its Andy Well mine in November 2017, due to depletion.
    - Northern Star is decreasing production from the Paulsens mine, citing increased costs as the trigger.
    - Matsa Resources began trial mining at the Fortitude project in the Northern Goldfields.
    - Eastern Goldfields poured first gold at the Davyhurst operation.

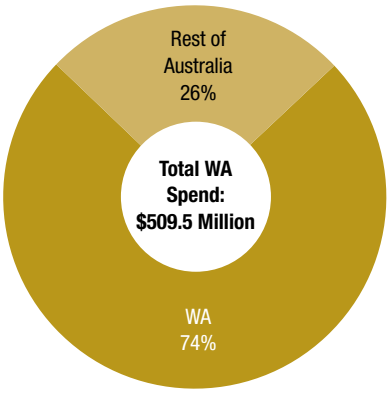


Figure 41 | **Gold exploration expenditure 2016–17**
Total Australian spend $689.2 Million
Source ABS

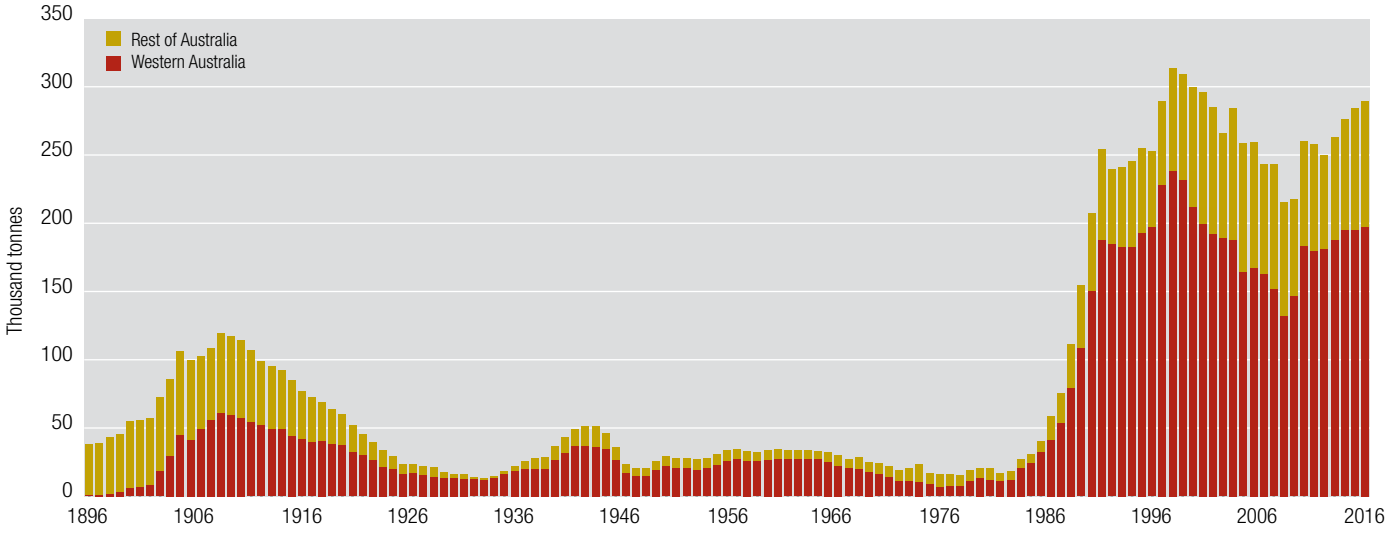


Figure 42 | **WA gold production v rest of Australia**
Source: DMIRS and DIIS

2.4 ALUMINA AND BAUXITE

Pricing

The Australian dollar alumina price increased more than 6 per cent to average $367.95 per tonne in 2016–17. This is more than $30 per tonne higher than the five and 10-year average annual price. The strong gains appear to be driven by increasing underlying aluminium prices, which have trended positively since the end of 2015.

However, alumina prices ended 2016–17 on a downward trend after the Chinese government announced plans to enforce production restrictions of up to 30 per cent on aluminium and steel as an air pollution mitigation measure. This, combined with a planned crackdown on illegal production in China and anticipated lower demand for alumina, despite the growth in aluminium prices helped prices to fall.

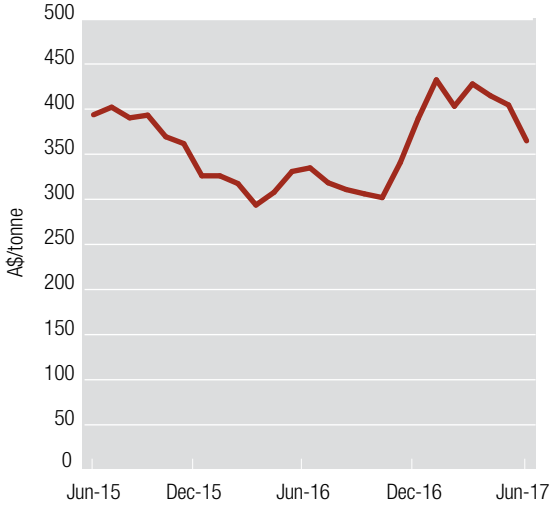


Figure 43 | **Alumina price**
Source: ABS

Quantity and value

Western Australia accounts for about 67 per cent of Australia's alumina production. This has been fairly consistent over the past 10 years, with Western Australia's producers operating at near capacity for much of that time.

Western Australian alumina and bauxite sales volumes have gradually increased year-on-year since 2010–11, but lower prices saw the first fall in sales value in 2015–16. As prices have risen, growth returned in 2016–17, with the volume sold up 1 per cent to 14 million tonnes and sales value up 3 per cent to $5.1 billion. Alumina was Western Australia's fourth most valuable commodity, accounting for almost 5 per cent of the mineral and petroleum sales value for the year.

Western Australian bauxite exports, which started in 2016, made up about 2 per cent of total sales by volume, but less than 1 per cent of total sales value, reflecting the premium paid for the refined alumina product.

The United Arab Emirates remained the top destination for Western Australian alumina, as it has been since 2013–14, increasing its share to 23 per cent of alumina exports. Bahrain and India accounted for 14 per cent and 8 per cent of exports respectively.

Chinese imports dropped by more than half, falling from $630 million in 2015–16 to $298 million in 2016–17, causing it to move from being Western Australia's second largest alumina customer to seventh. This was a consequence of plans by the Chinese government to decrease aluminium production over the winter of 2017–18. This pattern does not appear to be restricted to Western Australian exports. Overall Chinese alumina imports for the first six months of 2017 were down 41 per cent, year-on-year.

Notable events

- Alcoa received State Government approval to export 2.5 million tonnes of bauxite a year over the next five years. Alcoa simultaneously announced an agreement to sell 400,000 tonnes of bauxite from the Huntly mine to Chinese customers.
- The separation of Alcoa into upstream and downstream companies was delayed pending a court case scheduled for later this year.
- The Indonesian Government overturned its ban on bauxite exports.

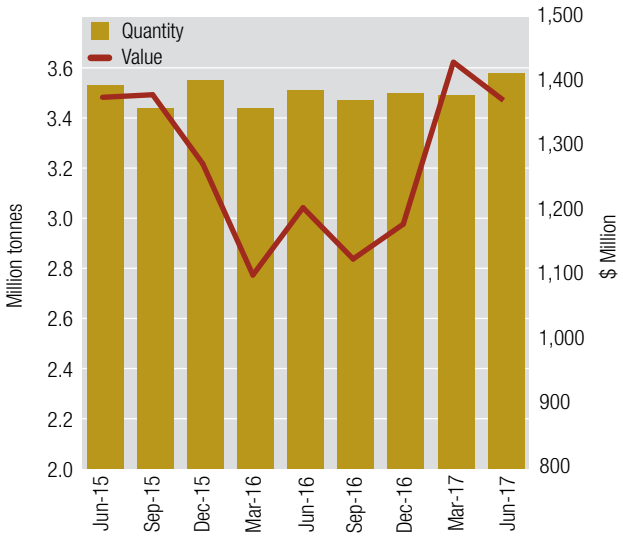


Figure 44 **Alumina and bauxite quantity and value by quarter**
Source: DMIRS

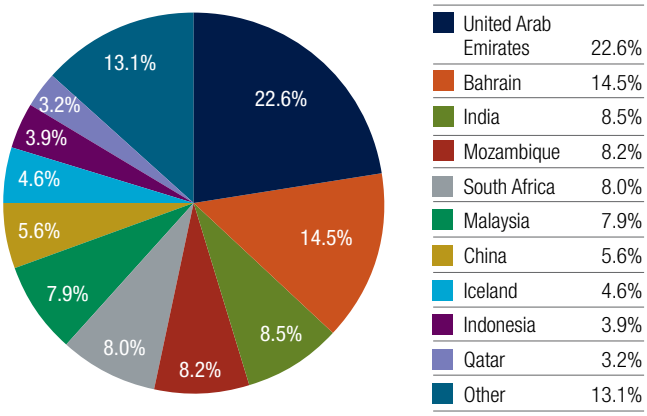


Figure 45 **Alumina exports $5.3 Billion**
Source: DMIRS estimate

The major commodities resources data file contains detailed information about alumina, including:

- quarterly quantity and value figures
- historic annual average prices and recent monthly prices
- value of alumina exports from Western Australia by destination
- annual historic production in Western Australia compared to the rest of Australia.

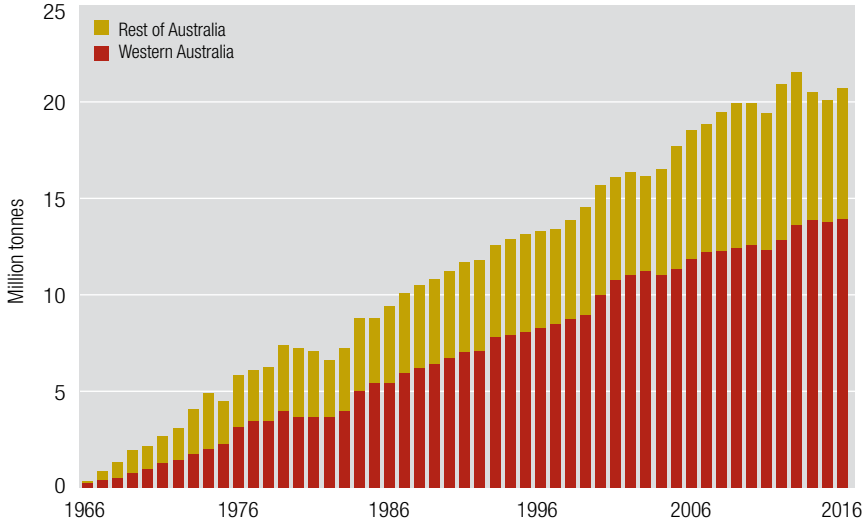


Figure 46 | **WA alumina production v rest of Australia**
Source: DMIRS and DIIS

2.5 NICKEL

Pricing

Nickel has again proven to be one of the more volatile commodities over the period. Prices were comparatively positive at the start of the financial year following strong stainless steel production in China and demand growth for nickel in batteries for electric vehicles, which pushed the monthly average to an 18-month high of US$11,142 per tonne in November 2016.

However, the nickel sector was again affected by global events. In January 2017, the Indonesian government partially relaxed its nickel ore ban, indicating a possible increase in exports. Global nickel prices subsequently fell more than 9 per cent between December 2016 and January 2017 from US$11,013 per tonne to US$9984 per tonne.

In May, the Filipino government announced it was unlikely to enforce the number of nickel mine closures it had anticipated in response to environmental concerns.

On the back of the strong prices through the first half of the financial year, the annual average nickel price increased 9 per cent from US$9320 per tonne in 2015–16 to US$10,150 per tonne in 2016–17. The increase in Australian dollar terms was slightly smaller (5 per cent) owing to the less favourable exchange rate.

Nickel miners producing cobalt as a by-product continued to take advantage of strong prices with the cobalt price hitting a high of US$58,917 per tonne in July, the highest monthly average since October 2008.

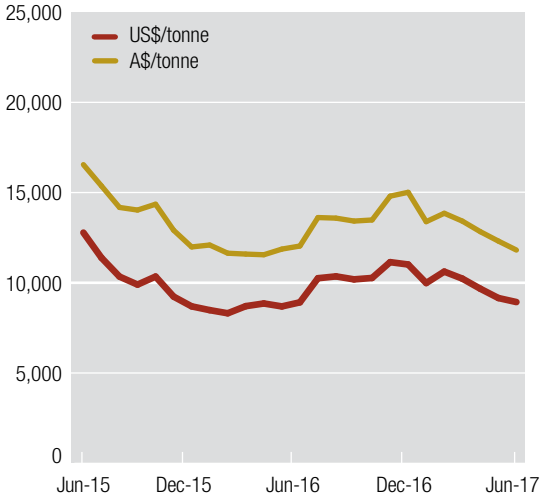


Figure 47 | **Nickel price**
Source: Argus Metals

Quantity and value

Western Australian production volumes have been trending down since 2012–13. In 2016–17, nickel volumes were down 10 per cent on the previous reporting period to 157,429 tonnes.

Declining nickel production in the March quarter was largely attributable to temporary disruptions. Glencore's Murrin Murrin mine reported a 33 per cent year-on-year drop in own-source nickel production in the March quarter 2017, which it attributed to maintenance stoppages. First Quantum reported a 21 per cent drop in output at Ravensthorpe, which it attributed to equipment maintenance and flooding.

Independence Group's Nova mine, which started production in the December quarter 2016, ramped up production over the period with an expected annual production capacity of 30,000 tonnes when fully operational.

Despite the small increase in the average annual nickel price, lower sales volumes resulted in a 5.5 per cent decrease in the value of the sector from $2.2 billion in 2015–16 to $2.1 billion in 2016–17.

The value of nickel exports was slightly more than $2 billion in 2016–17. Malaysia, Taiwan, China, South Korea and Japan were the State's top five nickel customers, accounting for 86 per cent of Western Australia's nickel exports.

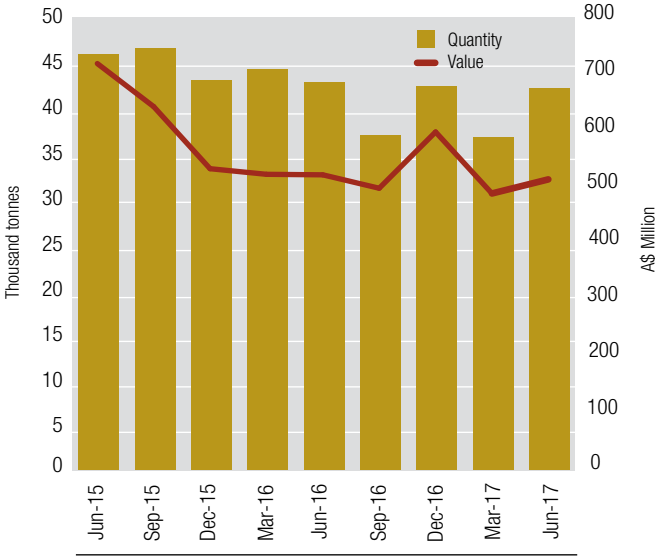


Figure 48 | **Nickel quantity and value by quarter**
Source: DMIRS

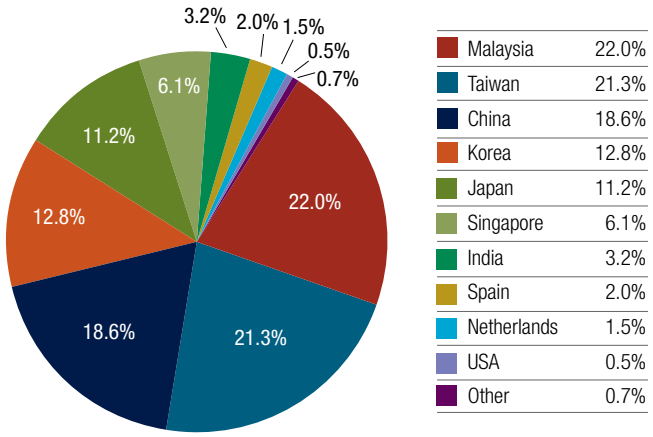


Figure 49 | **Nickel exports**
$2 Billion
Source: DMIRS

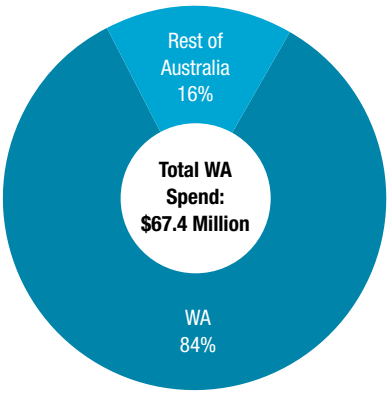


Figure 50 | **Nickel cobalt exploration expenditure 2016–17**
Total Australian spend $80.6 Million
Source: ABS

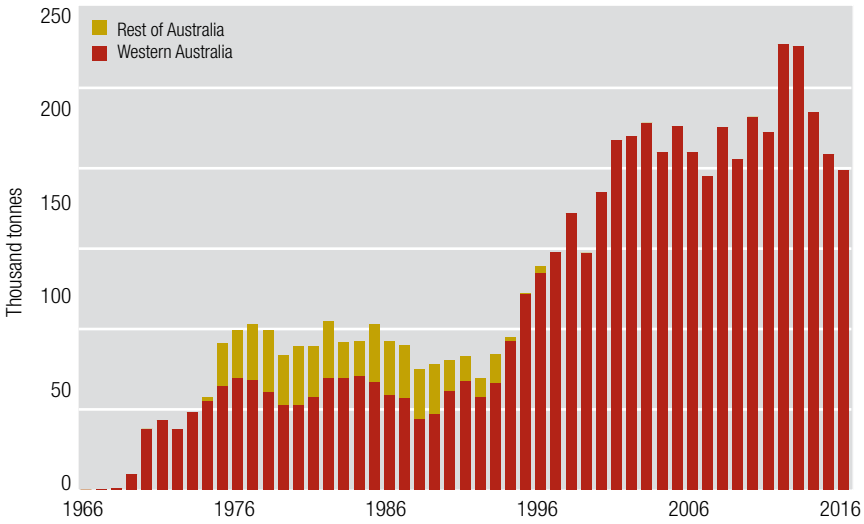


Figure 51 | **WA nickel production v rest of Australia**
Source: DMIRS and DIIS

Cobalt

In Western Australia, several nickel miners produce cobalt as a by-product and recent increases to the cobalt price have provided a small buffer against the persistently low nickel price.

Although Australia has significant cobalt reserves, there are no dedicated cobalt mines in operation. Most cobalt is mined as a by-product of copper, gold or nickel, and about 40 of Australia's gold and nickel operations are co-located with some form of cobalt deposit. These mines produce varying quantities of cobalt as a secondary commodity.

Most deposits are in Western Australia, though there are small producers in Queensland, New South Wales and South Australia. Australia accounted for 4 per cent of global cobalt production in 2011.

Notable events

- In the March quarter 2017, nickel and cobalt exploration expenditure increased by 187 per cent year-on-year to $20 million – the highest quarterly expenditure on nickel and cobalt exploration in more than two years.
- In May 2017, Poseidon Nickel released the results of a Definitive Feasibility Study for the restart of mining operations at the Silver Swan project once the nickel price improves. The project has an initial construction cost of $25 million and mine life of two years for 147,000 tonnes of ore and 8800 tonnes of contained nickel.
- In August 2016, First Quantum announced that it would place its Ravensthorpe nickel operations into care and maintenance by the end of October.
- Production at Western Area's Forrestania operations achieved record mill throughput of 618,000 tonnes, compared to a nameplate capacity of 550,000 tonnes per annum.
- Independence Group announced it will close the Long nickel mine in Kambalda due to the depletion of the deposit.
- BHP announced that it would spend $54.8 million on building the world's largest nickel sulphate plant at its Kwinana refinery. The facility is expected to produce 100,000 tonnes of nickel sulphate a year with first production expected in April 2019. A stage two expansion could increase production to 200,000 tonnes per annum.
- Western Areas has also announced that it will produce small volumes of a high-grade nickel sulphate from its Forrestania operations from the March 2019 quarter (about 1400 tonnes of sulphate based on annual nickel production of about 25,000 tonnes). It also signed new three-year off take agreements for the supply of nickel concentrate to BHP and Chinese stainless steel producer Tsingshan Group.

The major commodities resources data file contains information about nickel, including:

- quarterly quantity and value figures
- historic annual average prices and recent monthly prices
- value of nickel exports from Western Australia by destination
- annual historic nickel production in Western Australia compared to the rest of Australia.

2.6 BASE METALS

For the purposes of the Statistics Digest, base metals refer to copper, lead and zinc.

Pricing

Base metal prices increased across the board in 2016–17, with lead and zinc making substantial increases on 2015–16 prices.

Copper

After a sustained period of flat prices, copper shifted abruptly higher at the end of 2016 and into 2017. The monthly average copper price increased to its highest level in 18 months at $7750 per tonne in February 2017, 20 per cent higher than at the same time in the previous year.

The price rise coincided with strong Chinese demand and the Indonesian government's January announcement that copper concentrate exports would only be allowed conditionally. This announcement brought shipments to a temporary halt, most notably from Indonesia's Grasberg project (the world's second largest copper mine by production).

Other global factors influencing copper prices included a series of supply disruptions as a result of strike action which affected production at the Escondida mine in Chile, the world's largest copper mine, Cerro Verde in Peru and Grasberg.

The strike at Escondida lasted 44 days and was the longest in Chile's history. Chile's copper output fell 17 per cent in February and it's estimated that the lost output from the strike could total 230,000 tonnes of copper, or 1 per cent of global output.

In US dollar terms, the average annual copper price increased 10 per cent from US$4884 per tonne in 2015–16 to US$5388 per tonne in 2016–17. For Australian producers, this equated to an increase of 6 per cent from $6706 per tonne to $7146 per tonne for the same period.

Lead

The annual average price of lead increased 19 per cent between 2015–16 and 2016–17 to reach $2807 per tonne. In US dollar terms, the price averaged US$2116 per tonne in 2016–17, up 23 per cent from US$1713 in 2015–16. Short-term effects, such as movements in the US dollar and related economic data, coincided with some movements over the period, with the bulk of the price gains achieved towards the end of 2016 and through the first half of 2017.

Zinc

The average annual price of zinc increased almost 40 per cent between 2015–16 and 2016–17 to reach $3366 per tonne. This is well above the five and 10-year annual averages of $2490 and $2378 respectively.

The price increase coincided with an acute global production shortage, creating a supply deficit for zinc ore and concentrates. Rising prices also corresponded with a recovery in galvanised steel output.

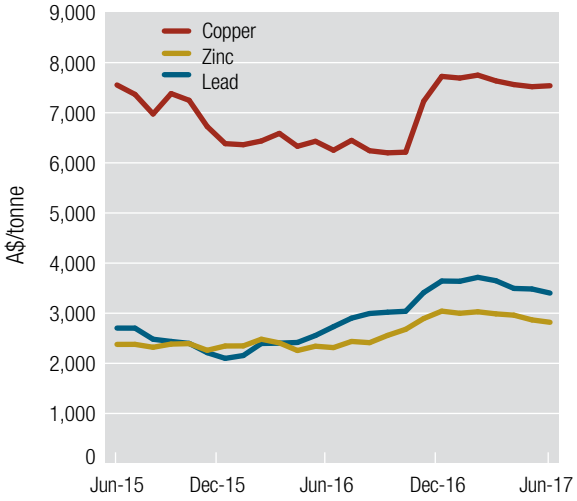


Figure 52 | **Copper, zinc and lead price**
Source: Argus Metals

Quantity and value

The value of base metals sold in 2016–17 was slightly less than $1.4 billion. Although the decrease on the previous year was slight (0.5 per cent), this still represented the lowest value since 2011–12. This fall coincided with rising prices across the base metals sector, and largely reflects falls in production volume.

Copper accounted for 85 per cent of the total value of base metals at $1.2 billion, nearly identical in value to the previous year, as price improvements almost perfectly cancelled out a 10.5 per cent drop in production volumes to 170,230 tonnes.

Decreases in copper by-product produced from suspended operations at nickel mines accounted for about 5000 tonnes of the fall in production. MMG's decision to decrease throughput at Golden Grove to preserve the value of the resource in the ground, and planned maintenance at Sandfire's DeGrussa copper gold mine, also disrupted copper supply and contributed to the decrease.

However, DeGrussa remained the State's largest copper producer, accounting for about 37 per cent of Western Australia's output. Boddington (22 per cent) and the Metals X Ltd-owned Nifty mine (16 per cent) were also significant contributors.

Zinc output was essentially static at 82,726 tonnes, resulting in sales valued at $194 million. Golden Grove production decreased in line with its decision to lower throughput, but this was compensated for by increased production at Independence Group's Jaguar operation. However, lower prices achieved for Jaguar's zinc concentrate diminished the contribution to overall value, which fell less than 1 per cent.

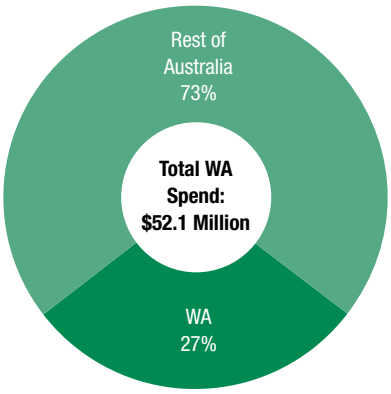


Figure 53 | **Copper, lead, zinc exploration expenditure 2016–17**
Total Australian spend $190.4 Million
Source: ABS

Lead production fell to its lowest level since 2004–05, with production of about 3500 tonnes worth slightly more than $10 million. Golden Grove was the sole lead producer in Western Australia.

Notable events

- In late 2016, LeadFX announced it had begun advance planning for a potential restart of the Paroo Station project. The company also announced plans (pending the results of a definitive feasibility study) to construct a lead refinery in the area, and convert the project from the production of lead concentrate to metal.
- Metals X sought to take advantage of higher copper prices and reduce risk, hedging up to 50 per cent of production from Nifty at between A$7500 and A$8100 per tonne for the following 12 months. Metals X also announced a 59 per cent increase in reserves at the newly acquired Nifty copper mine.
- Sandfire Resources began works to exploit the Monty copper deposit as a satellite of the nearby DeGrussa mine. First ore from this deposit is expected in 2018–19.
- EMR Capital bought the Golden Grove copper-lead-zinc project from MMG Limited in February 2017 for US$210 million.
- Sandfire and Talisman Mining progressed plans to develop the Monty project, with environmental approval granted mid-2017. Monty has a probable reserve of 80,000 tonnes of copper and 42 ounces of gold with a grade of 8.7 per cent copper. This makes it one of the highest grade copper mines in the world.
- Metalicity's proposed Admiral Bay direct-shipping ore zinc project, currently at feasibility stage, is expected to cost almost $1 billion and has a current resource of 170 million tonnes, grading 4.1 per cent zinc. Production is not expected until 2021.

The major commodities resources data file contains:

- quarterly quantity and value figures for base metals
- historic annual average prices for copper, lead and zinc and recent monthly prices
- value of base metals exports from Western Australia by destination
- annual historic base metals production in Western Australia compared to the rest of Australia.

2.7 MINERAL SANDS

In Western Australia, the mineral sands industry is primarily focused on titanium minerals such as ilmenite, which can be sold directly or upgraded to synthetic rutile. These minerals represented more than half of the industry's value for 2016–17. The remainder came from zircon, garnet and staurolite.

The Perth Basin, Murray Basin (New South Wales, Victoria and South Australia) and Eucla Basin (Western Australia and South Australia) host the major share of Australia's mineral sands resources. Major economic resources have recently been identified in the Canning Basin.

Pricing

Collectively, mineral sands prices in Western Australia were slightly lower year-on-year with rutile prices falling 7 per cent to $1201 per tonne and zircon falling 3 per cent to $1142 per tonne.

Quantity and value

Mineral sands sales volumes increased to their highest level since 2012–13 with almost 1.4 million tonnes across all mineral sands commodities. This was primarily due to dramatically increased sales from GMA Garnet's Port Gregory project, which increased sales volumes 125 per cent on the previous year. Price improvements meant garnet sales rose in value 146 per cent and exceeded $150 million.

However, the overall value of the industry was essentially static, as significant decreases in the production of rutile (50 per cent decrease to $20 million), leucoxene (70 per cent decrease to $5 million) and zircon (44 per cent decrease to $76 million) offset most of the gains. The result was a slight improvement in the value of sales to reach $554 million in 2016–17.

Industry strength varied considerably quarter to quarter, with the strongest quarter (December) representing 37 per cent of sales and the weakest quarter only 17 per cent. Iluka's Narngulu mineral separation plant was shut down late in 2016, which was the likely reason for the drop in sales and the relative weakness of the second half.

As is typical, Western Australian mineral sands exports exceeded reported production in 2016–17, with $794 million in exports. This discrepancy is the result of re-exporting of interstate production processed in Western Australia, as well as a small amount of production on mineral-to-owner land.

Unlike many of the commodities produced in Western Australia, mineral sands are exported to a wide range of countries – 35 in 2016–17. China was the State's largest export market, but accounted for just 25 per cent of exports. Other major destinations included the United Kingdom (12 per cent), Saudi Arabia (11 per cent) and the United States (11 per cent).

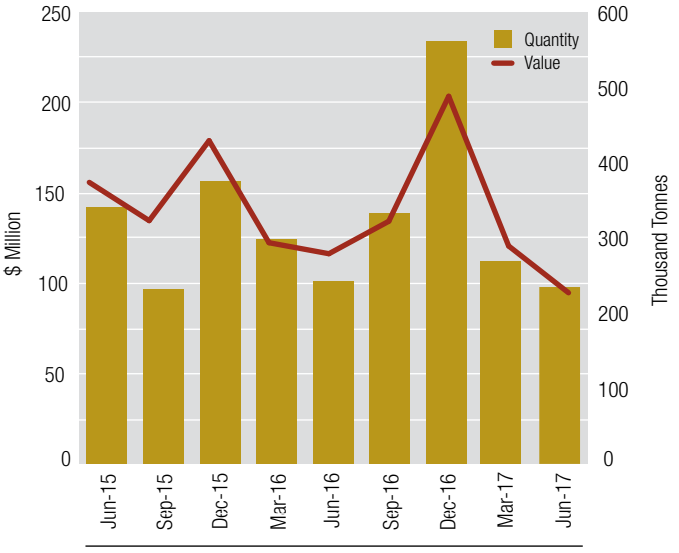


Figure 54 **Mineral sands quantity and value by quarter**
Source: DMIRS and DIIS

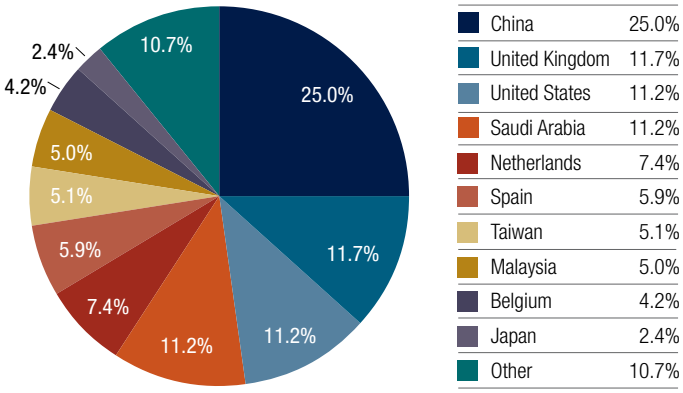


Figure 55 **Mineral sands exports $794 Million**
Source: DMIRS estimate
Note: Exports include titanium dioxide and product sourced from private land, overseas and other States and processed in Western Australia.

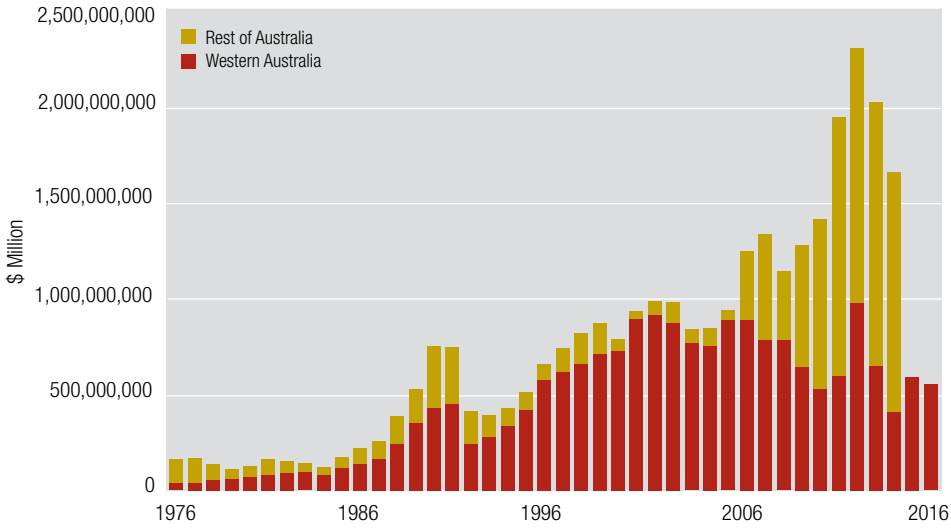


Figure 56 **WA mineral sands production v rest of Australia**
Includes Ilmenite, Leucoxene, Upgraded Ilmenite, Rutile, Zircon and Monazite
Source: DMIRS and DIIS
2015 and 2016 data for "Rest of Australia" was not available at time of publication

Notable events

- Tronox acquired mineral sands producer Cristal Mining Australia with the combined company operating 11 titanium dioxide pigment plants in eight countries with a capacity of 1.3 million tonnes per annum.
- Tronox operates Cooljarloo in Western Australia and will take over Cristal's Wonnerup project once the transaction is finalised. Iluka also acquired Sierra Rutile during the quarter, indicating a view to look outside Western Australia for growth.
- Sheffield Resources continued with the Thunderbird project development and increased reserves to 700 million tonnes during the March quarter. A bankable feasibility study was also released, indicating a net present value of more than $620 million and a 42-year mine life. Sheffield also signed up significant offtake agreements for the project and now has three contracts covering 40 per cent of total output from stage one. The company expects to have permit, finance and offtake arrangements finalised in the September quarter and expects to begin construction in late 2017.

2.8 DIAMONDS

Pricing

With no universal, transparent market price for diamonds and little publicly available data, it is difficult to determine the true situation regarding the prices received by mining companies.

However, there were indications that the market, at least for larger higher quality diamonds, recovered to some degree. Depleted inventories appear to have driven higher demand from jewellers, which improved prices for producers of high-quality diamonds. At the other end of the spectrum, poor prices for smaller, lower-grade diamonds may have been driven by changing consumer preferences in the United States and the substitution of natural diamonds by lower-priced Chinese synthetics.

Quantity and value

Diamond sale volumes in Western Australia were 12.6 million carats in 2016–17, down 9 per cent on 2015–16, while sales value was down 24 per cent from $354 million in 2015–16 to $268 million in 2016–17.

Notable events

- Higher-than-average rainfall in the Kimberley region, as well as maintenance works in the June 2017 quarter, affected the Argyle underground mine production.
- A possible extension of the Argyle underground mine was placed under review. Mineral resources that may be developed within the current mine plan were revised down from 44 million tonnes to 15 million tonnes (at 31 December 2016). The existing mine plan provides for production to 2020–21 with ore reserves of 29 million tonnes (at 31 December 2016).

2.9 OTHER

2.9.1 Coal

Pricing

Neither global nor Australian prices have a substantial effect on Western Australian coal prices as the coal is produced and sold locally, based on long-term contracts.

About 90 per cent of Collie coal is used as thermal coal, mostly in power stations, with some used to fire cement kilns in Perth. The rest is used for metallurgical purposes by the mineral sands industry to transform ilmenite to synthetic rutile and a small amount is used to reduce silica sand to silicon.

Quantity and value

Western Australia's two black coal mines are in Collie, in the South-West. The amount of coal sold decreased slightly more than 1 per cent from 6.9 million tonnes in 2015–16 to 6.8 million tonnes in 2016–17. Sales values were relatively stable with an increase of slightly more than 0.5 per cent to $338 million.

Notable events

- Yancoal, the manager of Premier Coal on behalf of owner Yanzhou Coal Mining Company, acquired Coal & Allied Industries, a subsidiary of Rio Tinto. The acquisition did not have any direct impact on Premier Coal.
- Lanco Resources, the parent company of Griffin Coal, entered into receivership in May 2017. Griffin Coal continued operating as usual.
- Both operations also managed industrial relations issues during the year.

2.9.2 Salt

Pricing

The price received for Western Australian salt dropped slightly in the reporting period, from $30.60 per tonne in 2015–16 to $26.87 per tonne on average

A note about salt pricing

Salt is not a standard product and its composition differs significantly, including purity and method of manufacture. There are also variations in individual contracts between specific customers and suppliers, and variations in shipping costs. Combined, these factors mean that prices vary across the world.

The salt price reported by DMIRS is the average free-on-board (FOB) price received by all salt producers in Western Australia and is based on information received from Western Australian producers. Comparisons between FOB prices and the cost including freight (CIF) or cost and freight (CFR) price paid in the destination country, may suggest a discrepancy if full shipping costs are not taken into account.

Under State Agreements, which govern the royalty rates for salt, highly detailed price audits are carried out and include examination of invoices for the various services associated with getting the salt to market, such as shipping and handling, as well as the price ultimately paid by the customer in the destination nation.

While the details of the audits are confidential, they confirm that once all costs are considered, DMIRS' reported price is an accurate representation of the value of the salt produced.

Quantity and value

Western Australia accounts for most of Australia's salt production. Dampier Salt, with operations in Dampier and Port Hedland in the Pilbara and Lake MacLeod in the Gascoyne, is the State's biggest producer. The company accounted for about 73 per cent of the salt sold from Western Australia by volume in 2016–17. Almost all of this production is exported, making Dampier Salt the world's largest exporter of high-quality bulk, solar salt.

Onslow Salt's operation at Onslow is Western Australia's next-largest salt operation, with 17 per cent of production by volume. The remainder comes from smaller producers, including those focused primarily on domestic production.

In 2016–17, salt sales totalled 11 million tonnes, essentially steady on 2015–16. The price decrease, however, resulted in a 13 per cent fall in sales value to $292 million.

Notable events

- K + S Group is proposing to construct and operate the $350 million, 3.5 million tonnes per annum Ashburton salt project. The environmental approvals process for the project began in October 2016 through referral to the Environmental Protection Authority (EPA). The EPA determined to assess the project at the level of Public Environmental Review.

2.9.3 Lithium, tantalum and tin

Emergence of the battery market

Global battery markets entered a period of extremely rapid growth in recent years, and the implications for Western Australia are potentially significant. This is partly due to the potential of battery technology itself, and its capability to revolutionise clean energy, vehicles, and consumer products. However, battery growth also creates opportunities for producers of key commodities, notably lithium, graphite, cobalt and nickel.

Western Australia has major deposits of some of these, and is well placed to capitalise on the opportunities that increased battery demand is creating.

Globally, Australia ranks fourth in lithium deposits – behind Chile, Argentina and China. Most of Australia's economic demonstrated resources (EDR) of lithium occur within hard rock pegmatite deposits in Western Australia, although other deposits have been found in the Northern Territory, and further exploration has started in other states.

Western Australia is the largest lithium producer, and significant resources of spodumene mean that it is likely to remain a major producer over the longer term. Many Western Australian companies are already targeting near-term concentrate production for sale to Chinese conversion facilities.

The Greenbushes deposit, the world's largest and highest grade spodumene deposit, contains about half of Australia's lithium EDR. It accounts for about 30 per cent of global lithium production. The Mount Cattlin mine began production in late 2016 while Mount Marion achieved its first shipment in February 2017.

There is also a strong prospect of further operations being developed, with Pilbara Minerals Limited and Altura Mining recently completing positive definitive feasibility studies for mines in the Pilgangoora region. Pilgangoora is now regarded as the world's second largest deposit.

The recent rise in the lithium price has also increased interest in operations where lithium has been produced as a by-product, such as the Bald Hill tantalum mine. In March 2017, Talison Lithium Pty Ltd announced that it had approved the expansion of Greenbushes to double annual production. The expansion will supply a $400 million lithium processing plant to be built at Kwinana, south of Perth.

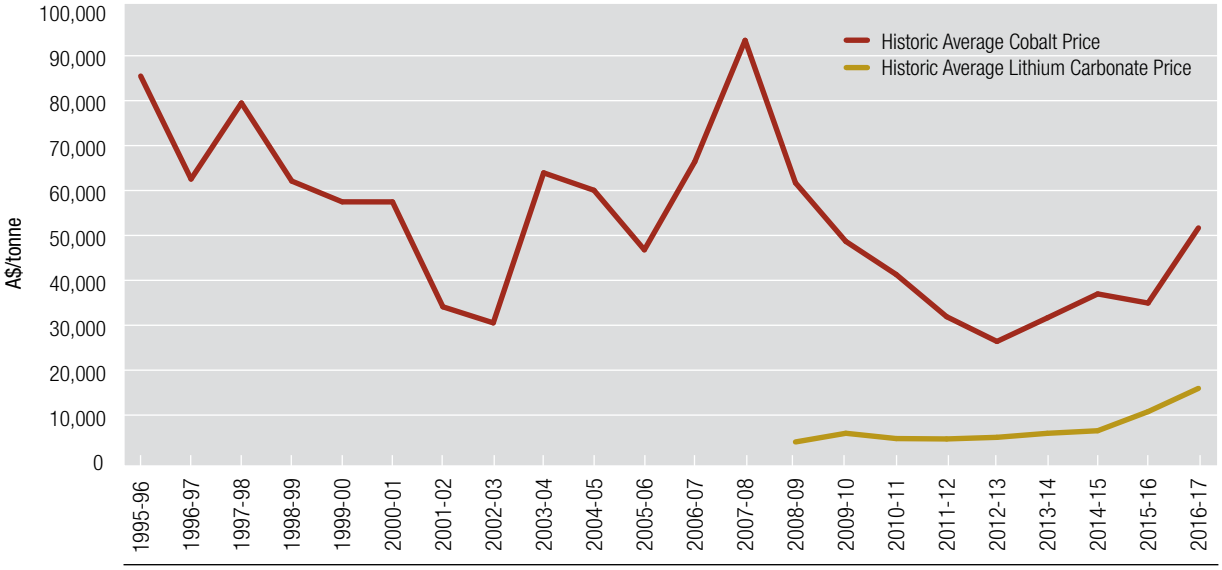


Figure 57 | **Battery minerals average annual price**
Source: Argus Metals

Price

The global lithium market is complex. Given the variety of distinct products, variations between geographically disparate markets and the relative dominance of long-term contracts between producers and large consumers, as opposed to spot markets, no standard global benchmark price has been established.

However, several pricing metrics have been established and they serve to indicate the general positive trend of the lithium market in recent years. For example, the average received price for lithium carbonate in China improved 21 per cent over the year to $17,764 per tonne in June. In 2016–17, it averaged $15,946, representing a 48 per cent improvement on the previous year and a 145 per cent improvement on 2014–15. This price growth has coincided with increasing demand for lithium as a key component in high-energy density batteries for use in consumer electronics, clean-energy storage and electric vehicles. Price growth has continued in tandem with increased supply – the USGS estimates an 11 per cent increase in global lithium production from calendar year 2015 to 2016.

Tin prices also improved, growing 22 per cent from $21,516 per tonne in 2015–16 to $26,354 per tonne in 2016–17.

Quantity and value

The value of Western Australian lithium, tantalum and tin grew substantially in 2016–17, improving 128 per cent to $616 million. The growth coincided with increases in volume as new or previously mothballed producers came online and the high price of spodumene. This resulted in an estimated 92 per cent increase in produced spodumene concentrate equivalent.

- Galaxy Resources' Mount Cattlin and Reed Industrial Minerals' Mount Marion projects started lithium concentrate shipments in early 2017.
- Mineral Resources also established a lithium direct-shipping ore operation at Wodgina, with a first shipment achieved in April 2017. It is being operated on a 12-month trial, targeting shipments of between 100,000 and 200,000 tonnes per month. The project was previously operated as a tantalum mine between 1989 and 2012.

- Pilbara Minerals and Altura Mining started construction on two lithium projects at Pilgangoora.
- Talison Lithium committed to doubling the lithium concentrate production capacity of the Greenbushes project to 1.34 million tonnes per annum at a capital cost of $320 million.
- Tawana Resources announced positive results from a pre-feasibility study on its Bald Hill lithium-tantalum mine, forecasting annual production of 155,000 tonnes per annum of lithium concentrate and 260,000 pounds per annum of tantalum, at a capital cost of $42 million.
- Kidman Resources and Chilean company Sociedad Quimica t Minera de Chila S.A. announced a 50:50 joint venture for the development of the Mount Holland lithium project. They will develop the Early Grey deposit and a possible downstream lithium refinery operation.
- In September 2016, Tianqi Lithium announced it would construct a $400 million lithium hydroxide processing plant with a capacity of 24,000 tonnes per annum, creating up to 500 jobs during construction and 118 jobs once operational. It is expected to be completed by the end of 2017. A feasibility study into the doubling the plant's capacity to 48,000 tonnes per annum was also approved
- Neometals and Mineral Resources entered into a Memorandum of Understanding in September 2016 to assess the development of a downstream lithium processing facility near the Mount Marion project.

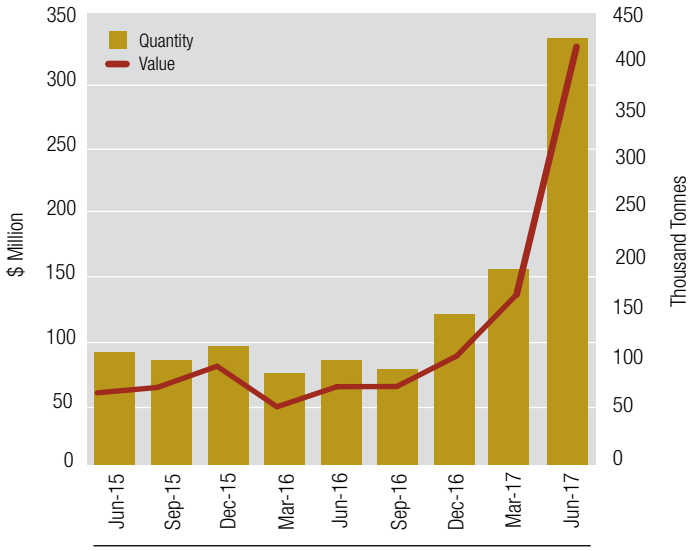


Figure 58 | **Spodumene concentrate quantity and value by quarter**
Source: DMIRS

2.9.4 Manganese

Pricing

Improved manganese prices have coincided with cuts to marginal supply and record levels of steel production in China, as well as positive market sentiment fuelling an increase in port stockpiles. However, the market remains fragile.

Low manganese prices during the previous financial year contributed to two of Australia's operating mines going into care and maintenance: Bootu Creek (Northern Territory) in December 2015 and Woodie Woodie in January 2016. As Woodie Woodie was Western Australia's only active manganese mine at the time, no manganese was mined in 2016–17. However, sales of existing stockpiles continued. Some limited processing of remnant low-grade stockpiles occurred between May and July 2016, with further processing of selected low-grade stockpiles restarting in January 2017.

Quantity and value

In 2016–17, the volume of manganese sold in Western Australia fell about 44 per cent to 236,470 tonnes. The sales value also fell (about 61 per cent) to $57 million against overall increases in price. This discrepancy coincided with declining average grades of stockpiled material.

Notable events

- Consolidated Minerals, the owner of the Woodie Woodie project, was acquired on 25 May 2017 by China Tian Yuan Manganese Limited, a subsidiary of Ningxia Tianyuan Manganese Industry Company Limited (TMI). TMI is one of the world's largest producers of electrolytic manganese metal, used in stainless steel production.
- At Hancock Prospecting's Nicholas Downs project, remaining manganese ore stockpiles were sold in the second half of 2017 with rehabilitation undertaken in preparation for closure.
- The State Government discontinued its discount on charges applied to manganese exports at the Utah Point Bulk Handling Facility.

2.9.5 Rare earth elements

Pricing

Demand for rare earth elements is driven by niche uses, primarily in the high-tech industries. They have applications in nuclear reactors, consumer electronics, electric and hybrid vehicles, batteries, lighting (phosphors) and lasers. However, the dominant driver of growth for many key rare earths (including neodymium, dysprosium and praseodymium) is the growth in demand for high-powered permanent magnets, primarily in electric vehicles (which require high-powered magnets for efficient electric motors) and wind turbines.

Western Australia's rare earths are mostly lanthanum, cerium, neodymium and praseodymium oxides. Average prices for these commodities were generally slightly weaker in 2016–17 compared to the previous year, falling 24, 9, 4 and 4 per cent respectively, resulting in an overall fall of 14 per cent for the realised price of Lynas Corporation Ltd ore. However, by the end of the reporting period, prices were on a positive trend, with major products neodymium and praseodymium improving by 5 and 10 per cent respectively since the start of 2017.

Quantity and value

Lynas operates Australia's only rare earths mine at Mount Weld, Western Australia, supplying rare earth concentrates to the Lynas Advanced Materials Plant in Malaysia. The mine started production in 2011 with an expected mine life of 20 years.

Lynas reported 14,616 tonnes of final product sales in 2016–17, with total sales revenue of $264 million.

Two other projects are relatively close to production:

- Northern Minerals Browns Range project in the Kimberley region is expected to produce 3100 tonnes per annum. A pilot plant production run is expected in 2018.
- Hastings Technology Metals Yangibana project in the Gascoyne region expects annual production of 8400 tonnes. A pre-feasibility study indicates production may start in 2019.

Notable events

- A second mining campaign at Mount Weld was conducted between January and May 2017 to extract about one year of processing feed. This was the first mining campaign since 2007–08, with the operation processing stockpiled ore since commissioning in 2011.
- There were some positive new developments in the industry with Northern Minerals approving the development of a $56 million, three-year pilot plant at the Browns Range project in April 2017. A single six-month mining campaign started in June 2017 with all ore to be stockpiled ahead of the pilot plant phase. Onsite plant construction was expected to begin in the September 2017 quarter with first pilot plant production targeted for the first half of 2018. The pilot project will enable the operator to assess the economic feasibility of a full-scale commercial operation.
- Hastings Technology Metals is also progressing a definitive feasibility study on its Yangibana project. It is targeting a capital cost of between $390 and $420 million, with the start of construction in the March 2018 quarter and first production by late 2019. This is a lead agency project of the Department of Mines, Industry Regulation and Safety, which will provide coordinated approvals support across Western Australian government agencies. It is currently being assessed by the EPA at the level of Public Environmental Review.

TABLE 4. Quick resources facts – 2016–17	
Output of minerals and energy	**$ million**
Western Australia	$104,959
Australia (DMIRS estimate only)	$215,010
WA minerals	$85,883
WA petroleum	$19,076
Major Western Australian commodities	**$ million**
Iron Ore	$63,653
Petroleum	$19,076
Gold	$10,830
Alumina	$5,088
Nickel	$2,340
Crude oil and condensate	**Million barrels**
Western Australia	72
Australia	105
WA share	69%
Natural gas (inc. LNG feedstock and CSG)	**Million cubic metres**
Western Australia	50,672
Australia	104,638
WA share	48%
Merchandise exports	**$ million**
Western Australia	$120,636
Australia	$290,859
WA share	41%
WA exports of minerals and energy as % share of all State Merchandise exports	90%
Mineral and energy exports	**$ million**
Western Australia	$108,234
Australia (DMIRS estimate only)	$171,180
WA share	63%
Exploration expenditure (mineral)	**$ million**
Western Australia	$1,028
Australia	$1,565
WA share	66%
Exploration expenditure (petroleum)	**$ million**
Western Australia	$652
Australia	$1,376
WA share	47%
Private new capital investment	**$ million**
Western Australia	$29,041
Australia	$114,281
WA share	25%
Mining investment	
Western Australia	$22,221
Australia	$38,668
WA share	57%
Economic impact	**$ million**
Australia GDP 2015-16	$1,658,740
Western Australian GSP 2015-16	$255,214
Mining component of WA GSP *	28%

* Note: The ABS categorise alumina as manufacturing and is not included in the GSP mining component above.

All data is for the 2016–17 financial year unless otherwise stated.

TABLE 5. Quantity and value of minerals and petroleum					
COMMODITY		FINANCIAL YEAR 2015–16		FINANCIAL YEAR 2016–17	
	UNIT	QUANTITY	VALUE	QUANTITY	VALUE
ALUMINA AND BAUXITE	t	13,941,243	4,939,232,470	14,037,628	5,087,629,856
BASE METALS					
Copper Metal	t	190,298	1,180,826,384	170,228	1,179,229,687
Lead Metal	t	5,988	14,810,595	3,488	10,208,858
Zinc Metal	t	82,676	195,494,453	82,726	194,144,951
TOTAL BASE METALS			1,391,131,432		1,383,583,496
CHROMITE	t	0	0	0	0
CLAYS		21,969	1,104,708	20,865	1,390,448
COAL	t	6,890,951	336,466,825	6,806,390	338,435,045
CONSTRUCTION MATERIALS					
Aggregate	t	1,143,211	42,635,640	1,052,475	29,142,593
Gravel	t	200,934	2,264,091	258,863	1,640,439
Rock	t	304,395	4,685,177	390,243	5,234,964
Sand	t	3,547,485	38,404,321	2,556,898	24,282,550
TOTAL CONSTRUCTION MATERIALS			87,989,228		60,300,546
DIAMONDS	ct	13,869,547	354,047,664	12,607,033	268,383,094
DIMENSION STONE		4,113	2,205,326	4,795	1,823,218
GEM & SEMI-PRECIOUS STONES	kg	242,919	623,746	331,892	727,953
GOLD	kg	196,198	10,116,600,502	204,841	10,830,285,999
GYPSUM	t	551,910	13,724,991	534,050	12,980,853
MINERAL SANDS					
Garnet	t	251,162	n/a	565,618	n/a
Ilmenite	t	174,687	39,692,103	168,528	41,113,554
Leucoxene	t	18,137	16,452,584	5,386	4,865,398
Rutile	t	41,242	40,658,897	20,189	20,429,432
Zircon	t	174,821	136,452,758	137,294	76,197,909
Other	t	0	319,799,674	0	411,257,426
TOTAL MINERAL SANDS			553,056,016		553,863,719
IRON ORE	t	748,100,421	48,767,233,356	789,821,113	63,652,928,276
LIMESAND-LIMESTONE-DOLOMITE	t	4,509,980	44,279,689	4,618,213	26,993,009
MANGANESE ORE	t	425,303	146,188,090	236,470	n/a
NICKEL INDUSTRY					
Cobalt	t	5,479	174,846,826	4,732	237,531,939
Nickel	t	175,752	2,202,734,451	157,429	2,081,067,035
Palladium and Platinum By-Product	kg	687	16,656,441	783	21,808,381
TOTAL NICKEL INDUSTRY			2,394,237,718		2,340,407,355
PETROLEUM					
Condensate	kl	6,775,142	2,213,709,834	6,037,603	2,228,626,174
Crude Oil	kl	7,685,922	3,042,849,325	5,404,294	2,063,573,585
LNG	t	20,955,641	10,764,545,353	28,685,477	12,681,122,863
LPG – Butane and Propane	t	531,595	249,059,073	527,391	273,097,308
Natural Gas	'000m^3	10,223,641	1,913,134,982	9,708,934	1,830,012,904

COMMODITY	FINANCIAL YEAR 2015–16			FINANCIAL YEAR 2016–17	
	UNIT	QUANTITY	VALUE	QUANTITY	VALUE
TOTAL PETROLEUM			18,183,298,567		19,076,432,835
SALT	t	10,974,721	336,253,755	10,874,279	292,285,826
SILICA-SILICA SAND	t	580,938	15,386,305	725,941	15,341,830
SILVER	kg	155,911	104,408,735	143,807	99,172,908
TIN-TANTALUM-LITHIUM		0	269,771,196	0	616,176,870
OTHER (Includes Vanadium, Manganese, Rare Earths, Spongolite and Talc)			199,236,526		299,850,707
TOTAL VALUE			88,256,476,845		104,958,993,844

Note: Quantities used in this table only apply to minerals and petroleum covered by the *Mining Act 1978*, the *Petroleum and Geothermal Energy Resources Act 1967*, the *Petroleum (Submerged Lands) Act 1982*, the *Offshore Petroleum Act 2006* and relevant State Agreement Acts.

n/a Breakdown of chromite, garnet, manganese, talc, spodumene, vanadium, rare earths, tin, tantalite and lithium not available.

TABLE 6. Quantity and value of selected major commodities

		2009–10		2010–11		2011–12	
COMMODITY	**UNIT**	**Quantity**	**Value ($M)**	**Quantity**	**Value ($M)**	**Quantity**	**Value ($M)**
ALUMINA AND BAUXITE	t	12,643,178	3,871,191,802	12,280,629	3,990,376,375	12,424,860	4,010,219,382
BASE METALS							
Copper Metal	t	151,963	1,172,476,451	150,030	1,332,356,150	159,171	1,180,779,699
Lead Metal	t	26,011	61,554,966	40,764	100,068,469	6,922	13,839,831
Zinc Metal	t	87,559	210,118,736	70,537	162,108,265	63,503	121,984,210
TOTAL BASE METALS			1,444,150,153		1,594,532,884		1,316,603,740
CHROMITE	t	59,034	n/a	81,925	n/a	164,219	n/a
CLAYS						75,091	1,663,209
COAL	t	6,712,019	325,855,375	7,234,455	296,259,551	6,986,433	289,629,252
CONSTRUCTION MATERIALS							
Aggregate	t	3,167,934	79,231,292	1,934,860	43,801,514	3,722,254	97,854,121
Gravel	t	184,993	1,521,930	230,785	1,760,531	283,899	2,454,938
Rock	t	531,078	9,160,687	298,262	3,251,624	509,983	6,262,935
Sand	t	3,226,618	27,573,978	4,818,062	34,712,549	6,286,702	54,502,065
Other							
TOTAL CONSTRUCTION MATERIALS			117,487,887		83,526,218		161,074,059
DIAMONDS	ct	16,280,757	304,332,534	10,121,587	303,092,471	8,689,501	343,293,394
DIMENSION STONE		5,371	339,102	8,669	861,017	7,590	1,450,510
GEM & SEMI-PRECIOUS STONES	kg	300,509	308,238	292,458	288,460	227,963	280,727
GOLD	kg	164,039	6,558,256,060	183,751	8,184,187,456	180,771	9,421,483,327
GYPSUM	t	877,669	17,980,733	587,374	10,931,443	334,178	4,690,980
MINERAL SANDS							
Garnet	t	237,978	45,356,185	226,620	42,689,083	301,945	59,591,878
Ilmenite	t	508,584	68,516,763	394,033	52,763,228	332,012	58,190,544
Leucoxene	t	76,591	24,831,505	26,030	12,165,130	22,231	16,691,847
Rutile	t	118,234	77,691,649	49,745	35,431,242	38870.25	52,250,227
Zircon	t	351,957	270,549,396	298,644	197,514,001	180,429	219,219,649
Other	t	606,241	177,539,532	421,723	135,619,863	540,074	458,168,418
TOTAL MINERAL SANDS		1,899,585	664,485,030	1,416,795	476,182,547	1,415,561	864,112,563
IRON ORE	t	384,964,868	35,214,420,583	397,604,213	57,533,101,329	454,385,064	60,972,726,991
LIMESAND-LIMESTONE-DOLOMITE		4,017,736	22,695,366	3,721,270	17,742,838	4,157,630	21,403,515
MANGANESE ORE	t	746,742	382,592,192	873,064	392,302,135	846,293	331,693,574
NICKEL INDUSTRY							
Cobalt	t	4,398	193,325,946	3,767	146,480,315	4,950	143,627,596
Nickel	t	180,152	3,976,771,529	194,177	4,686,173,467	209,370	3,721,964,396
Palladium and Platinum By-Product	kg	1,089	11,101,919	440	7,036,097	626	14,909,443
TOTAL NICKEL INDUSTRY			4,181,199,394		4,839,689,879		3,880,501,435
PETROLEUM							
Condensate	kl	7,418,012	3,501,186,255	6,881,791	3,988,524,336	5,888,608	3,842,111,571
Crude Oil	kl	11,842,075	6,385,071,844	13,924,847	8,528,862,521	11,121,616	7,676,633,459
LNG	t	15,717,041	7,494,248,320	17,290,205	8,328,719,118	15,610,570	9,495,543,132
LPG – Butane and Propane	t	987,896	696,901,992	923,763	774,197,459	835,271	734,484,653
Natural Gas	'000m^3	9,357,026	1,320,801,777	8,981,495	1,364,589,067	9,080,655	1,449,810,229
TOTAL PETROLEUM			19,398,210,189		22,984,892,501		23,198,583,045
SALT	t	10,969,479	417,460,428	12,246,504	366,935,890	12,807,461	353,776,447
SILICA-SILICA SAND	t	442,340	12,402,030	430,363	13,304,556	452,638	14,742,316
SILVER	kg	100,030	63,845,068	83,550	76,065,087	120,080	115,704,896
TIN-TANTALUM-LITHIUM							
Spodumene	t	247,422	73,436,811	352,418	103,317,680	461,121	138,413,821
Tantalite	t	n/a	n/a	95	n/a	347	49,931,724
Tin Metal	t	107	1,300,631	22	281,633	62	1,372,580
TOTAL TIN-TANTALUM-LITHIUM			74,737,442		131,425,734		189,718,125
OTHER (May include Feldspar, Red Oxide, Manganese, Vanadium, Chromite, Rare Earths, Spongolite and Talc)	t		44,510,961		64,129,732		103,198,080
TOTAL VALUE			**73,116,460,565**		**101,359,828,103**		**105,594,886,357**

2012–13		2013–14		2014–15		2015–16		2016–17	
Quantity	Value ($M)	Quantity	Value ($M)	Quantity	Value ($M)	Quantity	Value ($M)	Quantity	Value ($M)
13,530,752	4,027,810,217	13,717,952	4,295,348,699	13,771,412	5,022,721,218	13,941,243	4,939,232,470	14,037,628	5,087,629,856
209,266	1,423,043,554	211,186	1,559,565,610	184,495	1,283,046,797	190,298	1,180,826,384	170,228	1,179,229,687
16,641	35,049,525	78,651	178,764,058	59,248	136,949,662	5,988	14,810,595	3,488	10,208,858
55,848	103,867,913	54,060	118,261,576	77,831	197,040,406	82,676	195,494,453	82,726	194,144,951
	1,561,960,992		1,856,591,245		1,617,036,865		1,391,131,432		1,383,583,496
195,772	n/a	66,540	n/a	–	0	–	0	–	0
		5,139	345,148	17,670	1,043,438	21,969	1,104,708	20,865	1,390,448
7,494,280	310,812,886	6,275,422	263,701,680	6,553,064	306,733,911	6,890,951	336,466,825	6,806,390	338,435,045
4,391,376	148,775,764	2,154,534	47,255,402	1,963,871	69,239,676	1,143,211	42,635,640	1,052,475	29,142,593
561,135	3,947,125	51,853	338,431	193,968	2,161,823	200,934	2,264,091	258,863	1,640,439
1,109,761	27,142,818	402,652	10,070,061	1,746,693	47,505,138	304,395	4,685,177	390,243	5,234,964
5,415,504	62,093,160	3,796,749	28,420,888	6,042,214	56,115,401	3,547,485	38,404,321	2,556,898	24,282,550
	241,958,866		86,084,782		175,022,038		87,989,228		60,300,547
9,608,685	355,964,877	11,646,712	401,672,122	10,423,822	342,313,665	13,869,547	354,047,664	12,607,033	268,383,094
4,196	1,221,243	5,021	1,365,020	21,250	2,892,731	4,113	2,205,326	4,795	1,823,218
197,832	254,158	309,575	401,960	720,552	1,402,333	242,919	623,746	331,892	727,953
179,849	9,022,522,018	196,074	8,890,995,046	193,238	9,110,903,561	196,198	10,116,600,502	204,841	10,830,285,999
1,575,769	7,027,903	532,919	9,496,857	577,079	11,801,996	551,910	13,724,991	534,050	12,980,853
317,336	64,834,324	357,266	68,896,504	299,022	n/a	251,162	n/a	565,618	n/a
270,770	72,680,422	78,900	19,515,066	99,674	21,000,789	174,687	39,692,103	168,528	41,113,554
29,071	31,231,788	29,268	26,205,650	16,965	14,636,208	18,137	16,452,584	5,386	4,865,398
46,938	80,261,379	65,084	65,938,306	30,206	29,582,184	41,242	40,658,897	20,189	20,429,432
215,831	189,547,782	212,068	114,307,405	182,859	136,321,656	174,821	136,452,758	137,294	76,197,909
475,411	372,123,979	335,684	176,168,377	440,970	291,166,037		319,799,674		411,257,426
1,355,357	810,679,675	1,078,271	471,031,307		492,706,874	1,149,464	553,056,016	1,395,989	553,863,719
511,760,416	56,204,322,877	623,507,315	75,165,582,340	718,806,504	54,375,654,674	748,100,421	48,767,233,356	789,821,113	63,652,928,276
4,091,849	24,239,571	3,116,623	23,378,197	5,056,131	52,316,742	4,509,980	44,279,689	4,618,213	26,993,009
649,695	n/a	711,536	n/a	800,985	n/a	425,303	146,188,090	236,470	n/a
6,200	159,147,805	6,236	175,117,788	6,036	210,567,512	5,479	174,846,826	4,732	237,531,939
227,463	3,511,711,762	209,710	3,419,023,118	183,315	3,169,605,001	175,752	2,202,734,451	157,429	2,081,067,035
658	15,045,619	1,015	28,523,097	464	13,380,730	687	16,656,441	783	21,808,381
	3,685,905,186		3,622,664,003		3,393,553,243		2,394,237,718		2,340,407,355
6,116,968	3,922,032,524	5,559,221	4,032,961,171	6,753,212	3,488,373,293	6,775,142	2,213,709,834	6,037,603	2,228,626,174
8,609,425	5,972,058,200	7,303,854	5,724,962,343	7,844,408	4,493,521,248	7,685,922	3,042,849,325	5,404,294	2,063,573,585
19,804,919	12,147,214,397	20,049,826	14,804,193,332	20,447,845	13,817,045,230	20,955,641	10,764,545,353	28,685,477	12,681,122,863
752,910	634,052,635	630,636	586,349,207	553,055	405,561,785	531,595	249,059,073	527,391	273,097,308
8,713,949	1,434,550,772	9,368,839	1,655,819,689	9,875,339	1,826,592,934	10,223,641	1,913,134,982	9,708,934	1,830,012,904
	24,109,908,528		26,804,285,741		24,031,094,489		18,183,298,567		19,076,432,835
12,389,643	381,652,888	12,992,042	410,097,847	11,726,606	374,622,315	10,974,721	336,253,755	10,874,279	292,285,826
498,232	16,886,756	449,587	15,847,051	483,809	17,927,564	580,938	15,386,305	725,941	15,341,830
123,740	100,560,679	137,180	93,414,212	151,133	96,323,318	155,911	104,408,735	143,807	99,172,908
485,879	178,786,684	342,065	150,564,377	441,615	208,670,000	417,286	241,996,770	866,422	601,448,658
201	17,940,739	58	4,074,774	70	n/a	183	n/a		n/a
193	2,703,339	–	n/a	14	n/a	22	n/a		n/a
	199,430,762		154,639,152		251,051,748		269,771,196		616,176,870
	425,002,389		494,402,726		507,533,600		199,236,526		299,850,707
	101,488,122,472		**123,060,999,987**		**100,183,612,885**		**88,256,476,845**		**104,958,993,844**

TABLE 7. Value of minerals and petroleum by region by commodity

REGION	2016–17 Value
Pilbara Region	
Iron Ore	61,681,715,092
Gold and Silver	864,553,962
Copper	334,328,667
Manganese Ore and Salt	293,340,395
Construction Materials	30,244,183
Other	109,692,456
Total	**63,313,874,755**

Offshore Petroleum	
Liquefied Natural Gas	12,681,122,863
Crude Oil and Condensate	4,263,033,069
Natural Gas	1,782,754,676
LPG Butane and Propane	273,097,308
Total	**19,000,007,916**

Goldfields-Esperance Region	
Gold	7,109,028,942
Nickel and Cobalt	2,000,346,187
Rare Earth Oxide, Platinum and Palladium	251,507,405
Copper and Zinc	150,806,832
Silver	39,456,237
Gypsum and Limesand Limestone	10,623,896
Construction Materials and Granite	8,522,996
Other	132,752,176
Total	**9,703,044,672**

Peel Region	
Gold, Silver and Copper	1,569,312,452
Total	**1,569,312,452**

Mid West Region	
Gold and Silver	1,189,866,097
Iron Ore	906,572,420
Copper, Lead and Zinc	671,860,314
Mineral Sands	189,454,601
Natural Gas	35,946,198
Condensate and Crude Oil	26,482,730
Gypsum and Talc	12,624,143
Limesand Limestone	2,264,532
Clays and Construction Materials	1,516,723
Gem and Semi Precious Stones	311,531
Total	**3,036,899,289**

REGION	2016–17 Value
Wheatbelt Region	
Iron Ore	1,064,640,764
Nickel and Copper	311,101,330
Gold and Silver	309,789,037
Mineral Sands	269,630,701
Condensate and Natural Gas	13,168,330
Salt and Silica and Silica Sand	8,477,150
Gypsum	6,690,123
Limesand Limestone Dolomite, Construction Materials and Clays	5,735,102
Total	**1,989,232,537**

Kimberley Region	
Diamonds	268,383,094
Gem and Semi Precious Stones, Gold and Silver	64,692,633
Nickel, Copper and Cobalt	16,508,687
Limesand Limestone Dolomite and Construction Materials	5,165,749
Crude Oil	827,660
Total	**355,577,823**

South West Region	
Alumina and Bauxite	1,483,383,850
Tantalum Pentoxide, Spodumene and Tin Metal	376,056,511
Coal	338,435,045
Mineral Sands	94,778,418
Sandstone and Limesand Limestone	1,533,165
Total	**2,294,186,989**

Gascoyne Region	
Salt	48,037,328
Gypsum and Limesand Limestone	5,770,652
Construction Materials and Gem and Semi Precious Stones	1,281,278
Other	9,435
Total	**55,098,693**

Perth Metropolitan Region	
Alumina and Bauxite	3,604,246,006
Construction Materials	14,971,250
Silica and Limesand Limestone	14,648,495
Total	**3,633,865,751**

Great Southern Region	
Spongolite, Silica and Limesand Limestone	7,892,966
Total	**7,892,966**

TABLE 8. Value of minerals and petroleum by region by local government area

REGION	2016–17 Value
Pilbara Region	
Ashburton	31,826,719,824
East Pilbara	30,996,895,082
Port Hedland Town and Marble Bar	381,117,021
Karratha	109,142,828
Total	**63,313,874,755**
Offshore Petroleum	**19,000,007,916**
Goldfields-Esperance Region	
Coolgardie	2,514,162,807
Kalgoorlie-Boulder	2,360,048,000
Laverton	1,913,734,083
Leonora	1,771,463,747
Menzies and Esperance	634,106,950
Ravensthorpe and Dundas	509,529,085
Total	**9,703,044,672**
Peel Region	
Waroona/Murray and Boddington	1,569,312,452
Total	**1,569,312,452**
Mid West Region	
Meekatharra and Morawa	917,737,658
Cue, Coorow and Geraldton	916,583,141
Yalgoo	494,448,829
Wiluna and Three Springs	448,256,345
Mullewa and Mt Magnet	112,460,986
Irwin	63,839,395
Northampton and Perenjori	57,416,259
Carnamah	26,156,676
Total	**3,036,899,289**

REGION	2016–17 Value
Great Southern Region	
Albany, Denmark and Plantagenet	7,892,966
Total	**7,892,966**
Wheatbelt Region	
Yilgarn	1,265,087,029
Kondinin	311,262,510
Dandaragan	272,235,750
Lake Grace and Westonia	118,401,206
Gingin and Koorda	18,850,682
Moora and Wyalkatchem	1,464,777
Dalwallinu	1,697,712
Northam and Kellerberrin	232,872
Total	**1,989,232,537**
Kimberley Region	
Wyndham-East Kimberley	269,731,640
Halls Creek	81,201,464
Broome	3,571,716
Derby-West Kimberley	1,073,003
Total	**355,577,823**
South West Region	
Collie	1,821,818,895
Bridgetown-Greenbushes	376,056,511
Capel and Dardanup	94,778,418
Donnybrook-Balingup, Manjimup and Augusta-Margaret River	1,437,313
Harvey	95,852
Total	**2,294,186,989**
Gascoyne Region	
Exmouth, Shark Bay and Upper Gascoyne	37,004,599
Carnarvon	18,094,094
Total	**55,098,693**
Perth Metropolitan Region	
Cockburn, Kwinana and Rockingham	3,612,409,007
Kalamunda, Swan and Mundaring	18,709,595
Wanneroo	2,747,149
Total	**3,633,865,751**

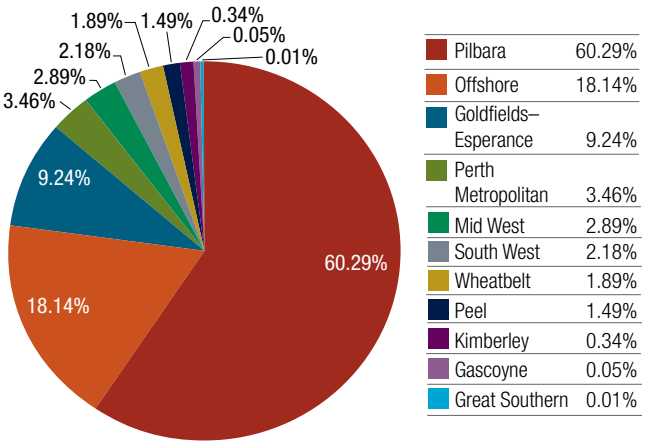


Figure 59 **Value of mineral and petroleum by region 2016–17**
$104.95 Billion
Source: DMIRS

TABLE 9. Average annual employment in the WA mineral sector		
PRIMARY COMMODITY	**2015–16 NoI***	**2016–17 NoI***
Baryte	1	2
Bauxite and Alumina	7,234	6,645
Base Metals	2,358	2,239
Chemicals	122	115
Chromite and Platinoids	4	3
Clays	132	116
Coal	1,128	1,098
Construction Materials	1,558	2,482
Diamonds	1,026	821
Diatomite and Spongolite	2	2
Dimension Stone	291	202
Gem & Semi-Precious Stones	6	1
Gold	23,566	27,131
Gypsum	35	38
Iron Ore	51,056	53,013
Limestone – Limesand	310	558
Manganese	335	74
Mineral Sands	2,336	2,396
Nickel	5,645	5,900
Phosphate	152	181
Potash	4	0
Rare Earths	174	175
Salt	869	845
Silica and Silica Sand	226	567
Silver	11	10
Talc	90	92
Tin, Tantalum and Lithium	740	1,084
Uranium	0	0
Vanadium – Titanium	6	6
Other	852	859
WA Onshore and Coastal Waters Petroleum:	1,382	1,382
Grand Total	**101,650**	**106,652**

The Economic Indicators data file provides full site-by-site breakdown of employment within the WA minerals and onshore petroleum sector.

SOURCE: Safety Regulation System (SRS) and Petroleum Reporting Database (PetReps), Resources Safety Division, Department of Mines, Industry Regulation and Safety. Figures include employees as well as contractors.

*NoI: Number of Individuals (Average on-site)

TABLE 10. Principal mineral and petroleum producers (effective Sep 2017)

BASE METALS (copper–lead–zinc)

Birla Minerals Pty Ltd
Level 3, 256 Adelaide Terrace
Perth WA 6000
(08) 9366 8800
Nifty
www.adityabirlaminerals.com.au

BHP Billiton Ltd (Nickel West)
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Kambalda
www.bhpbilliton.com

Doray Minerals Ltd
Level 1, 1292 Hay Street
West Perth WA 6005
(08) 9226 0600
Deflector
www.dorayminerals.com.au

MMG Ltd
Level 23, 28 Freshwater Place
Southbank VIC 3006
(03) 9288 0888
Golden Grove
www.mmg.com

Independence Group NL
Level 5, South Shore Centre
85 South Perth Esplanade
South Perth WA 6151
(08) 9238 8300
Kambalda, Teutonic Bore – Jaguar
www.igo.com.au

Newcrest Mining Ltd
234 Railway Parade
West Leederville WA 6007
(08) 9270 7070
Telfer
www.newcrest.com.au

Newmont Mining Corporation
Level 2, 388 Hay Street
Subiaco WA 6008
(08) 9423 6100
Boddington Gold
www.newmont.com

Sandfire Resources NL
Level 1, 31 Ventnor Avenue
West Perth WA 6005
(08) 6430 3800
DeGrussa-Doolgunna
www.sandfire.com.au

BAUXITE–ALUMINA

Alumina

Alcoa of Australia Ltd
181–205 Davy Street
Booragoon WA 6154
(08) 9316 5111
Jarrahdale - Kwinana
www.alcoa.com/australia

South32 Ltd
Level 35, 108 St Georges Tce
Perth WA 6000
(08) 9324 9000
Worsley Alumina
www.south32.net

CLAY

Attapulgite

Hudson Resources Ltd
Level 2, 131 Macquarie Street
Sydney NSW 2000
(02) 9251 7177
Lake Nerramyne
www.hudsonresources.com

Saponite

Watheroo Minerals Pty Ltd
14 Brushwood Brook Drive
Yallingup WA 6282
(08) 9756 6121
Watheroo Clays
www.bentonitewa.com.au

COAL

Lanco Infratech Ltd
1st Floor, 677 Murray Street
Perth WA 6005
(08) 6188 2200
Lanco
www.griffincoal.com.au

Yancoal Australia Ltd
Level 26, 363 George Street
Sydney NSW 2000
(02) 8583 5300
Premier
www.yancoal.com.au

CONSTRUCTION MATERIALS

Aggregate

Boral Resources (WA) Ltd
63-69 Abernethy Road
Belmont WA 6104
(08) 9333 3400
Mt Regal, Pilbara Area, Seven Mile Hill

Holcim (Australia) Pty Ltd
200 Adelaide Terrace
East Perth WA 6004
(08) 9212 2000
Newman, Nickol Bay, Turner River
www.holcim.com.au

MLG OZ Pty Ltd
22 Coath Road
West Kalgoorlie WA 6433
(08) 9022 7746
Tarmoola
www.mlgoz.com.au

WA Limestone
401 Spearwood Avenue
Bibra Lake WA 6163
(08) 9434 7777
Gregory West, Mount Minnie Granite
www.walimestone.com

Gravel

MLG OZ Pty Ltd
22 Coath Road
West Kalgoorlie WA 6433
(08) 9022 7746
Eight Mile Rock Hole, Jonah Bore
www.mlgoz.com.au

Norwest Sand & Gravel Pty Ltd
Lot 5 Wilson Way
Wickham WA 6720
(08) 9187 1488
Cossack, Mt Welcome, Nickol River

TABLE 10. Principal mineral and petroleum producers (effective Sep 2017)

WA Limestone
401 Spearwood Avenue
Bibra Lake WA 6163
(08) 9434 7777
Pickering Brook
www.walimestone.com

Rock

Holcim (Australia) Pty Ltd
200 Adelaide Terrace
East Perth WA 6004
(08) 9212 2000
Golden Mile Rock
www.holcim.com.au

WA Limestone
401 Spearwood Avenue
Bibra Lake WA 6163
(08) 9434 7777
Port Hedland
www.walimestone.com

Sand

Holcim (Australia) Pty Ltd
200 Adelaide Terrace
East Perth WA 6004
(08) 9212 2000
Baldivis, Turner River Dune,
Widgiemooltha
www.holcim.com.au

Hanson Constructions Pty Ltd
Level 1, 35 Great Eastern Highway
Rivervale WA 6103
(08) 9311 8811
Gnangara, Jandabup
www.hanson.com.au

DIAMONDS

Argyle Diamond Mine
Lissadell Road
East Kimberley WA 6740
(08) 9168 4900
Argyle
www.riotinto.com

GOLD

AngloGold Ashanti Australia Ltd
Level 13, 44 St Georges Terrace
Perth WA 6000
(08) 9425 4600
Sunrise Dam, Tropicana
www.anglogoldashanti.com

Barrick Gold of Australia Ltd
Level 9, 125 St Georges Terrace
Perth WA 6000
(08) 9212 5777
Golden Mile
www.barrick.com

Doray Minerals Ltd
1292 Hay Street
Perth WA 6005
(08) 9226 0600
Andy Well, Deflector
www.dorayminerals.com.au

Evolution Mining Ltd
Level 15, 37 St Georges Terrace
Perth WA 6000
(08) 6216 9700
Edna May, Mungari
www.evolutionmining.com.au

Gold Fields Australia Pty Ltd
Level 5, 50 Colin Street
West Perth WA 6005
(08) 9211 9200
Agnew, Lawlers, Darlot,
Granny Smith, St Ives
www.goldfields.com.au

Hanking Gold Mining Pty Ltd
Level 26, 140 St Georges Terrace
Perth WA 6000
(08) 6210 8900
Marvel Loch – Southern Cross
www.hanking.com.au

Metals X Ltd
Level 3, 18-32 Parliament Place
West Perth WA 6005
(08) 9220 5700
Central Murchison, Higginsville,
Mt Henry, South Kalgoorlie
www.metalsx.com.au

Newcrest Mining Ltd
234 Railway Parade
West Leederville WA 6007
(08) 9270 7070
Telfer
www.newcrest.com.au

Newmont Mining Corporation
Level 2, 388 Hay Street
Subiaco WA 6008
(08) 9423 6100
Boddington
www.newmont.com

Northern Star Resources Ltd
Level 1, 388 Hay Street
Subiaco WA 6008
(08) 6188 2100
Jundee, Kanowna, Kundana East,
Paulsens, Plutonic
www.nsrltd.com

Norton Gold Fields Ltd
Level 36, Exchange Plaza
2 The Esplanade
Perth WA 6000
Paddington, Binduli
www.nortongoldfields.com.au

Ramelius Resources Ltd
Level 1, 130 Royal Street
East Perth WA 6004
(08) 9202 1127
Kathleen Valley Gold, Mt Magnet,
Vivien Gold
www.rameliusresources.com.au

Regis Resources Ltd
Level 1, 1 Alvan Street
Subiaco WA 6008
(08) 9442 2200
Garden Well, Moolart
www.regisresources.com.au

Sandfire Resources NL
Level 1, 31 Ventnor Avenue
West Perth WA 6005
(08) 6430 3800
DeGrussa
www.sandfire.com.au

Saracen Mineral Holdings Ltd
Level 11, 40 The Esplanade
Perth WA 6000
(08) 6229 9100
Carosue Dam, Deep South,
Porphyry, Red October, Tarmoola,
Thunderbox gold
www.saracen.com.au

TABLE 10. Principal mineral and petroleum producers (effective Sep 2017)

Silver Lake Resources Ltd
Suite 4, Level 3
85 South Perth Esplanade
South Perth WA 6151
(08) 6313 3800
Randalls
www.silverlakeresources.com.au

St Barbara Ltd
7 Rheola Street
West Perth WA 6005
(08) 9476 5555
Gwalia
www.stbarbara.com.au

GYPSUM

CSR Ltd
Triniti 3
39 Delhi Road
North Ryde NSW 2113
(02) 9235 8000
Jurien Bay North
www.csr.com.au

Dampier Salt Ltd
37 Belmont Avenue
Belmont WA 6104
(08) 9270 9270
Lake MacLeod
www.riotinto.com.au

Gypsum Industries of Australia
Suite 1, 110 Robinson Avenue
Belmont WA 6104
1800 644 951
Cowcowing Lakes South
www.aglime.com.au

Whitfield Minerals Pty Ltd
32 Tuckey Street
Mandurah WA 6210
(08) 9535 9299
Lake Cowan

MINERAL SANDS

Garnet Sand

GMA Garnet Pty Ltd
122 Goulds Road
Narngulu WA 6532
(08) 9923 6000
Port Gregory
www.garnetsales.com

Ilmenite, Leucoxene, Rutile, Staurolite and Zircon

Doral Mineral Sands Pty Ltd
Lot 501 Harris Road
Picton WA 6229
(08) 9725 5444
Dardanup
www.doral.com.au

Iluka Resources Ltd
Level 23, 140 St Georges Terrace
Perth WA 6000
(08) 9360 4700
Capel, Eneabba
www.iluka.com

Tronox Australia Ltd
Brand Highway
Cataby WA 6507
(08) 9690 9200
Cooljarloo
www.tronox.com.au

IRON ORE

Atlas Iron Ltd
Level 18, Raine Square
300 Murray Street
Perth WA 6000
(08) 6228 8000
Abydos, Mt Webber, Wodgina
www.atlasiron.com.au

BC Iron Ltd
Level 1, 15 Rheola Street
West Perth WA 6005
(08) 6311 3400
Iron Valley
www.bciron.com.au

BHP Billiton Ltd
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Jimblebar, Mining Area C,
Newman, Yandi
www.bhpbilliton.com

Citic Pacific Mining Management Pty Ltd
45 St Georges Terrace
Perth WA 6000
(08) 9226 8888
Sino – Cape Preston Iron
www.citicpacificmining.com

Cliffs Natural Resources Pty Ltd
The Quadrant Building
Level 12, 1 William Street
Perth WA 6000
(08) 9422 3405
Koolyanobbing
www.cliffsnaturalresources.com

Fortescue Metals Limited
Level 2, 87 Adelaide Terrace
East Perth WA 6004
(08) 6218 8888
East Pilbara, Solomon
www.fmgl.com.au

Gindalbie Metals Ltd
6 Altona Street
West Perth WA 6059
(08) 9480 8700
Karara–Blue Hills
www.gindalbie.com.au

Hamersley Iron Pty Ltd
152 St Georges Terrace
Perth WA 6000
(08) 9327 2000
Hamersley Iron, Robe River – Deepdale, Yandicoogina
www.hamersleyiron.com

Hancock Prospecting Pty Ltd
28-42 Ventnor Avenue
West Perth WA 6005
Roy Hill
www.hancockprospecting.com.au

Mineral Resources Ltd
1 Sleat Road
Applecross WA 6153
(08) 9329 3600
Carina
www.mineralresources.com.au

TABLE 10. Principal mineral and petroleum producers (effective Sep 2017)

Mt Gibson Iron Ltd
Level 1, 2 Kings Park Road
West Perth WA 6005
(08) 9426 7500
Koolan Island, Mt Gibson Iron,
Tallering Peak
www.mtgibsoniron.com.au

LIMESAND–LIMESTONE

Aglime of Australia
Suite 1, 110 Robinson Avenue
Belmont WA 6104
(08) 9277 5529
Dongara–Denison, Lancelin, Jurien Bay
www.aglime.com.au

Archistone Pty Ltd
27 Jandakot Road
Jandakot WA 6164
(08) 9417 2444
Moore River,
Yanchep Reconstituted Stone
www.archistone.com.au

Cockburn Cement Ltd
Lot 242, Russell Road
Munster WA 6166
(08) 9411 1000
Cockburn, Coogee, Denison, Ledge
Point, Wesco Rd
www.cockburncement.com.au

FQM Australia Nickel Pty Ltd
1/24 Outram Street
West Perth WA 6005
(08) 9346 0100
Ravensthorpe Limestone
www.first-quantum.com

Lime Industries Pty Ltd
43 Hector Street
Osborne Park WA 6017
(08) 9241 1100
Boranup Limesand
www.limeindustries.com.au

Minara Resources
Level 10, Alluvion
58 Mounts Bay Road
Perth WA 6000
(08) 9212 8400
Mt Zephyr Calcrete
www.minara.com.au

WA Limestone
401 Spearwood Avenue
Bibra Lake WA 6163
(08) 9434 7777
Postans
www.walimestone.com

NICKEL

BHP Billiton Ltd (Nickel West)
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Kambalda
www.bhpbilliton.com

FQM Australia Nickel Pty Ltd
1/24 Outram Street
West Perth WA 6005
(08) 9346 0100
Ravensthorpe Nickel
www.first-quantum.com

Minara Resources
Level 10, 58 Mounts Bay Road
Perth WA 6000
(08) 9212 8400
Murrin Murrin
www.minara.com.au

Western Areas Ltd
2 Kings Park Road
West Perth WA 6005
(08) 9334 7777
Forrestania
www.westernareas.com.au

PALLADIUM

BHP Billiton Ltd (Nickel West)
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Kambalda
www.bhpbilliton.com

PETROLEUM

AWE Ltd
Level 3, 1101 Hay Street
West Perth WA 6005
(08) 9480 1300
Corbyas
www.awexplore.com.au

BHP Billiton Petroleum (North West Shelf) Pty Ltd
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Macedon, Pyrenees
www.bhpbilliton.com

Chevron Australia Pty Ltd
Level 24, QV1 Building
250 St Georges Terrace
Perth WA 6000
(08) 9216 4000
Barrow Island, Gorgon
www.chevronaustralia.com

Origin Energy Resources Ltd
34 Colin Street
West Perth WA 6005
(08) 8635 3485
Beharra Springs
www.originenergy.com.au

Quadrant Energy Pty Ltd
Level 9, 100 St Georges Terrace
Perth WA 6000
(08) 6218 7100
East Spar, Harriet, John Brookes,
Reindeer, Stag, Van Gogh
www.quadrantenergy.com.au

Roc Oil (WA) Pty Ltd
Suite 2, Ground Floor
100 Havelock Street
West Perth WA 6005
(08) 9219 7111
Cliff Head
www.rocoil.com.au

Santos Ltd
Level 2, 40 The Esplanade
Perth WA 6000
(08) 9333 9500
Mutineer–Exeter
www.santos.com.au

Vermilion Oil and Gas Australia Pty Ltd
Level 5, 30 The Esplanade
Perth WA 6000
(08) 9215 0300
Wandoo
www.vermilionenergy.com

TABLE 10. Principal mineral and petroleum producers (effective Sep 2017)

Woodside Energy Ltd
240 St Georges Terrace
Perth WA 6000
(08) 9348 4000
Amanda Claire/Belnaves/Brunello, Angel, Athena, Cossack, Enfield, Goodwyn, Hermes, North Rankin, North West Shelf, Pluto, Vincent, Wanaea
www.woodside.com.au

PLATINUM

BHP Billiton Ltd (Nickel West)
125 St Georges Terrace
Perth WA 6000
1300 55 47 57
Kambalda
www.bhpbilliton.com

RARE EARTHS

Lynas Corporation Ltd
7 Tully Road
East Perth WA 6004
(08) 6241 3800
Mount Weld
www.lynascorp.com

SALT

Dampier Salt Ltd
37 Belmont Avenue
Belmont WA 6104
(08) 9270 9270
Dampier, Lake MacLeod, Port Hedland
www.dampiersalt.com.au

Shark Bay Salt Pty Ltd
Level 16, 2 The Esplanade
Perth WA 6000
(08) 9265 8000
Onslow Salt, Shark Bay Salt
www.salt.com.au

WA Salt Supply Ltd
185-187 Cockburn Road
North Coogee WA 6163
(08) 9431 9431
Lake Deborah East
www.wasalt.com.au

SILICA – SILICA SAND

AustSand Mining
Suite 5, 363-367 Albany Hwy
Victoria Park WA 6100
(08) 9361 6288
Mindijup
www.austsandmining.com.au

Simcoa Operations Pty Ltd
973 Marriott Road
Wellesley WA 6232
(08) 9780 6666
Kemerton
www.simcoa.com.au

Hanson Constructions Pty Ltd
Level 1, 35 Gt Eastern Hwy
Rivervale WA 6103
(08) 9311 8811
Gnangara
www.hanson.com.au

SPONGOLITE

Southern Spongelite Industries Pty Ltd
Red Gum Pass
Kendenup WA 6323
(08) 9841 7549
Red Gum Spongolite

TALC

Imerys Talc Australia Pty Ltd
21 Glyde Street
Three Springs WA 6519
(08) 9954 1427
Three Springs Talc
www.imerystalc.com

TIN–TANTALUM–LITHIUM

Spodumene

Talison Lithium Pty Ltd
Level 4, 37 St Georges Terrace
Perth WA 6000
(08) 9263 5555
Greenbushes
www.talisonlithium.com

Tantalum

Global Advanced Metals
Level 3, Centrepoint Tower
123B Colin Street
West Perth WA 6005
(08) 6217 2500
Greenbushes
www.globaladvancedmetals.com

Tin

Global Advanced Metals
Level 3, Centrepoint Tower
123B Colin Street
West Perth WA 6005
(08) 6217 2500
Greenbushes
www.globaladvancedmetals.com

ABBREVIATIONS

A$	Australian dollar	Mct	million carats
ABS	Australian Bureau of Statistics	Mha	million hectares
bbl	barrels of oil	MMbbl	million barrels
bbl/d	barrels per day	Moz	million ounces
Bcm	billion cubic metres	Mt	million tonnes
Btu	British Thermal Units	Mtoe	million tonnes of oil equivalent
ct	carat	Mt/a	million tonnes per annum
DIIS	Department of Industry, Innovation and Science	OPEC	Organization of Petroleum Exporting Countries
GDP	Gross Domestic Product	oz	ounce
GJ	Gigajoule	oz/a	ounce per annum
Gm^3	billion cubic metres	PJ	petajoules
ha	hectares	RBA	Reserve Bank of Australia
kl	kilolitres	t	tonne
km	kilometres	t/a	tonnes per annum
km^2	square kilometres	Tcf	trillion cubic feet
kt	thousand tonnes	t/d	tonnes per day
LME	London Metal Exchange	TJ/d	terajoules per day
m	metre	US$	United States dollar
Mboe	millions of barrels of oil equivalent		

WEIGHTS AND MEASURES

kilo	10^3	1,000
mega	10^6	1,000,000
giga	10^9	1,000,000,000
tera	10^{12}	1,000,000,000,000
peta	10^{15}	1,000,000,000,000,000
exa	10^{18}	1,000,000,000,000,000,000
zetta	10^{21}	1,000,000,000,000,000,000,000
yotta	10^{24}	1,000,000,000,000,000,000,000,000

UNITS AND CONVERSION FACTORS

	Metric Unit	Symbol	Imperial Unit
Mass	1 gram	g	= 0.032151 troy (fine) ounce (oz)
	1 kilogram	kg	= 2.204624 pounds (lb)
	1 tonne	t	= 1.10231 United States short ton [1 US short ton = 2,000 lb]
	1 tonne	t	= 0.98421 United Kingdom long ton [1 UK long ton = 2,240 lb]
	1 tonne LNG	t	= 52,000,000 British Thermal Units (Btu)
Volume	1 kilolitre	kL	= 6.28981 barrels (bbl)
	1 cubic metre	m^3	= 35.3147 cubic feet (ft^3) [1 kilolitre (kl) = 1 cubic metre (m^3)]
Energy	1 kilojoule	kJ	= 0.94781 British Thermal Units (Btu)

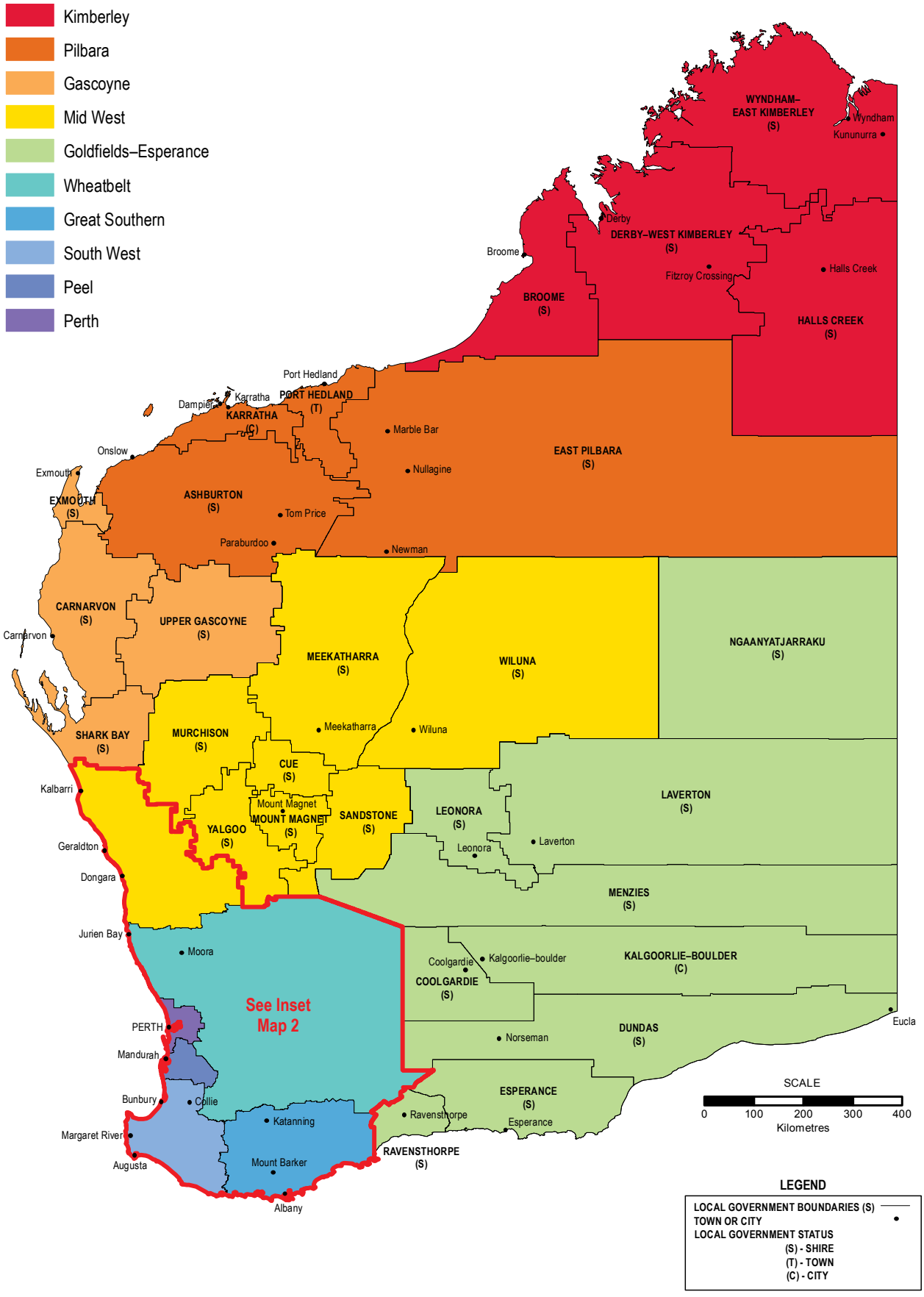
	Energy Content	Prefix	
Coal	19.7 GJ/t	kilo (k)	10^3
Condensate	32.0 MJ/L	mega (M)	10^6
Crude oil	37.0 MJ/L	giga (G)	10^9
LNG	25.0 MJ/L	tera (T)	10^{12}
Natural gas	38.2 MJ/m^3	peta (P)	10^{15}
LPG-butane	28.7 MJ/L (1tonne LPG-butane = 1,720 litres)		
LPG-propane	25.4 MJ/L (1tonne LPG-propane = 1,960 litres)		

DATA SOURCES

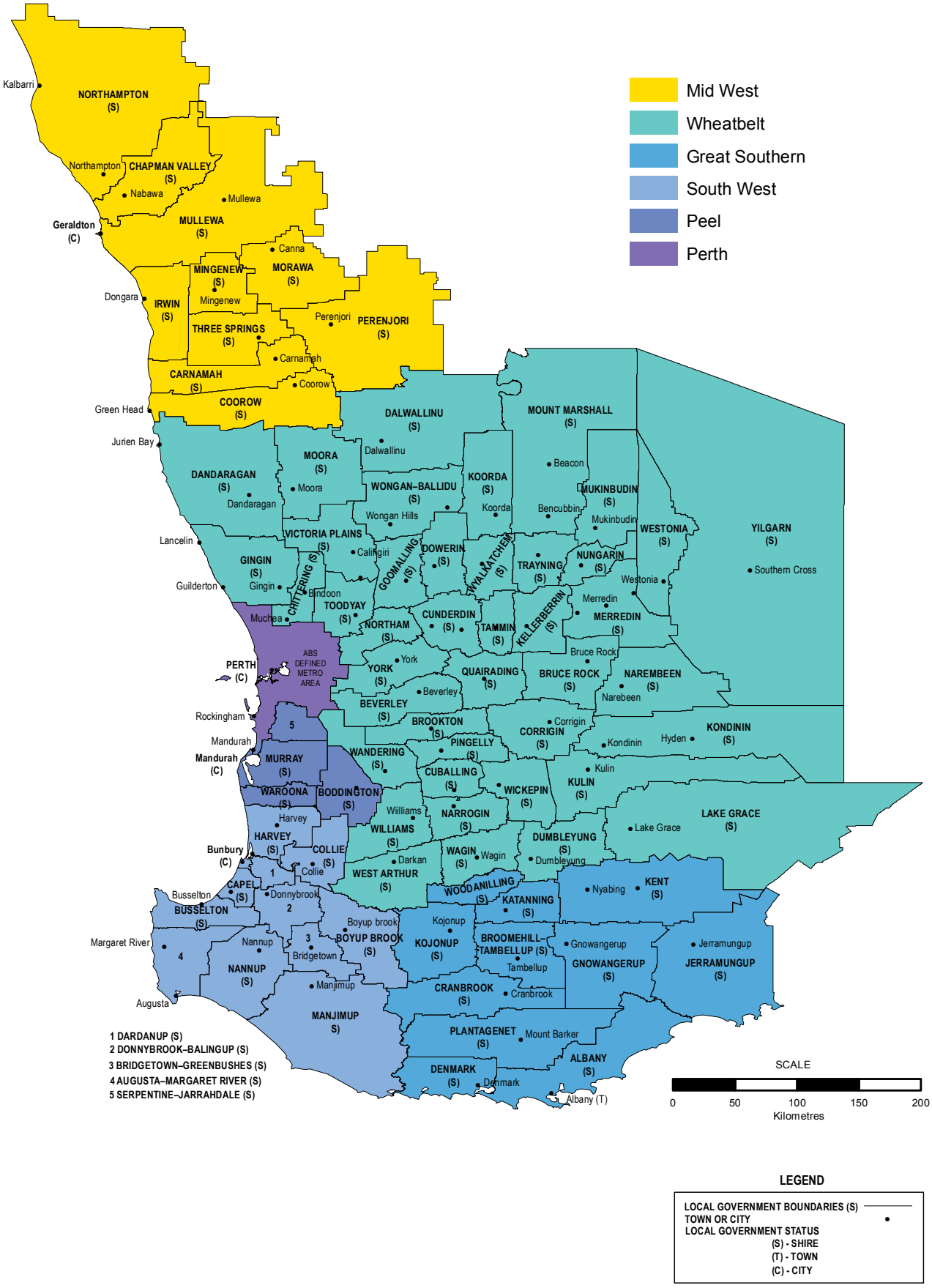
Quantities and values for minerals and petroleum in this publication are collected from a variety of sources including royalty returns, various company annual reports, quarterly Australian Stock Exchange reports, State port authority statistics, the ABS, DIIS and various commercial data suppliers.

Quantities specified relate to either mine production or sales as listed below for each commodity.

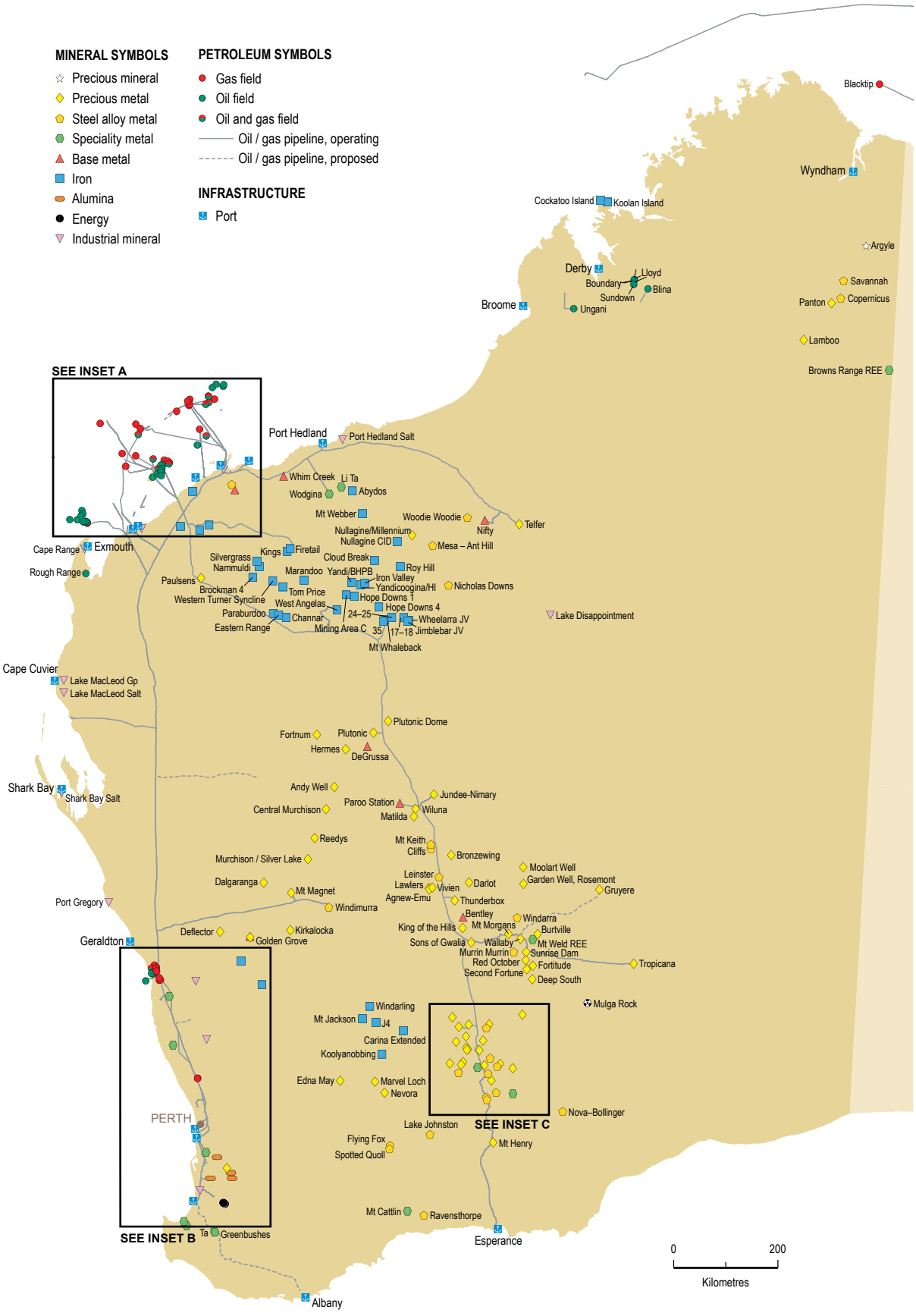
Mine Production
Clays
Coal
Construction materials
Dimension stone
Gypsum
Limesand–Limestone–Dolomite
Silica – Silica Sand
Talc
Sales
Alumina
Base metals (Copper, Lead and Zinc)
Chromite
Diamonds
Gem and semi-precious stones
Gold
Mineral sands
Industrial pegmatite minerals
Iron ore
Manganese
Nickel industry (Nickel, Cobalt, Platinum and Palladium)
Petroleum
Pigments
Rare earths
Salt
Silver
Spongolite
Tin–Tantalum–Lithium
Vanadium



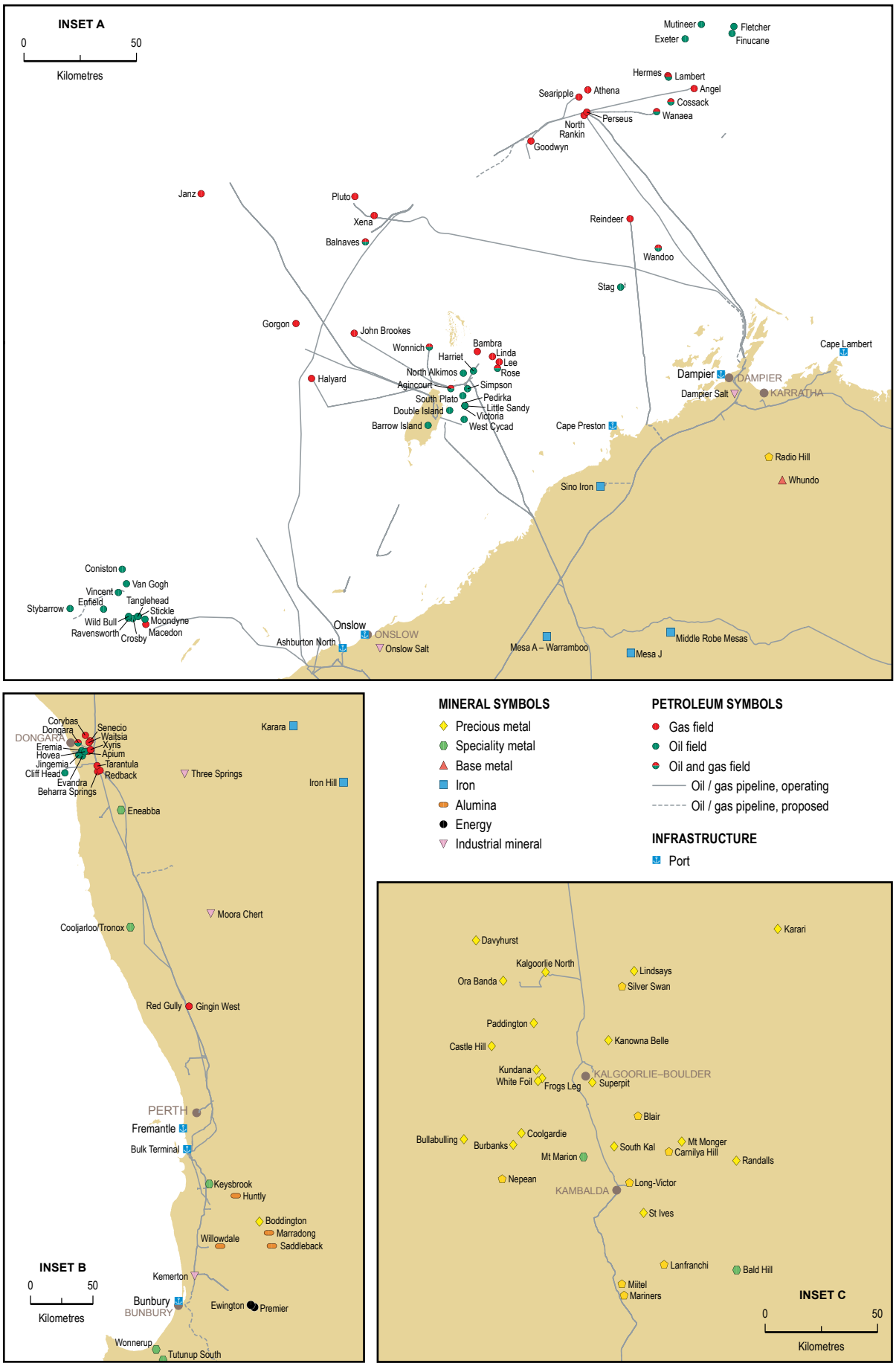
Map 1. Local Government and Regional Boundaries



Map 2. Local Government and Regional Boundaries Insert



Map 3. Major Mineral and Petroleum Projects in Western Australia



Map 4. Major Mineral and Petroleum Projects in Western Australia Insert


KOMATSU
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PC8000
CAT
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Government of Western Australia
Department of Mines, Industry Regulation and Safety
Mineral House, 100 Plain Street
East Perth, Western Australia 6004

Tel: +61 8 9222 3333
Fax: +61 8 9222 3862
Web: www.dmirs.wa.gov.au

For specific enquiries regarding this publication
please email: statistics@dmirs.wa.gov.au

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