



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

WESTERN AUSTRALIAN MINERAL AND PETROLEUM

STATISTICS DIGEST

2018-19



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3 SUPPLEMENTARY INFORMATION



FOREWORD

It is with great pleasure that I introduce this year's Mineral and Petroleum Statistics Digest. This year marks 125 years of publishing resource industry statistics for Western Australia. Through its many forms, the Department has published information ranging from the amount of gold exports from the Customs House way back in 1894, to the amount of meters drilled across the State, to the value of investment expected in a given period.

The mineral and petroleum industry is crucial to Western Australians, with the materials mined here used in our buildings, cosmetics and medicines as well as in the technology and infrastructure we need for our future. The industry's opportunities, challenges, investments and needs are inseparable from WA's future and so its performance and contributions to our economy are highly valued.

Globally, commodity drivers for 2018–19 were much the same as the twelve months prior with US–China trade discussions, Chinese stimulus policies and US fiscal policies influencing prices. Another factor to be shaping global commodity markets is the slowing supply growth rates over the last five years which, when combined with major supply shocks affecting iron ore, copper and alumina markets, has created upwards pressure on prices for these commodities. Perhaps the biggest supply shock seen in recent years has been the failure of Vale's dam in Brazil which is estimated to have added US\$10–15 per tonne to the iron ore price alone.

As iron ore is WA's biggest mineral commodity, this has had a very positive flow on effects for the State's industry and the economy more broadly. But while the financial year results have delivered another record performance, we can expect global commodity markets to moderate over the coming years.

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



OVERVIEW

Commodity markets were on a roller-coaster ride for much of 2018–19 as US–China trade tensions entered their third year. The end of 2018 was marked by political tensions which played a part in weakening commodity prices before their recovery in the first quarter of 2019. The recovery followed the resumption of trade negotiations and a series of supply shocks to some commodities, including the Vale dam accident in Brazil (iron ore, nickel); heavy floods in Chile (copper); protests in Peru (copper); smelter restrictions in response to environmental concerns in China (lead, zinc); and export restrictions in Indonesia (tin).

Locally, the Australian dollar was down almost eight per cent from an average of 77 US cents in 2017–18 to 72 US cents in 2018–19. Generally, global commodity prices held up well with the financial year average price of most commodities increasing on the gains made in 2017–18. Iron ore rebounded strongly on the back of the losses it recorded in the previous financial year.

Following these changes, Western Australia remains one of the world’s top contributors to the global commodity market. According to United States

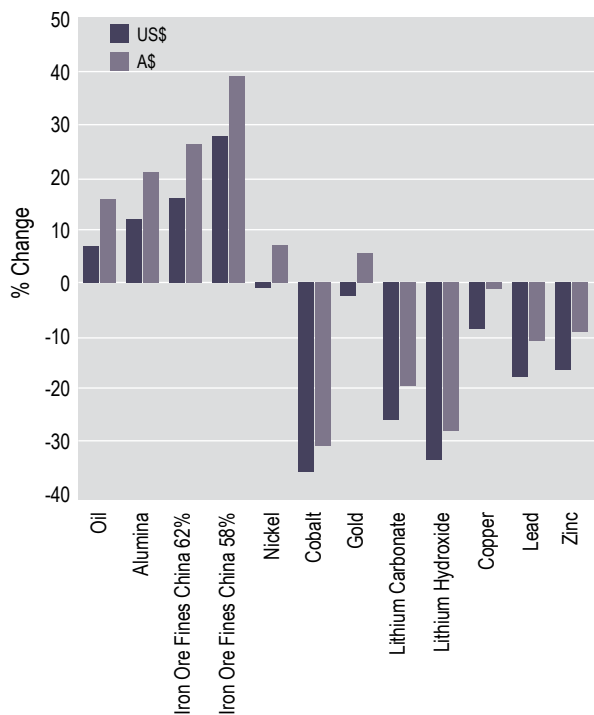


Figure 1 | **Percentage price change between 2017–18 and 2018–19**
Source: LME, Kitco, Argus Metals, WATC and DMIRS

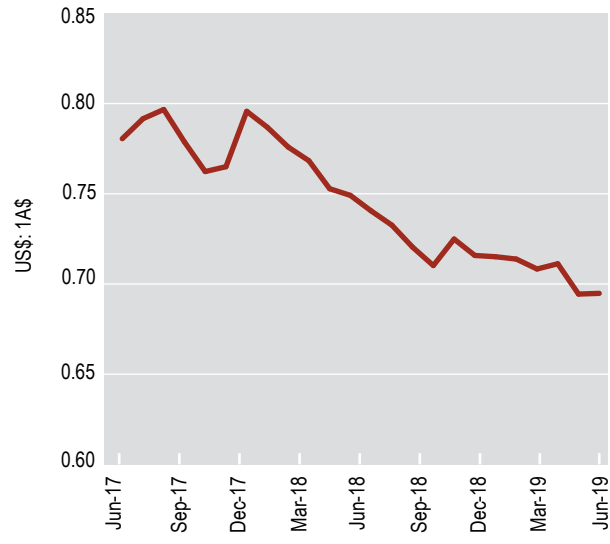


Figure 2 | **Monthly average exchange rate**
Source: Reserve Bank of Australia

Geological Survey (USGS) data, WA ranked among the top five countries for the production of eight different major minerals and in the top 10 of a further three.

Overall in 2018–19, WA’s mineral and petroleum industry reported record sales of \$145 billion. The bulk of the \$30 billion increase on 2017–18 was the result of improved iron ore prices and increasing LNG volumes and prices.

Mineral sector highlights

Mineral commodities still dominate the State’s resources sector, accounting for 74 per cent, or \$107 billion, of total sales value. Iron ore was by far the most valuable commodity, accounting for 73 per cent of mineral sales and 54 per cent of overall sales.

Iron ore recorded sales valued at \$78.2 billion in 2018–19, up 26 per cent on the previous year and setting a new record for iron ore sales values. This was largely achieved through improved iron ore prices as the volume of iron ore sold actually declined from 839 million tonnes (Mt) to just less than 794 Mt.

Gold sales volumes decreased for the first time since 2014–15. However the continued strength of the gold price meant the value of the sector reached a new high of almost \$12 billion, a five per cent increase on 2017–18.

Alumina and bauxite sales accounted for almost eight per cent of mineral sales and six per cent of total sales. Sales volumes increased more than four per cent year-on-year, attributable to an increase in bauxite sales than alumina sales. This meant that the value of the sector increased 25 per cent from \$6.6 billion in 2017–18 to \$8.3 billion in 2018–19.

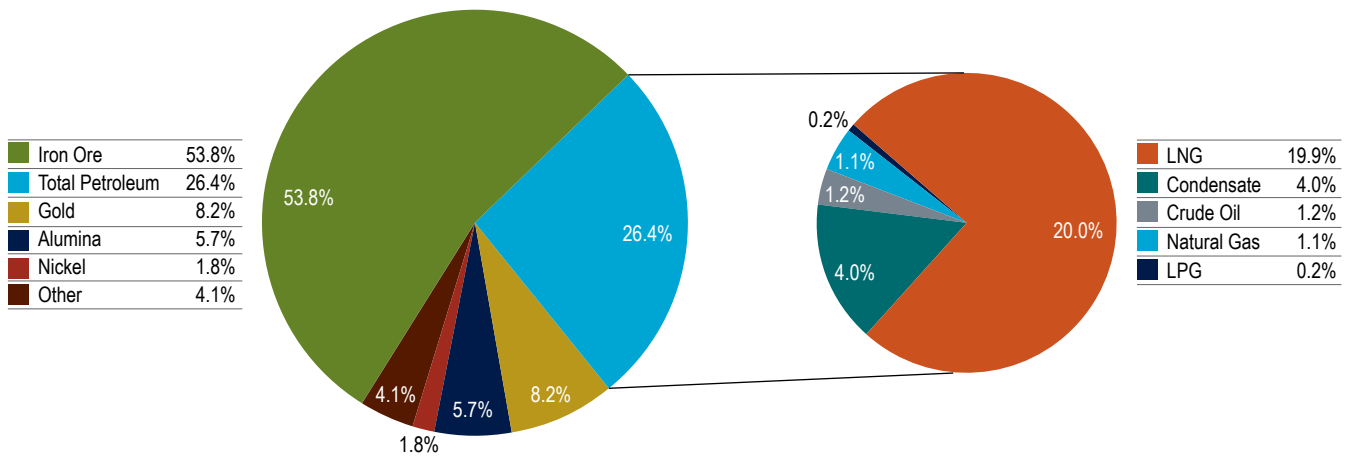


Figure 3 | **Financial year 2018-19 mineral and petroleum summary**
\$145.4 Billion
 Source: DMIRS

WA's nickel sector was relatively stable for the period with prices supporting a small, increase in sales value to almost \$2.7 billion despite a six per cent decline in sales volumes.

The remaining minerals sales values comprised:

- Base metal sales of slightly less than \$1.6 billion (down six per cent)
- Coal sales of \$319 million (down four per cent)
- Cobalt sales of \$331 million (down 35 per cent)
- Mineral sands sales of \$529 million (up 39 per cent)
- Salt sales of \$303 million (down less than one per cent)
- Spodumene sales of \$1.5 billion (down two per cent).

Petroleum sector highlights

The petroleum sector, which comprises crude oil, condensate, LNG, natural gas and LPG, accounted for 26 per cent of the total value of WA's mineral and petroleum sales in 2018-19. This made it the second most valuable sector after iron ore.

The sector was valued at \$38.4 billion in 2018-19, an increase of 45 per cent from \$26.5 billion in 2017-18.

LNG remains WA's most valuable petroleum product, accounting for 20 per cent of all mineral and petroleum sales in 2018-19. The value of LNG sales rose from \$18.9 billion in 2017-18 to \$29 billion in 2018-19.

In 2018-19, crude oil volumes were down 34 per cent to 3.2 gegalitres (GL), while condensate production increased almost 60 per cent to 11.4 GL.

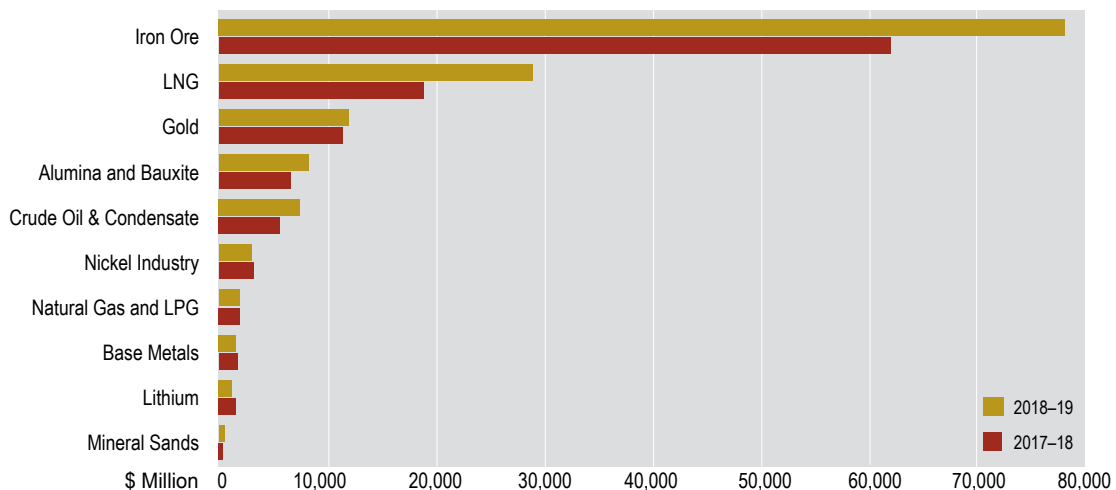


Figure 4 | **Major commodities by value**
\$145.4 Billion
 Source: DMIRS

AVAILABILITY OF DETAILED RESOURCE DATA

The Department publishes detailed resource data on its website. Three separate Excel files are available:

1. Major commodities – this file contains information about the scale and scope of WA’s mineral and petroleum industry, as well as detailed information about the State’s major commodities. It includes data relating to sales values and volumes, prices, exports and production, compared with the rest of Australia.
2. Economic indicators – this file contains information about how the State’s mineral and petroleum industry contributes to the economy through exploration, 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 to where to find more detailed information.

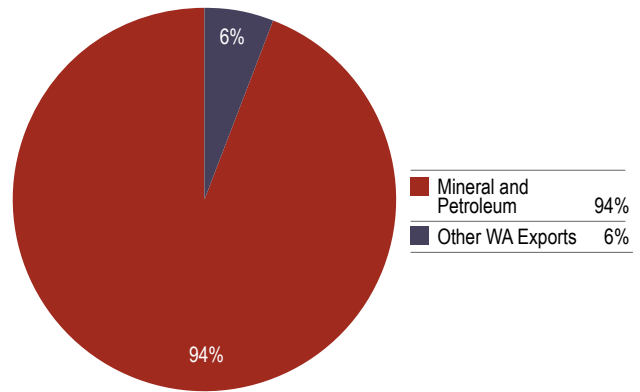


Figure 5 WA merchandise exports 2018–19
\$161.85 Billion
 Source: DMIRS and ABS
 Note: Minerals and Petroleum includes \$5.53 billion worth of gold and \$332.1 million worth of Mineral Sands that is refined or processed in WA but produced in other States/Territories/overseas.

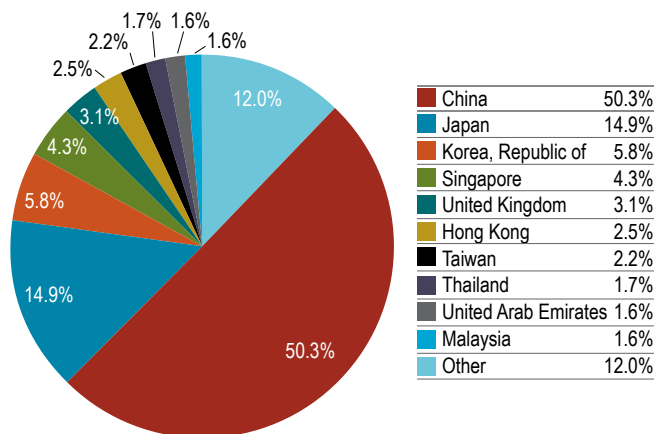


Figure 6 WA merchandise exports by country 2018–19
\$161.85 Billion
 Source: ABS

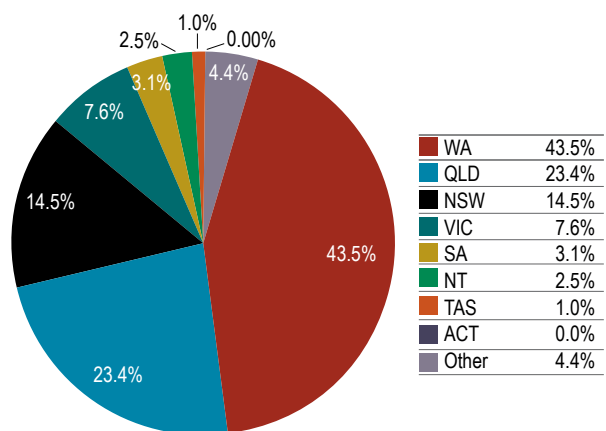


Figure 7 Australian merchandise exports 2018–19 by state/territory
\$372.09 Billion
 Source: ABS
 Note: “Other” refers to exports where state of origin is not released by ABS or where merchandise is re-exported.

1 INDUSTRY ACTIVITY

1.1 PRINCIPAL RESOURCE PROJECTS

WA's mining industry consists of 116 predominantly higher-value and export-oriented mining projects.

The State's mining industry also comprised hundreds of quarries and small mines producing clays, construction materials, dimension stone, gypsum, limestone, limesand, and spongolite for the local construction industry.

There were also 13 major mineral processing operations which transform bauxite into alumina; gold dore into gold bars; nickel concentrate into nickel matte, nickel powder and nickel briquettes; rutile and synthetic rutile into titanium dioxide pigment; zircon into fused zirconia; and silica sand into silicon metal.

The number of gold projects was down to 47 in 2018–19 from 53 in 2017–18. The decline is predominantly due to the depletion of resources at several, mostly small scale, gold projects that re-started in a high price environment. The number of iron ore and nickel projects was also down due a combination of depleted resources, challenging market conditions, and operational changes.

In addition to the above mining projects, there are 23 principal petroleum projects producing oil, gas and condensates from 57 fields onshore and in the Commonwealth Waters around WA.

The total number of petroleum projects is down from 24 in 2017–18, with the end of production at Fletcher-Finucane, Mutineer-Exeter, and Red Gully offsetting the start-up of the Ichyths LNG and Prelude FLNG projects.

However, the number of producing fields increased due to the Greater Western Flank Phase Two expansion of the NWS coming on stream in October 2018.



A list of the principal resource projects is available on the department's website.

1.2 EXPORT ACTIVITY

Western Australian resources have been exported to more than 150 countries in the past 12 years. While the majority of these countries receive relatively small amounts, the top 25 countries each imported more than \$1 billion worth of non-gold resources¹ and of the top 25, only six exceeded \$10 billion.

The State's merchandise exports were the highest for any 12-month period since records began with exports worth more than \$161 billion in the year to June. China continues to play a massive role in the State's trade. In June alone, WA exported about \$9.3 billion of merchandise to China, with exports throughout the year totalling \$81.4 billion, or just more than half of total shipments. Sales to Japan also strengthened with \$24.1 billion of merchandise exports to Japan, compared with \$18.9 billion in the previous 12 months.

Overall, Australia's resources exports have doubled over the last 10 years with a strong period of project investment driving record export volumes. Australia's resources sector accounted for 58 per cent of Australia's total export revenue in 2018–19.

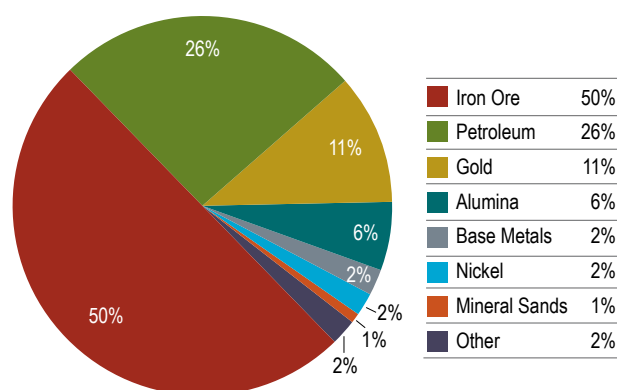


Figure 8 | **WA mineral and petroleum exports 2018–19**
\$152.1 Billion
 Source: DMIRS and ABS

¹ Gold is excluded primarily due to the distorting effect of re-exports of overseas material processed in WA by the Perth Mint. See "Gold", below, for more details.

1.3 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.

The difference between the individual and FTE data

The department reports employment data in two ways:

1. Full-time Equivalent (FTE): The total number of positions that would be available within the mining industry if all work was performed by standardised full-time employees.
2. Total Number of Individuals (NoI): The number of individual people who have performed at least one hour's work on a mine site or for a mining company.



1.3.1 Mining

WA's mining industry employed an average of 124,010 people during 2018–19, up from 112,036 the previous year. This figure includes people employed in mine site infrastructure construction, mineral processing, mine site surveying, transport and catering – essentially those people operating on site². Mineral exploration activities employed, on average, a further 3086 people.

However, this figure should be used with caution as FTE employment in 2018–19 was lower at 98,634. The disparity between FTE employment and the Nol employed emerged as the uptake of contract employment overtook full-time employment methods. In June 2009, the disparity between FTE and the number of individuals employed was just 1.8 per cent. That figure now stands at 25 per cent.

The iron ore sector remained the State's largest mineral sector employer, with an average of 45,264 FTEs, while gold and alumina were the next largest employers with 25,700 FTEs and 6994 FTEs respectively.

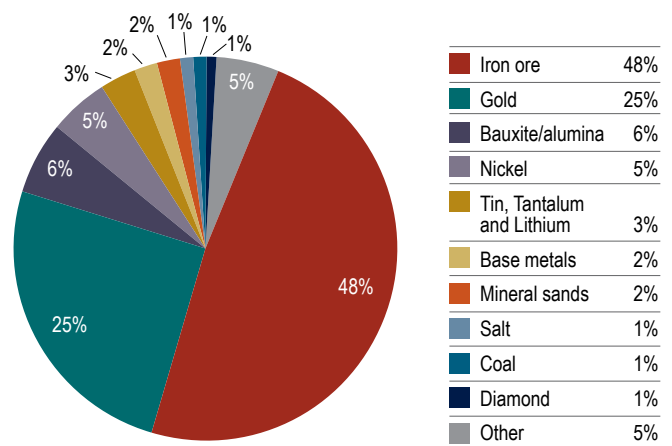


Figure 9 | **WA minerals direct employment by mineral commodity 2018–19**
124,010 individuals
Source: DMIRS

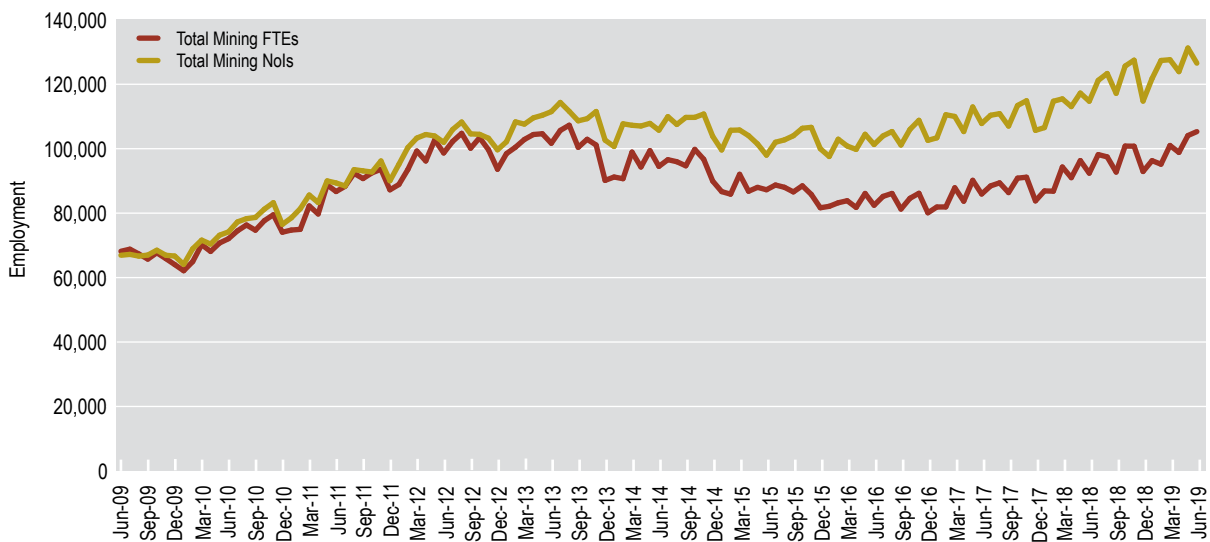


Figure 10 | **FTE vs Nol employment in WA's mining industry 2009–19**
Source: DMIRS

² 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.

1.3.2 Employment at State regulated petroleum projects

The Department captures employment data for areas of the petroleum sector which are subject to State legislation. This includes petroleum facilities and pipelines both onshore and in coastal waters. The Department does not capture employment data for offshore petroleum projects.

The average number of people employed by onshore and coastal petroleum projects increased from 1472 to 1564 in 2018–19. The data represents the average number of people employed at operating sites, including contractor employees³. A similar disparity exists for the petroleum sector between the Nol reported and the FTE. In 2018–19, the number of FTEs employed across the petroleum sector was 1256, compared with 1156 in the previous period.

The Dampier to Bunbury Natural Gas Pipeline is regularly this sector's largest employer with an average of 361 people (or 322 FTEs) employed in 2018–19. However, Quadrant Energy's Devil Creek and Varanus operations were a close second with 315 people (319 FTEs).

1.4 ROYALTIES

Royalties for all minerals and petroleum produced on State land and in State waters are paid into the State 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 (NWS) in the form of Commonwealth grants, in accordance with an agreement between the WA and Australian Governments.

The WA Government received royalty revenue from the State's mineral and petroleum producers totalling \$5.6 billion in 2018–19, an increase of 10 per cent on 2017–18⁴.

Iron ore provided the bulk of collections (74.5 per cent, including NWS grants) for 2018–19, up nine per cent on the previous year's receipts. Consistent with the strong market conditions seen in the gold sector across the past few years, contributions rose almost seven per cent to \$291 million in 2018–19.

Petroleum royalty receipts fell during the previous two years however the start-up of new projects helped petroleum royalties increase 264 per cent from \$3.2 million to \$11.7 million in 2018–19. The State also received \$889 million in grants for the NWS, an increase of 30.4 per cent on 2018–19.

The figure reported in this digest is the "royalty receipts" for the relevant period, i.e. the cash that was actually received by the State Government during 2018–19. This means that the royalty receipts are offset from sales value figures by one quarter and comprise the June, September, December 2018 quarters and the March 2019 quarter.

For commodities subject to an ad-valorem royalty rate, e.g. iron ore, the royalty payable is calculated from the gross sales value less any allowable deductions. For commodities on a specific rate, e.g. construction materials, the royalty payable is calculated on a per-tonne basis.



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 NWS grants from 1984–present.

³ This figure comprises only operations subject to State petroleum legislation, and excludes LNG operations and land based service operations.

⁴ 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 1. Royalty receipts and North West Shelf grants 2017–18 and 2018–19				
Commodity	2017–18 Total A\$	2018–19 Total A\$	2018–19 growth	
			A\$	%
Alumina	99,232,000	135,004,000	35,772,000	36.0%
Copper, Lead & Zinc	70,778,000	76,167,000	5,389,000	7.6%
Diamonds	12,094,000	11,625,000	-469,000	-3.9%
Gold	272,771,000	291,416,000	18,645,000	6.8%
Mineral sands	12,291,000	18,560,000	6,269,000	51.0%
Iron ore	4,476,871,000	4,884,196,000	407,325,000	9.1%
Lithium	78,713,769	83,247,252	4,533,483	5.8%
Nickel	56,958,000	65,991,000	9,033,000	15.9%
Petroleum *	3,212,000	11,676,000	8,464,000	263.5%
Other	69,636,231	86,701,748	17,065,517	24.5%
Total royalty receipts	5,152,556,000	5,664,583,000	512,027,000	9.9%
North West Shelf Grants	681,965,000	889,356,000	207,391,000	30.4%
Total revenue	5,834,521,000	6,553,938,000	719,417,000	12.3%

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

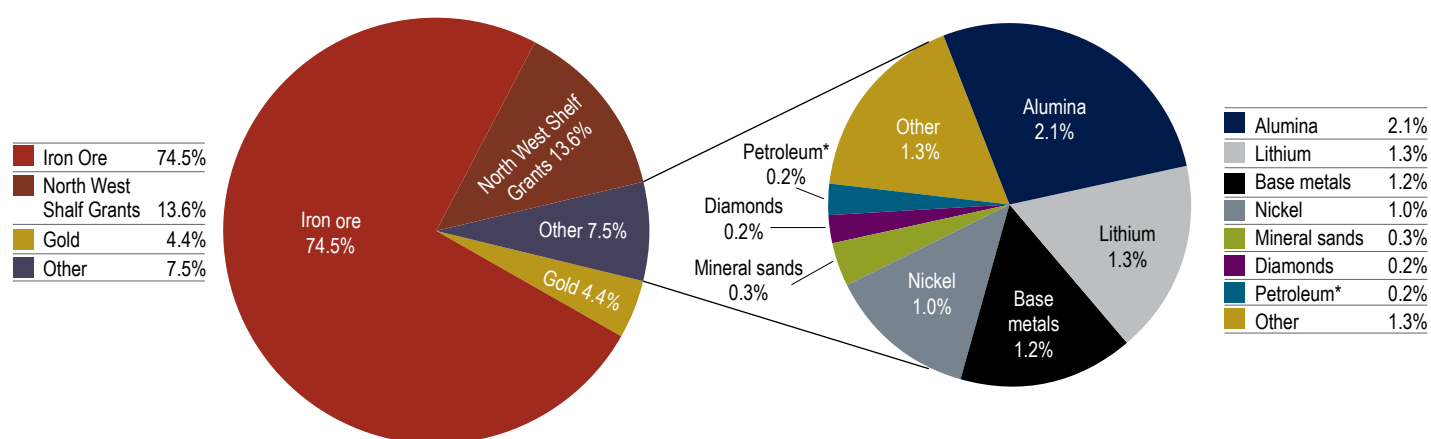


Figure 11 | **Royalty receipts and North West Shelf grants 2018–19**
\$6.55 Billion
 Source: DMIRS and Department of Treasury

1.5 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 in Australia, including WA
- new capital investment for mining in Australia, including WA.

1.5.1 Mining investment and new capital expenditure

WA's share of national mining investment has averaged about 57 per cent for the past 10 years. In 2018–19, almost \$17 billion was invested in the State, representing about 51 per cent of national expenditure.

Nationally, mining investment fell for the sixth consecutive year, down from \$94.7 billion in 2012–13 to \$33.4 billion (65 per cent).

In terms of new capital expenditure, that is spending on new buildings and other structures as well as plan and machinery, WA's share of expenditure is just 20 per cent (\$24.3 billion) of the Australia's total spend (\$122 billion). WA's expenditure has averaged about 31 per cent of Australia's total over the past 10 years.

The substantial decline in investment is the result of the completion of major, multi-billion dollar iron ore and LNG projects. While the scale of investment seen between 2010–11 and 2013–14 is unlikely to be repeated soon, interest and investment in the resource sector remains, albeit at a smaller scale.

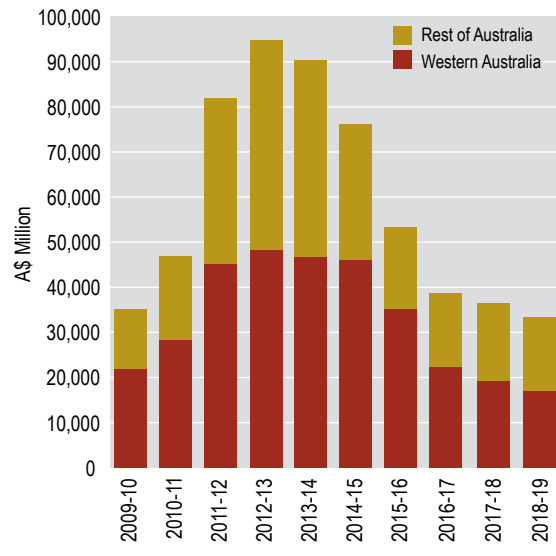


Figure 12 | **Mining investment**
Source: ABS

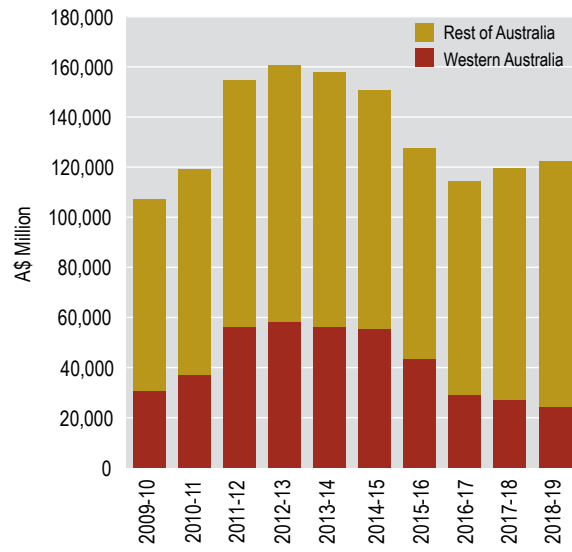


Figure 13 | **New capital expenditure**
Source: ABS

1.5.2 Resource project investment pipeline

The Department maintains a mineral and petroleum investment database to estimate actual and possible investment in WA's resources industry⁵.

Where possible, information is collated in relation to expected capital expenditure, project timing and employment during the construction and operation phases. Mineral and petroleum projects are categorised as:

- 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 (FID), but are waiting for approval 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 2019, WA had resource projects in the pipeline valued at an estimated \$108 billion, down slightly from the March 2019 estimate of \$113 billion.

Recently announced new projects include:

- Australian Vanadium's \$500 million vanadium project near Meekatharra.
- Stage one of Caravel Minerals' \$481 million namesake copper mine.
- EcoMag's \$130 hydrated magnesium carbonate processing plant.
- Red 5's \$218 million expansion of the King of the Hills gold mine.
- Atlantic's \$127 million Windimurra vanadium pentoxide plant rebuild.
- Stage one of Kibaran Resource's \$32.5 million Kwinana graphite plant.
- Metal X's \$27 million restructure of the Nifty copper mine which aims to improve performance and reduce costs at the mine.

Sector	Commodity	CAPEX (A\$ million)	
		Committed/ under construction	Planned/ possible
Minerals	Gold	264	959
	Iron ore	15,820	1,509
	Nickel, copper and zinc	356	3,349
	Lithium	2,558	4,247
	Infrastructure	0	70
	Other minerals	733	8,321
	Sub-total Minerals	19,731	18,455
Petroleum	Crude oil and condensate	0	0
	Gas	0	5,000
	LNG	5,714	58,951
	Pipelines and infrastructure	0	0
	Sub-total Petroleum	5,714	63,951
Total forecast investment		25,445	82,406

Source: DMIRS

⁵ 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.

The value of projects under construction or in the committed stage of development was an estimated \$25 billion, up from \$24 billion in March this year. This minor change is attributed to projects such as FMG's \$3.6 billion Iron Bridge magnetite mine progressing through the development pipeline, while other projects like Woodside's Greater Western Flank expansion (\$2 billion) and Greater Enfield (\$2.5 billion) projects were completed.

The value of planned or possible projects decreased from \$88 billion to \$82 billion between March and September. The decrease is due to the movement of projects through the pipeline as well as the suspending of other projects such as the planned stage three expansion at Greenbushes and the 3rd, 4th and 5th stage expansions at the Kemerton lithium plant amid challenging market conditions.

1.6 EXPLORATION



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

- historic and current expenditure on mineral exploration in WA 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 WA compared with the rest of Australia

1.6.1 Minerals exploration

Consistent investment over time and access to land for exploration are important. Exploration and subsequent mine development is needed to sustain WA's position as a leading mineral producer.

As reported by the Australian Bureau of Statistics (ABS), Australia's mineral exploration expenditure was \$2.3 billion in 2018–19, up from \$2 billion in 2017–18. WA contributed \$1.4 billion (61 per cent) of this spend with the gold, iron ore and base metal sectors attracting the largest shares. Gold exploration expenditure in WA increased eight per cent from \$591.5 million in 2017–18 to \$672.8 million in 2018–19. Iron ore exploration increased 13 per cent from \$274 million in 2017–18 to \$310.1 million in 2018–19.

Notable events

- Independence Group uncovered a nickel system much larger than previously apparent through near-mine exploration work at Nova.
- RNC Minerals delivered an almost 390 per cent increase in measured and indicated resources within its Beta Hunt gold mine to 710,000 ounces and a three-fold increase in inferred resources to 250,000 ounces.
- Liontown Resources boosted the resource at the Kathleen Valley project by 353 per cent to 75 Mt for 2.5 Mt of lithium carbonate equivalent and 23 million pounds of tantalum pentoxide. Liontown Resources raised \$18 million to fund further exploration and development studies at its Kathleen Valley and Buldania lithium prospects.

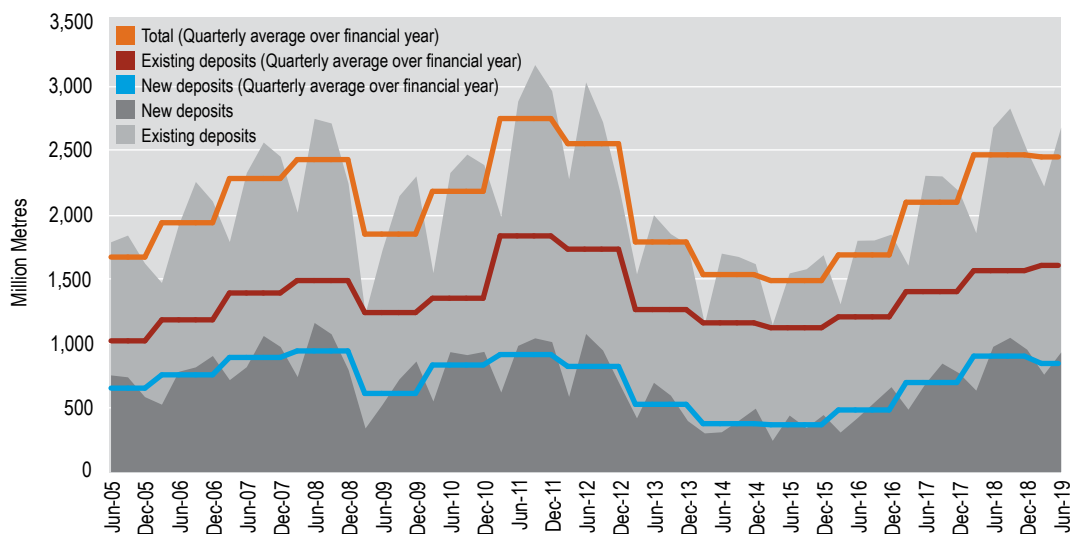


Figure 14 | Australia-wide drill metres – new and existing deposits
Source: ABS

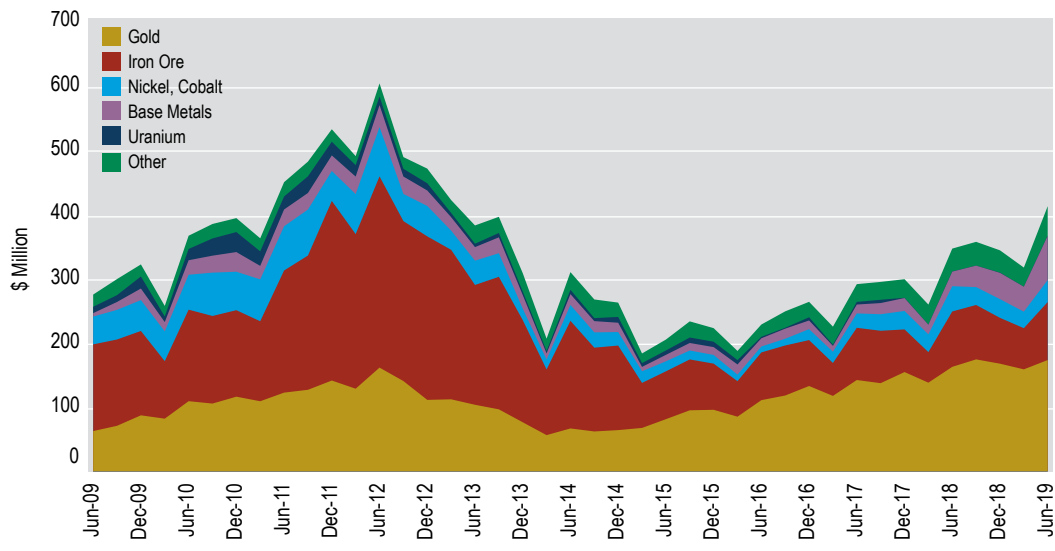


Figure 15 | **WA mineral exploration spend by commodity**
Source: DMIRS and ABS

- Cobre announced the discovery of a volcanic-associated massive sulphide deposit containing copper, gold, silver and zinc at its Perrinvale project.
- In February, Rio Tinto has revealed a copper-gold-silver discovery at the Winu project in WA's Paterson. The results from the discovery came from 24 holes as part of a US\$250 million global exploration program. The largest intersection came in at 741 metres at 0.45 per cent copper, 0.52 grams per tonne (g/t) gold and 2.94 g/t silver, with four intersections returning copper grades of greater than one per cent, one of which also had gold grades above 1 g/t. The highest-grade intersection indicated was 60 meters at 1.03 per cent copper, 1.22 g/t gold and 4.3 g/t silver, with narrower, higher-grade intersections also cited including 6 meters at 4.7 per cent copper, 2.5 g/t gold and 26 g/t silver.
- Northern Minerals announced a high-grade maiden resource estimate of 144,000 tonnes grading 2.23 per cent total rare earth oxides for the Dazzler prospect, 15 km north of the Browns Range deposit near Halls Creek. This grade is more than three times the average of the Browns Range deposit. Northern Minerals also commenced an infill and drilling program at the Dazzler and Iceman prospects for mineral resource extension and definition.
- Salt Lake Potash defined a 73 Mt sulphate of potash high-grade resource for its Lake Way project in the Northern Goldfields region.

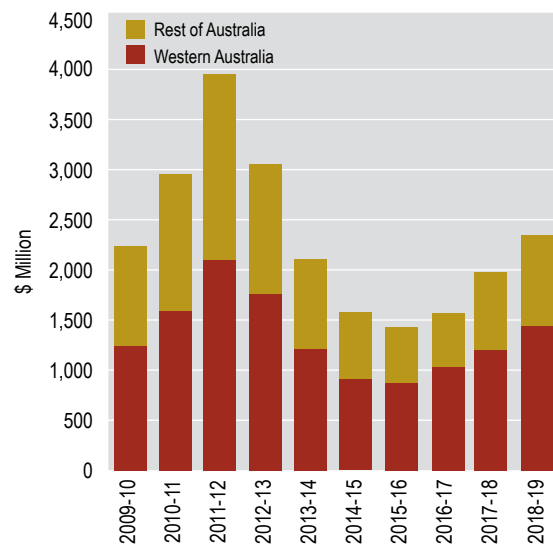


Figure 16 | **Mineral exploration expenditure**
Source: ABS

- Mincor Resources increased the size of the mineral resource at its Cassini nickel project, raising the total to 780,000 tonnes of 3.7 per cent nickel, a 52 per cent increase over the previous estimate in August 2018. Mincor is continuing with extension drilling, aiming to further expand the resource.
- Venus Metals announced a "world-scale" vanadium resource at its Youanmi project of 134.7 Mt grading 0.34 per cent vanadium pentoxide for a contained 458,900 tonnes. This result is supporting additional metallurgical test work and scoping studies to advance the project.

1.6.2 Petroleum exploration

The ABS also reports on onshore and offshore petroleum exploration expenditure. Nationally, petroleum exploration expenditure has fallen every year since 2013–14. 2018–19 marks the first increase in petroleum exploration expenditure with almost \$1.3 billion spent across Australia. High oil prices in Australian dollar terms are thought to be behind the modest return of confidence in the oil and gas industry.

WA's petroleum exploration expenditure also increased year-on-year, up from \$562 million in 2017–18 to \$734 million in 2018–19 (a three per cent increase). WA's share of national petroleum exploration spend also increased to 58 per cent in 2018–19, the highest it's been since 2015–16.

In terms of the split of exploration across onshore and offshore activities, data is only available at a national level. In 2018–19, Australia's total onshore petroleum exploration expenditure was \$436 million versus \$812 million for offshore exploration.

Notable events

- Shell is planning a 3D seismic survey to be conducted between July and December 2019 across three permits it holds in the offshore Browse and Bonaparte Basins.
- Following the landmark Dorado discovery in July 2018, the successful appraisal result has given Carnarvon Petroleum and its Joint Venture partner, Santos, confidence to progress plans for the field development. Exploration and appraisal wells are planned for the Dorado and Roc South fields with Carnarvon Petroleum having raised \$50 million in February to fund the program. The Dorado discovery is one of the largest oil discoveries ever on the NWS.

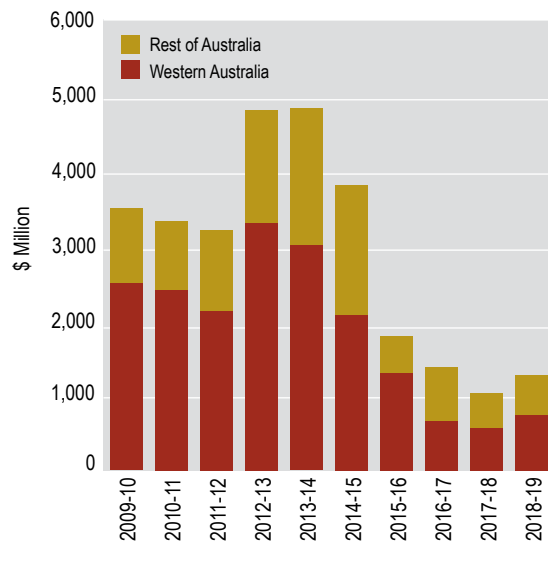


Figure 17 | Petroleum exploration expenditure
Source: ABS

1.7 TENEMENT ACTIVITY

Tenement activity is one of several indicators of the industry's health and the scale of mining activities across WA. In 2018–19, 47.2 million hectares of land was covered by mining tenements, up from 44.2 million hectares in 2017–18.

The number of exploration licences increased for the third consecutive year, up from 5474 to 5862 year-on-year.

The number of prospecting licences increased over the year from 5257 in 2017–18 to 5391 in 2018–19.

The following graph identifies three aspects of tenement activity:

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

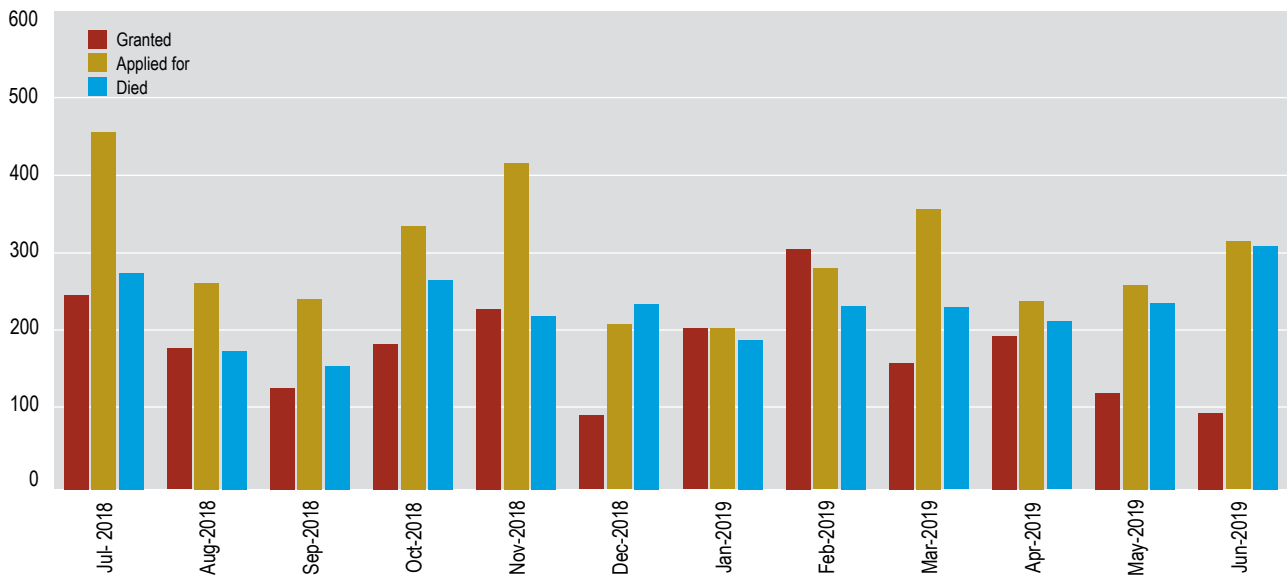


Figure 18 | **Tenement activity 2018–19**
Source: DMIRS

State petroleum titles are administered under three Acts:

1. The *Petroleum (Submerged Lands) Act 1982* – generally applies to the State’s territorial sea up to the three-nautical mile mark, including the territorial sea around State islands.
2. The *Petroleum and Geothermal Energy Resources Act 1967* – 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* – applies to petroleum pipelines on land within the State.

As at 12 August 2019, the area covered by petroleum titles regulated by WA State legislation was 81,697 sq km, compared with the 78,550 sq km reported in August 2018.



The spatial indicators resources data file contains historic information about the number and type of mineral and petroleum tenements.

2 COMMODITY REVIEW

2.1 IRON ORE

Pricing

The iron ore price performed well over the reporting period with both the 62 per cent and 58 per cent iron prices reaching \$US triple digits for the first time since 2014. This was largely the result of a number of supply shocks including Vale's issues in Brazil and production downgrades from Rio Tinto and BHP. These events contributed to global ore inventory stockpiles falling more than 30 Mt between February and May 2019.

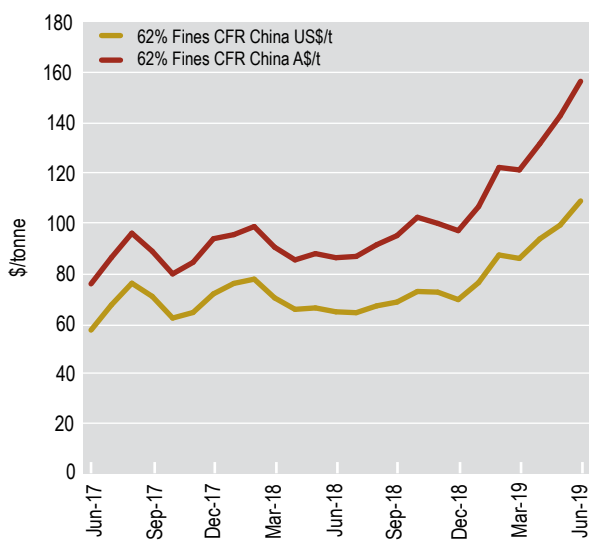


Figure 19 | Iron ore price – 62% fines
Source: Argus Metals

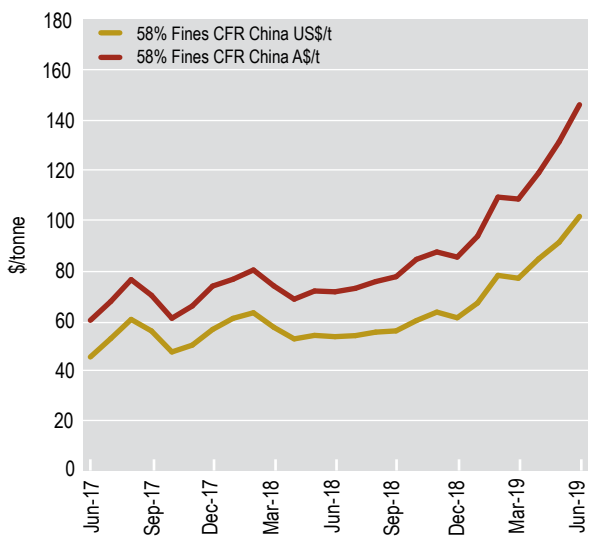


Figure 20 | Iron ore price – 58% fines
Source: Argus Metals

The 62 per cent iron ore spot price averaged US\$80.31 (A\$112.63) for 2018–19, a 16 per cent increase in US-dollar and a 26 per cent increase in Australian-dollar terms. The improved prices also extended to the 58 per cent iron spot price which averaged US\$70.62 (\$99.10) for 2018–19. The US-dollar yearly average increased 28 per cent over the period, while the Australian-dollar price average rose almost 40 per cent.

WA producers benefited from a relatively low exchange rate, as well as a narrowing in the price spread between high and low grade ores as Chinese steel makers substituted low grade ores to mitigate the loss of Vale's high grade supply. This was a welcome reprieve for local producers who were being affected by heavy price discounting over the previous 18 months.

Quantity and value

WA's iron ore sales totalled 794 Mt in 2018–19, a decrease of 5.4 per cent on 2017–18. This is the first decrease in yearly sales volumes since 1998–99 when sales fell by a similar percentage. Weather and fire related disruptions as well as changes to mine sequences contributed to the decline.

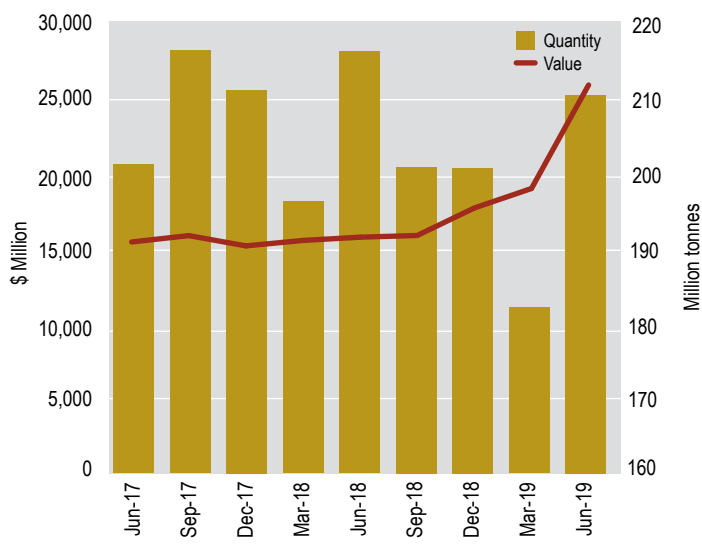


Figure 21 | Iron ore quantity and value by quarter
Source: DMIRS

Despite the decrease in sales volumes, the increase in the Australian-dollar price meant that the value of the iron ore sector rose 26 per cent from \$62.1 billion in 2017–18 to \$78.2 billion in 2018–19.

China remained the State’s largest iron ore customer accounting for 82 per cent (\$62.4 billion) of iron ore exports. Japan and South Korea were the next two largest markets accounting for \$5.7 billion (7.5 per cent) and \$4.5 billion (six per cent) in exports respectively.

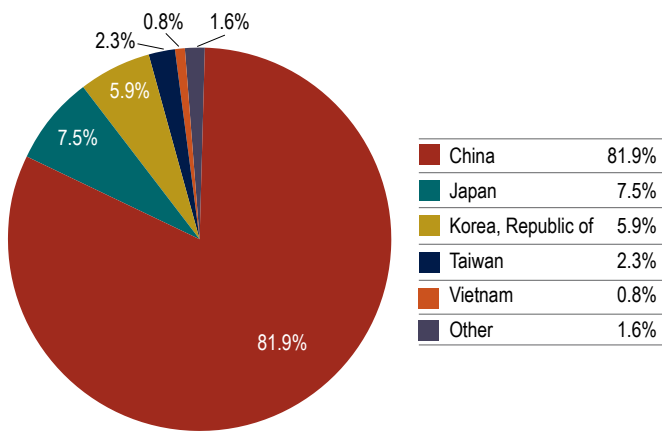


Figure 22 | **Iron ore exports 2018–19**
\$76.2 Billion
 Source: ABS



Figure 23 | **Iron ore exploration expenditure 2018–19**
Total Australian spend \$322.6 Million
 Source: ABS

The big three – iron ore snapshot

Fortescue Metals Group’s (FMG) Eliwana, Rio Tinto’s Koodaideri, and BHP’s South Flank iron ore projects are set to add 50 Mt, 43 Mt, and 80 Mt respectively to WA’s annual iron ore exports.

FMG’s US\$1.275 billion Eliwana project is expected to start production towards the end of 2020. In addition to establishing a new mining zone, the Eliwana project will include the construction of a new ore processing facility with a 30 Mtpa capacity, communication and accommodation infrastructure and about 140 km of new rail and associated infrastructure.

Construction at the site is currently underway with preliminary works started in late 2018 and earthworks commencing in February 2019. Construction of the main mining area and processing facility is expected by December of 2019.

Rio Tinto’s US\$2.6 billion Koodaideri development includes a processing plant and a 166 km rail line connecting the mine to Rio Tinto’s existing network. Construction is set to start this year with first production expected in the last quarter of 2021.

Once operational, the site will feature technology such as autonomous trucks, trains and drills, and systems which for the first time connect all components of the mining value chain. Koodaideri includes more than 70 points of technological interest, including:

- a real time digital replica of the processing plant
- fully integrated mine automation and simulation systems
- an automated workshop
- data analytics capabilities and control loops to optimise production and reduce downtime.

A US\$44 million pre-feasibility study into phase two of the project that would increase iron ore production to 70 Mtpa.

BHP’s US\$2.9 billion South Flank project is on track to become the company’s largest iron ore operation. It is expected to replace the 80 Mtpa production deficit following the planned closure of BHP’s Yandi mine, which is reaching the end of its economic life. First ore is targeted in 2021 with the project expected to have a 25-year life span.

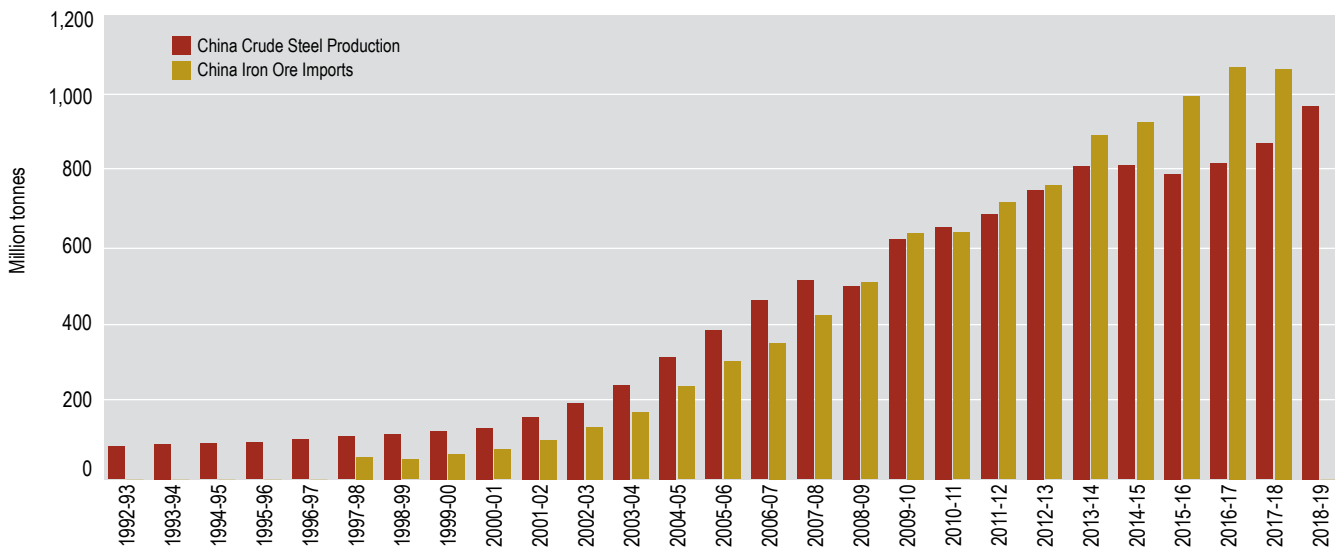


Figure 24 | China's crude steel production and iron ore imports
 Source: World Steel Association and TEX Report
 Note: China's total iron ore imports for 2018-19 were unavailable at the time of publication.

Notable events

- The Government announced it would support Mineral Resources Limited (MRL) to continue operations at the Koolyanobbing iron ore project. Assistance includes a royalty rebate of up to \$5 million for royalties paid in the June Quarter of 2018, a full royalty rebate and discounted port charges at Esperance for up to 30 Mt of production over five years. In return, MRL has agreed to export about 6 Mtpa over five years through Esperance port and to transfer the Esperance port iron ore loading infrastructure to the Southern Ports Authority for no cost when mining is completed. MRL acquired the project for an undisclosed sum from previous owner Cliffs Natural Resources which announced it would close Koolyanobbing from June 2018 to focus on its North American operations.
- Atlas Iron was acquired by Redstone Corporation, a subsidiary of Hancock Prospecting in December 2018.
- Hancock Prospecting and Rio Tinto announced the opening of a new pit, Baby Hope, at the joint venture Hope Downs 1 mine in the Pilbara. Baby Hope is expected to be a multi-year operation that will help extend Hope Downs 1 to at least 2027. The high-grade lump yield of 47 per cent at Hope Downs 1 is crucial to maintaining Pilbara Blend's product specifications.

- In November, BHP suspended railway operations after a loaded iron ore train, consisting of four locomotives and 268 cars, travelled without a driver for almost 100 km. The site was cleared and operations restarted soon after. This incident was followed by another derailment in the following week, this time by MRL, involving empty wagons travelling from Esperance back to the company's Koolyanobbing operations.

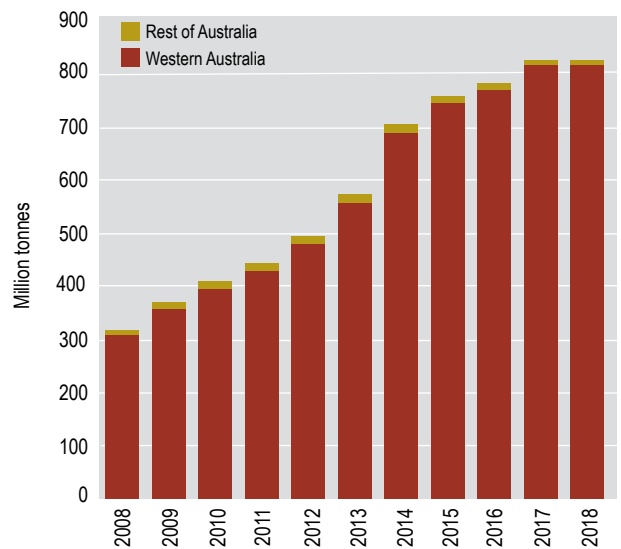


Figure 25 | WA iron ore production v rest of Australia
 Source: DMIRS and DIIS

- FMG began shipments of its 60 per cent iron West Pilbara Fines (WPF) blend with the first shipment leaving from Port Hedland bound for China.
- MRL announced the completion of its deal to purchase the Pilbara-based Kumina Iron Ore Project from BCI Minerals. Kumina has a JORC Inferred Mineral Resource of 78.3 Mt at 59 per cent iron. The sale of Kumina is part of BCI Minerals' larger plans to divest from the Australian iron ore business. The company has plans to sell off its Iron Valley and Bungaroo South properties, its Cape Preston East port rights, and several other iron ore exploration tenements.
- In March 2019, Macarthur Minerals entered into a binding life-of-mine offtake agreement with Glencore International for the sale of iron ore from its Lake Giles iron ore project in the Yilgarn region of WA. The offtake agreement includes 4 Mtpa of iron ore products for the first 10 years production with the option to extend for another 10 years. Macarthur Minerals is looking to develop Lake Giles to produce magnetite concentrate with product grades above 65 per cent iron. Macarthur Minerals is currently seeking to complete its bankable feasibility study for the project and secure project financing.
- In April, FMG and joint venture partner Formosa Steel approved the development of the US\$2.6 billion Stage two Iron Bridge project in WA. FMG, which holds a 60.7 per cent stake in the project, expects the site to produce 20 Mtpa of 67 per cent iron, with a 20-year mine life commencing production in the first half of 2022.
- Mount Gibson Iron re-commenced operations at its Koolan Island project and completed its final shipment of stockpiled ore from the Iron Hill mine. The company initially intends to take advantage of higher prices by commencing shipments of low-grade stockpiled materials (50-55 per cent iron).

- Tropical Cyclone Veronica shut down Pilbara iron ore exports with the total impact estimated at 23-25 Mt.
- Ansteel announced it would take full ownership of the Karara magnetite iron ore project after it purchased Gindalbie Metals' 47.8 per cent share in the project for about \$25 million.
- Rio Tinto completed construction on its \$1.37 billion AutoHaul project at the end of 2018.



The major commodities resources data file contains:

- quarterly production and sales value figures for iron ore in WA
- historic annual average price of iron ore and recent monthly prices
- value of iron ore exports from WA by destination
- annual historic iron ore production in WA 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.

2.2 PETROLEUM

In 2018–19, the value of petroleum products produced in State areas, onshore and offshore, and in adjacent Commonwealth offshore areas totalled \$38.4 billion, up 45 per cent from \$26.5 billion in 2017–18⁶.

Petroleum sales accounted for 26 per cent of all mineral and petroleum sales, making the petroleum sector WA's second most valuable after iron ore. The majority of petroleum production (more than 90 per cent) originates from projects in adjacent Commonwealth offshore areas.

Japan remained the primary export destination for petroleum, taking 43 per cent, or \$16.9 billion, of WA's petroleum production. China and Singapore were the next largest with 15 per cent and 13 per cent of petroleum exports respectively.



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)

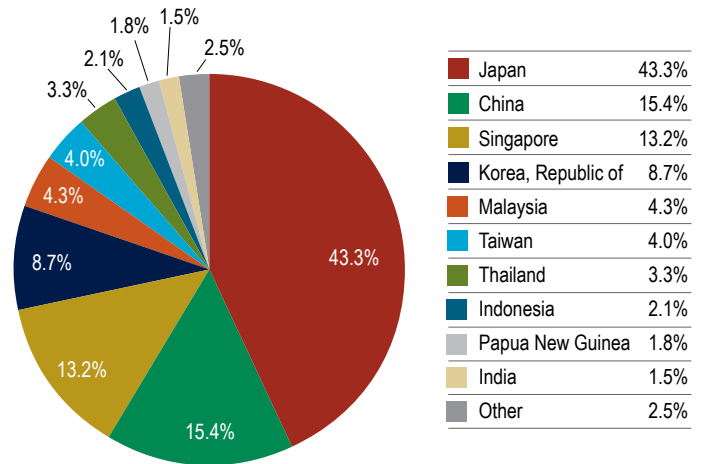


Figure 26 **Petroleum exports 2018–19**
\$39.2 Billion
Source: DMIRS and ABS

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

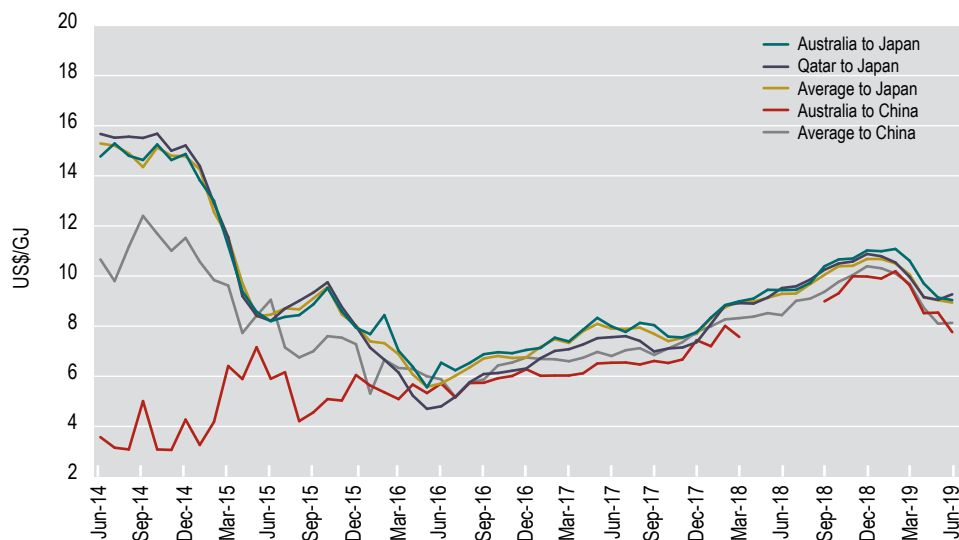


Figure 27 **LNG import prices**
Source: Argus Monthly LNG and EnergyQuest
Note: The average LNG import price from Australia to China between April and September 2018 was unavailable at the time of publication.

⁶ In early 2016, changes in information sharing between the Australian and WA State Governments resulted in the department needing to source alternative data. This new dataset was not comparable with the sales data previously provided by the National Offshore Petroleum Titles Administrator resulting in the need for some estimates. From Q1 2016, DMIRS has relied on externally-sourced production data and estimated the value of production from these offshore fields based on total production and the prevailing market prices at the time.

2.2.1 Liquefied natural gas (LNG)

Pricing

Gas prices and gas pricing mechanisms vary from region to region. Most LNG in the Asia Pacific region is sold under long-term contracts in which the price of LNG is linked to the price of oil. In terms of LNG spot prices, these have been progressively diverging from oil-linked LNG contract prices.

The fall in LNG spot prices is believed to be driven by the ramp-up of new capacity in the US, Australia and Russia combined with declining imports by Japan (on the back of the restart of nuclear plants in the region) and South Korea, respectively the world's largest and third largest LNG buyers.

The LNG spot price in Asia has fallen significantly since November 2018, with prices at their lowest point since 2016. The more than 100 per cent fall has been brought on by increases in supply from Australia and US as well as the mild weather in North Asia. However, prices began to strengthen in June 2019 in line with seasonal increases in winter.

The annual price of LNG from Australia to Japan has not declined as much as the LNG spot price, reflecting the long-term contracts that the majority of WA producers operate under. In July 2019, the average Japanese import price was US\$8.94 per GJ, slightly more than the price for LNG from Australia to South Korea at US\$8.60 per GJ, and down just four per cent and eight per cent respectively compared with the same time last year.

Quantity and value

Australia currently has ten operational LNG projects responsible for exporting more than 80 Mt of LNG per year. Of these, five are located in areas off the northern coast of WA – The NWS, Prelude, Pluto, Gorgon and Wheatstone.

LNG was again WA's most valuable petroleum product in 2018–19, accounting for 20 per cent of the value of the State's mineral and petroleum sales. LNG sales rose 53 per cent from \$18.9 billion in 2017–18 to \$28.9 billion in 2018–19.

The volume of LNG produced in WA increased 113 per cent in the five years to 2018–19, with sales reaching a record 37.9 Mt in 2018–19. The year-on-year increase was 5.7 million tonnes (15 per cent) in the 2018–19 financial year.

The increase in LNG sales volumes was driven by the ramp-up in production from the Gorgon and Wheatstone projects, a slight uplift in volumes from the NWS and additional production from the Prelude FLNG project

which commenced in February. Sales increased despite the disruption to operations caused by Cyclone Veronica and scheduled maintenance in early 2019.

Most of WA's LNG is exported to Japan which has been the leading importer of LNG in the world since the 1970s. In 2018–19, WA petroleum exports to Japan, the majority of which is LNG, rose 33 per cent from \$12.8 billion to \$17 billion. However, Japan's demand for LNG is expected to decline in the coming years as it recommissions offline nuclear reactors. China climbed to become WA's second largest petroleum export destination from fourth in the previous financial year recording a 166 per cent increase to \$6 billion.

Australia and Qatar continue to jostle for the title of the world's largest LNG exporter. Recently, the US Energy Information Administration (EIA) stated that Australia is on track to consistently export more LNG than Qatar. New facilities have pushed Australia's export capacity from 2.6 billion cubic feet per day (bcf/d) in 2011 to more than 11.4 bcf/d in 2019. The EIA says Australia has already surpassed Qatar in LNG production capacity.

Notable events

- Inpex shipped its first cargo of condensate and LNG from Ichthys in October 2018.
- A preliminary deal was struck with the NWS Joint Venture partners to process LNG from Browse and Chevron's Clio–Acme projects. A final investment decision on the Browse project is set for 2020.
- Qatar left OPEC in advance of moves to scale up LNG production.
- Tropical Cyclone Veronica affected output at Chevron's Gorgon and Wheatstone LNG projects.
- Woodside announced its intention to replace existing long-term contracts, which are due to expire in 2025, with more flexible deals of shorter duration. Woodside's signing of a 10-year heads of agreement with China's ENN Group for one Mtpa of LNG from 2025 appears to be the first of these.
- Shell shipped its first cargo of condensate from its Prelude FLNG project in late March and its first LNG cargo in June. The facility, capable of holding 175 Olympic-sized swimming pools of LNG in its storage tanks alone, was the last of eight new LNG projects that came online in Australia between 2012 and 2018.
- Woodside opened its Pluto LNG truck-loading facilities in April as part of a plan to expand domestic markets and eventually replace a significant amount of the three billion litres of diesel used in the Pilbara each year. Woodside and Sheffield Resources also reached agreement for the supply of LNG to the Thunderbird mineral sands project.

- The South Korean government lowered import fees and cut sales tax on LNG for power generation from 1 April to encourage a shift to cleaner fuel sources. The move is expected to boost the use of LNG, which has previously been levied with higher taxes than coal. This should have positive flow-on effects for WA producers.

2.2.2 Crude oil and Condensate

Pricing

The annual average oil price, based on a combination of Brent, West Texas Intermediate and Tapis, was US\$66.61 per barrel in 2018–19, up slightly from US\$61 per barrel in 2017–18. This is the third consecutive year of price growth.

In 2018–19, prices started at the US\$74 per barrel mark but since then, oil markets have entered a period of volatility, reflecting uncertainty over global economic conditions and oil supply prospects. The initial price strength was supported by the curtailment of supply under a production agreement, called the “Vienna Agreement”, between OPEC, Russia, Kazakhstan, Mexico and seven other countries (collectively referred to as “OPEC+”). However, by May, over-compliance with that agreement as well as unplanned outages in Venezuela and Iran decreased total world oil production by more than twice the amount expected.

Prices dropped significantly during November and December 2018 and into January 2019. More recently attacks on tankers in the Gulf of Oman have caused the cost of shipping insurance to rise and further heightening of tensions in the Middle East could drive oil prices higher.

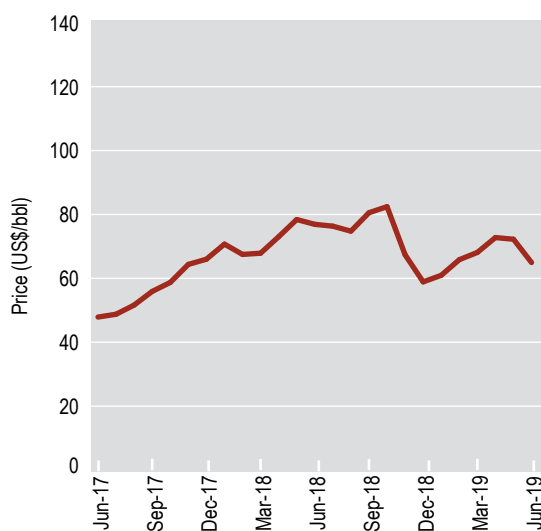


Figure 28 | **Tapis crude oil price**
Source: WA Treasury Corporation and DMIRS

Quantity and value

About 70 per cent of Australia’s crude oil and condensate production comes from the Carnarvon Basin in WA.

Crude oil volumes in 2018–19 fell for the fourth consecutive year, down 34 per cent from 4.9 GL (30.8 million barrels) to 3.2 GL (20.2 million barrels). Maintenance shutdowns at the Pyreness project and the ceasing of production at Enfield in November 2018 contributed to this decline. The result was a decrease in the value of WA crude oil from \$2.3 billion to \$1.7 billion.

WA condensate is produced as a by-product of natural gas production from the NWS fields. As expected with the increase in LNG volumes, the volume of condensate sales also increased year-on-year. Condensate sales increased 60 per cent to 11.4 GL (71.5 million barrels) in 2018–19, the highest sales volume ever recorded in the State. The previous highest was 7.5 GL (47.1 million barrels) in 2009.

Condensate sales have grown 158 per cent over the last two years due to the increased sales volumes and partly the increase in the condensate price.

The composition of Western Australia’s oil exports is changing, with condensate exports growing strongly this year while crude oil exports have declined. This is also a national trend with the majority of Australian exports destined for Asian refineries and petrochemical processors. Singapore and Thailand are typically the major buyers.

In 2018–19, Australia is estimated to have exported 257,000 barrels a day, or 76 per cent of its crude oil and condensate production.

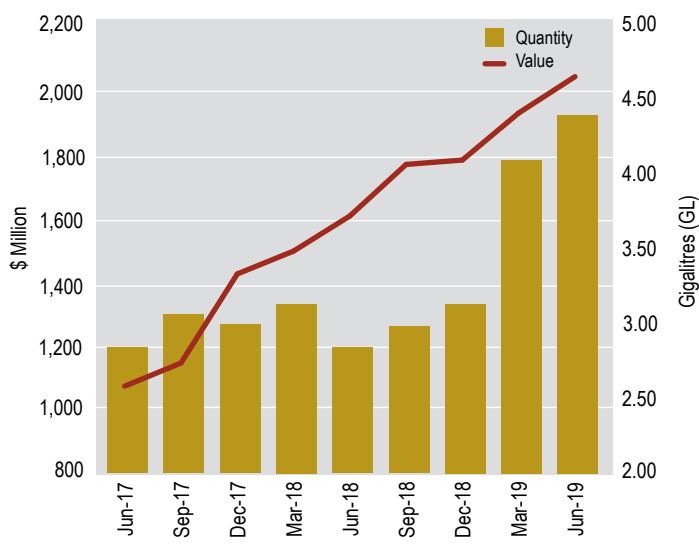


Figure 29 | **Crude oil and condensate quantity and value by quarter**
Source: DMIRS and EnergyQuest

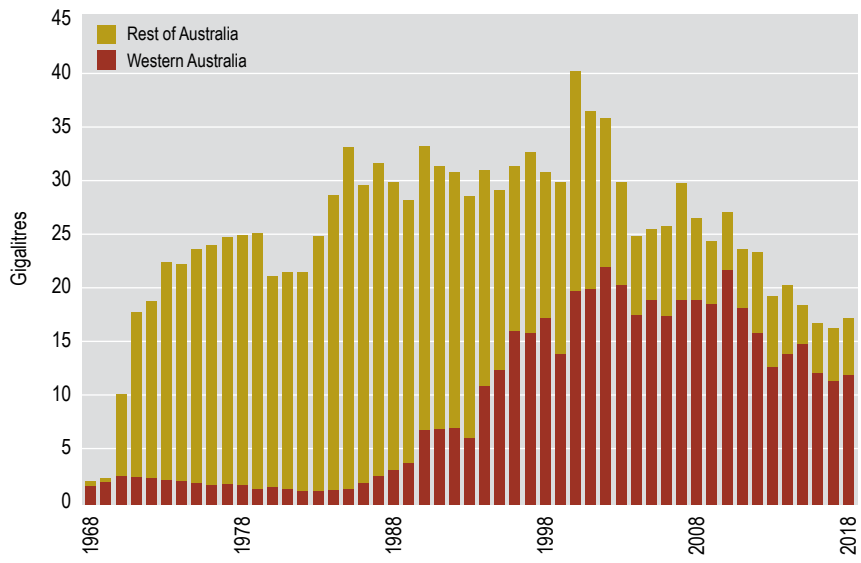


Figure 30 | Crude oil and condensate production WA v rest of Australia
Source: DMIRS and EnergyQuest

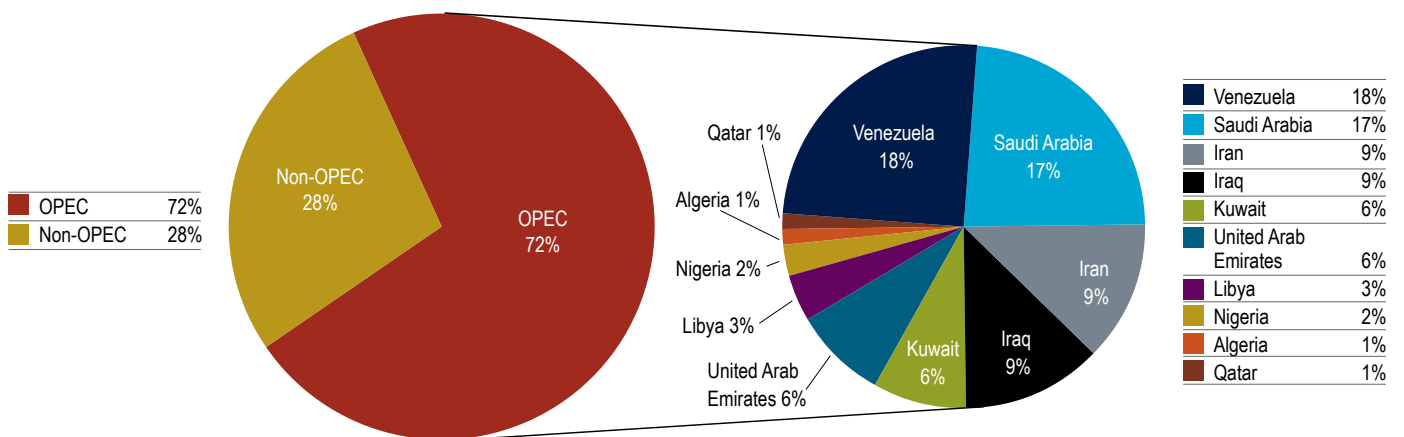


Figure 31 | OPEC share of world crude oil reserves 2018
Source: BP Statistical Review of World Energy 2018

Notable events

- In June, Woodside's Vincent and Enfield fields temporarily ceased production in preparation for the Greater Enfield expansion. The project achieved first oil on 25 August and will add new production of 40,000 barrels per day, although some of this gain will be offset by the permanent shutdown of the Enfield oil field.
- BHP's Pyrenees operations are back online, after planned maintenance in 2018, but production levels since then have been below expectations.
- Jadestone's Montara field restarted in January, after a maintenance shut down, almost doubling its production in the March quarter 2019, year-on-year.
- In late October 2018, new condensate production came online from the Browse Basin with the start-up of Train 1 at INPEX's Ichthys facility. Ichthys has a nameplate capacity of 100,000 barrels a day of condensate and has ramped up quickly, producing at more than 50 per cent of capacity in the March quarter 2019.
- Also in the Browse Basin, Shell's Prelude facility commenced operations, producing about 25 per cent of its nameplate capacity of 36,000 barrels of condensate a day. The output of both is expected to increase further through 2019.
- Santos acquired Quadrant Energy for US\$2.15 billion in November 2018. This includes the 171 million barrel Dorado discovery.
- On 4 September 2018, Woodside celebrated its 5000th cargo from the NWS.

- Production began from the Greater Western Flank expansion of the NWS project in October 2018. Construction came in under budget and ahead of schedule.
- The State Government announced the lifting of a moratorium on hydraulic fracturing on existing petroleum titles or about two per cent of the State. A range of new regulations for hydraulic fracturing was also announced.
- Shell and ConocoPhillips sold their interests in the Greater Sunrise offshore fields to Timor Gap, the national oil company of Timor-Leste, for US\$300 million and US\$350 million respectively.

2.2.3 Natural Gas

Pricing

In 2018–19, the average price of gas sold into the Dampier to Bunbury Natural Gas Pipeline (DBNGP), Parmelia pipeline and Goldfields pipeline was \$4.05 per GJ, representing a decrease of almost six per cent from the 2017–18 average of \$4.27 per GJ.

WA has ample supply of domestic gas over the short to mid-term with gas supply from existing operations expected to outstrip demand until at least 2021. This is likely to place more downwards pressure on WA's domestic gas prices. However, unless additional sources of supply are developed, prices are likely to increase as large domestic gas supply contracts come to an end. If all prospective projects such as Browse, Equus, Scarborough and Waitsia Stage two are developed, supply is expected to be sufficient to meet demand which should keep prices low.

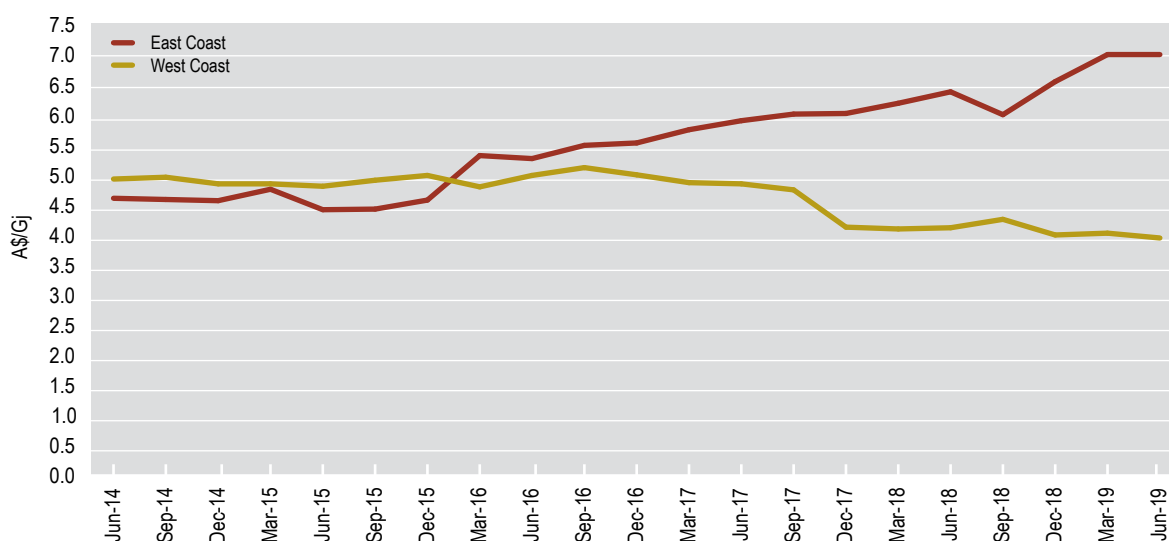


Figure 32 | **Average quarterly natural gas price**
Source: EnergyQuest and DMIRS

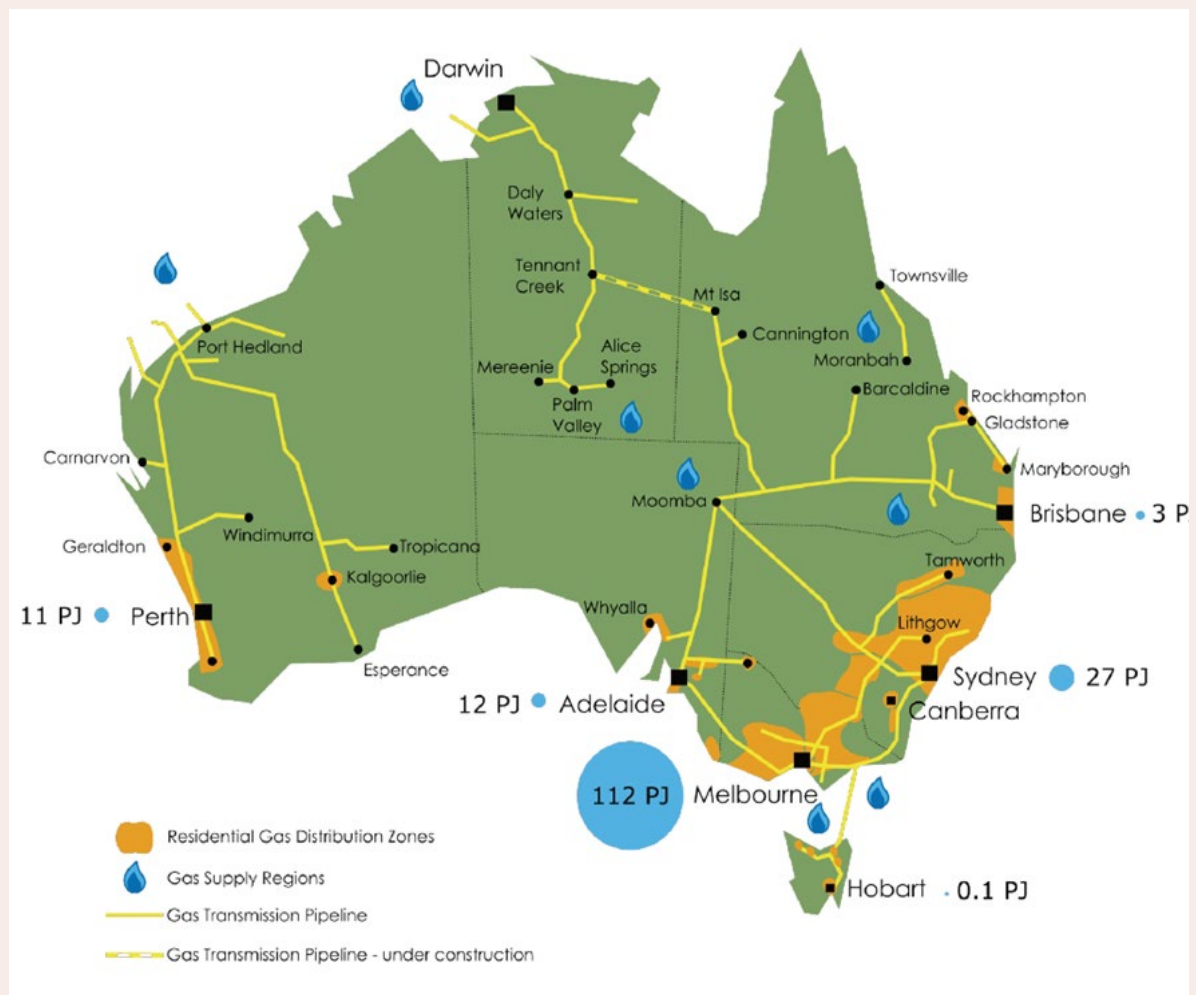
Domestic gas prices: WA versus the East Coast

The issue of domestic gas availability and prices in Australia's Eastern States has become increasingly prevalent over the past five years. Unreliable supply has led to higher gas and energy prices and greater public scrutiny of the East Coast's National Electricity Market. On the other hand, WA's gas reliability has remained stable with prices declining over the same period.

There has been an increased supply of domestic gas brought on by new LNG projects (e.g. Wheatstone, Gorgon) and the State's policy that 15 per cent of the gas produced is reserved for domestic use. The increased supply has also led to an increase in competition in the domestic wholesale gas market, which has contributed to lower wholesale gas prices.

Another reason for the decline in WA's wholesale gas prices is the timing of contract renewals. As 99 per cent of all wholesale gas sold in WA is through contracts which are commonly linked to international crude oil prices, domestic gas prices are influenced by the crude oil price at the time the contract is set. In WA, many of these contracts were negotiated and indexed against crude oil at a time of historically high prices. The renegotiating and reindexing of these bilateral contracts has contributed to the decline in WA's gas price over the past four years.

Australia's gas distribution and gas transmission network



Source: Australian Energy Market operator.

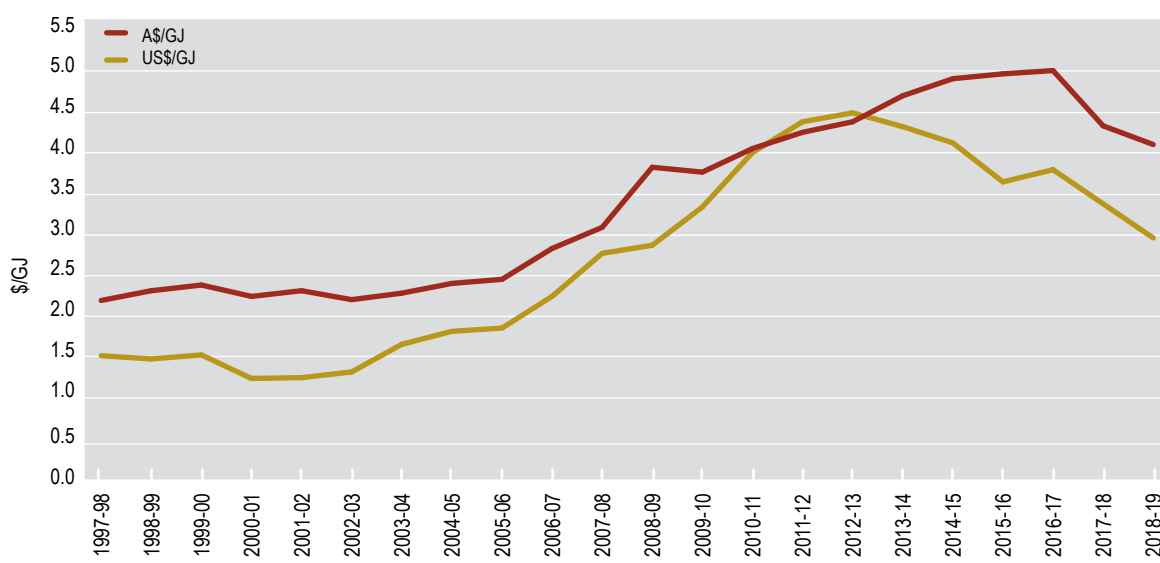


Figure 33 **Western Australian average domestic natural gas price**

Source: DMIRS

The value of WA domestic gas sales is based on the summation of total domestic gas sale values as at the point of entry into the Dampier to Bunbury Natural Gas Pipeline (DBNGP) or where applicable, the Parmelia and Goldfields pipeline.

Quantity and value

In 2018–19, the quantity of natural gas supplied into the domestic market increased from 382 petajoules (PJ) which is 10 billion cubic metres (bcm) to 390 PJ or 10.3 bcm, the second highest volume on record.

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 increase in domestic gas sales volumes was not enough to offset lower prices and, as a result, the value of domestic gas sales decreased from \$1.63 billion in 2017–18 to \$1.58 billion in 2018–19.

The NWS project is the largest contributor to WA's domestic gas supply. However this is expected to change as the project's offshore gas fields near the end of their productive life and domestic gas contracts begin to end in the early 2020s.

Notable events

- Domestic gas supplies started flowing from the Pluto LNG project, some six years after it commenced. It will supply about 2.5 per cent of WA's gas usage. Additional domestic gas, representing 1.5 per cent of the State's usage, will be supplied through Pluto LNG's trucking facility.

- Domestic gas production began from the Wheatstone LNG plant on 5 March 2019.
- The Australian Gas Infrastructure Group completed a seismic survey and risk assessment on its Tubridgi gas storage facility to evaluate possible expansion.
- An updated WA Gas Statement of Opportunities showed potential gas supply from committed projects is insufficient to meet gas demand in the future, with a shortfall emerging in 2021–22.

2.3 GOLD

Pricing

Gold has delivered another strong price performance throughout the period, supported by the US–China trade conflict as well as the US Federal Reserve's new cash rate policy delivering a series of cuts to support the local economy.

The gold price reached a monthly average of US\$1359 (\$1958.23) an ounce in June 2019. During 2018–19, the annual gold price averaged US\$1263.82 (\$1772.12), a six per cent increase in prices for Australian producers.

Quantity and value

WA gold sales volumes were down slightly from the record 212 tonnes (7.6 million ounces) in 2017–18 to 211 tonnes (7.5 million ounces) in 2018–19. Continued strong gold prices delivered a 4.6 per cent increase in the value of the sector from \$11.4 billion in 2017–18 to \$11.9 billion in 2018–19⁷.

The gold sector is WA's second most valuable mineral commodity and accounts for about 70 per cent of Australia's total gold production (estimated to be about 11 million ounces). According to some industry commentators, most Australian treatment plants are operating at full capacity, but this is not expected to continue.

The top 10 gold projects in WA accounted for 52 per cent of the State's total gold production. They were:

- Newmont Goldcorp Corporation's Boddington mine (nine per cent with 685,382 ounces)
- AngloGold Ashanti's Tropicana mine (seven per cent with 514,157 ounces)
- KCGM's Kalgoorlie Super Pit/Mt Charlotte mines (seven per cent with 503,858 ounces)
- Newcrest's Telfer mine (six per cent with 451,870 ounces)
- Gold Field's St Ives mine (five per cent with 368,850 ounces)
- Northern Star Resources' Jundee mine (four per cent with 290,668 ounces)
- Gold Field's Granny Smith mine (four per cent with 277,209 ounces)
- Regis Resources' Duketon mine (four per cent with 273,699 ounces)
- AngloGold Ashanti's Sunrise Dam mine (four per cent with 270,759 ounces)
- Gold Field's Agnew mine (three per cent with 234,524 ounces)

⁷ The ABS releases WA 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 WA. Therefore, the ABS export figure for WA includes gold produced in other jurisdictions.

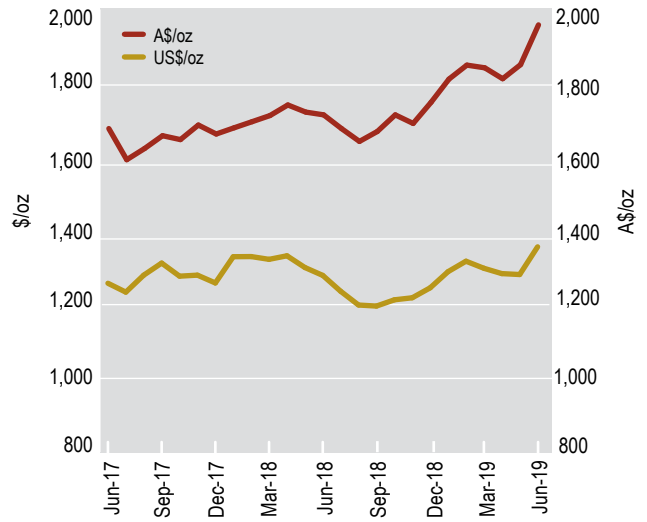


Figure 34 | **Gold price**
Source: Perth Mint and Kitco

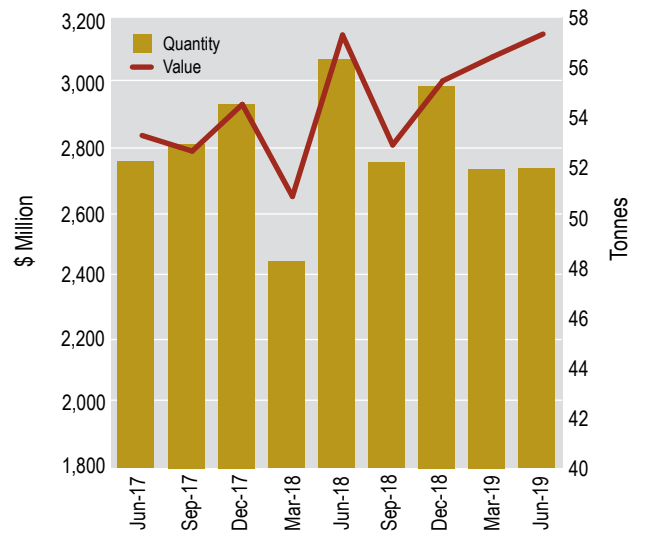


Figure 35 | **Gold quantity and value by quarter**
Source: DMIRS

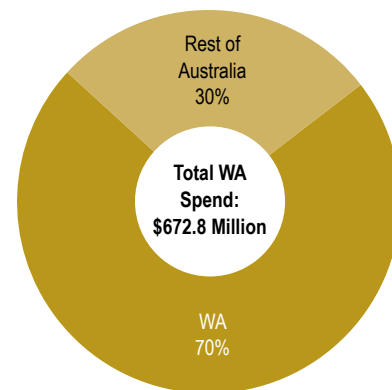


Figure 36 | **Gold exploration expenditure 2018–19**
Total Australian spend \$963.9 Million
Source: ABS

In 2009–10, India was WA's largest gold export market, accounting for more than half (\$7.1 billion) of the State's gold exports. However, gold exports to India have fallen significantly since then and in 2018–19, gold exports to India were valued at just \$579 million and only 3.5 per cent of the State's gold exports. The reasons for this significant decline include higher import duties and increased gold refining capacity in India.

Together, China, the United Kingdom and Hong Kong now account for the bulk of WA's gold exports with 30.5 per cent, 26 per cent and 23 per cent of exports respectively.

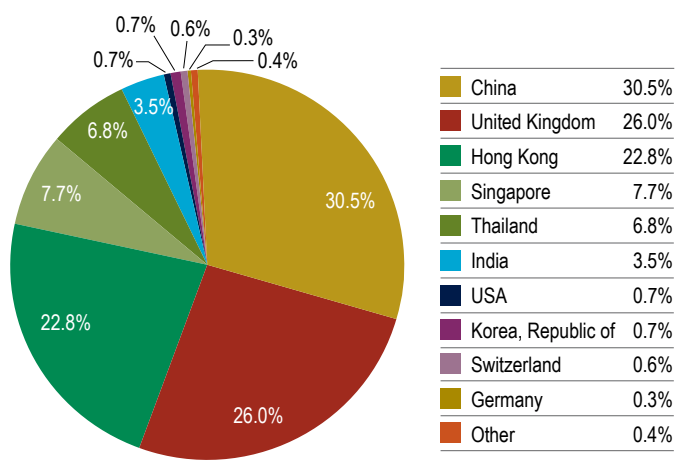


Figure 37 | **Gold exports 2018–19**
\$16.6 Billion

Source: ABS and DMIRS estimate

Note: Includes gold refined/processed and exported from WA that is produced from mining operations in other states, territories and overseas.

Notable events

- According to the Office of the Chief Economist, world gold mine production is expected to decline from 3399 tonnes in 2019 to 3202 tonnes by 2021. Declining world mine production is expected across most major gold producing countries including Australia – which is expected to account for the closure of over 51 tonnes of mine capacity between 2019 and 2021.
- Over the medium to long term, Australia's position as the world's second largest gold producer is expected to be challenged by Russia as some mature gold mines in WA reach their end of life.
- Doray Minerals sold the mothballed Andy Well project to Galane Gold during the period. Galane will focus on exploration and evaluation of the mine in the short term.
- Beacon Minerals began commissioning its Jaurdi project in June 2019.
- Gold Road Resources announced on 1 July that the \$621 million Gruyere project had achieved its first gold pour. The project will now target production of 300,000 ounces of gold per year.
- Gold Fields will build a hybrid solar and battery power generation system that will be integrated with an existing natural gas generation system at its Granny Smith project. It also announced it will invest in a similar renewable and low-carbon energy at its Agnew mine.

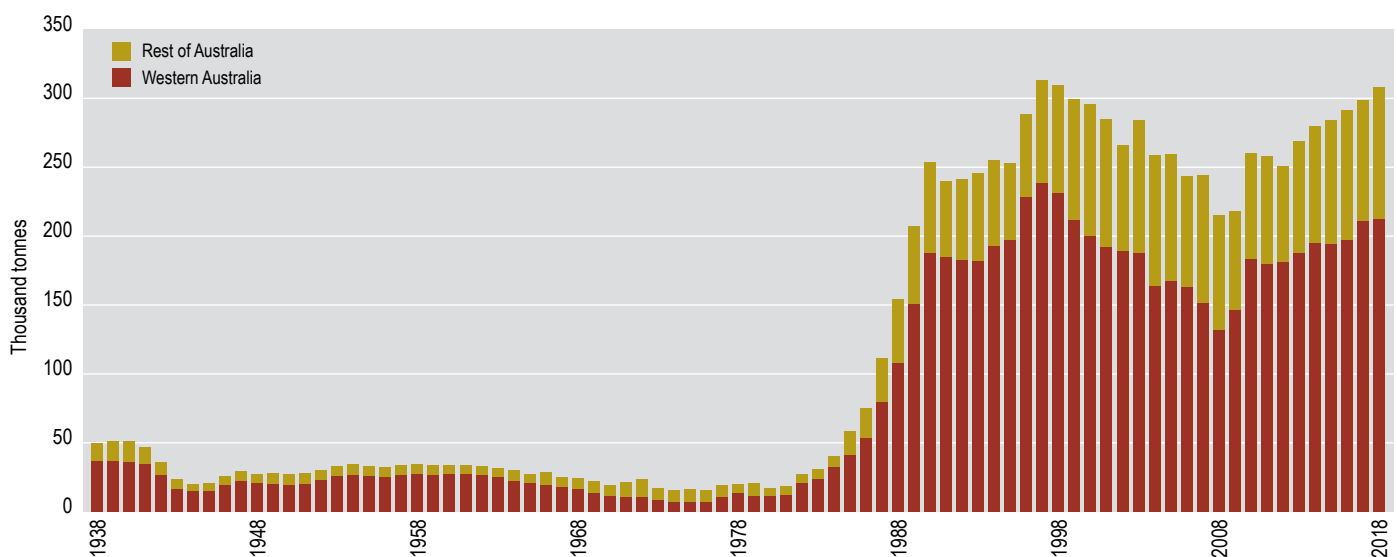


Figure 38 | **WA gold production v rest of Australia**
Source: DMIRS and DIIS

- Newmont Mining Corporation completed its US\$10 billion acquisition of Goldcorp Inc., creating Newmont Goldcorp Corporation, a company with the world's largest gold reserves and resources.
- The merger between Silver Lake Resources and Doray Minerals was completed with Silver Lake Resources now the owner and operator of the Deflector project (as well as the Mount Monger project).
- In June, RNC Minerals acquired Westgold Resources' Higginsville mines for \$50 million in cash and shares.
- Pantoro has reached an agreement to purchase a 50 per cent stake in the Central Norseman gold project (currently on care and maintenance) for \$25 million in cash and \$20 million in shares.
- Blackham Resources raised \$25.8 million in capital to support an increase in annual production at the Matilda–Wiluna gold project.
- Gascoyne Resources entered administration in June following operational issues at its Dalgaranga project.
- Eastern Goldfields (to be renamed Ora Banda Mining) completed a recapitalisation to extinguish debts and fund a restart of the Davyhurst processing plant.
- Mincor Resources commenced production from Widgiemooltha at the beginning of the financial year and announced it was planning to divest the project at the end of the financial year.

Did you know?

Gold is in greater abundance in Australia than in any other country. Australia has the world's largest economic demonstrated resources (EDR) of gold, with 18 per cent of global EDR. The Australian gold industry has gold reserves totalling more than 353 million ounces of gold and five of the world's 20 largest gold mines. It is the world's second largest gold producer and the sixth largest gold exporter.

2.4 ALUMINA AND BAUXITE

Pricing

The average annual alumina price increased for a second consecutive year from an average of \$489.16 per tonne in 2017–18 to an average of \$591.81 per tonne in 2018–19. This is the highest annual average price recorded since the department began tracking alumina prices in 1985.

However, after peaking at \$730.89 in October 2018, monthly averages have been on a downwards trend in 2019 as escalating trade tensions between the US and China continued to dampen aluminium demand from China – the world's largest aluminium consumer.

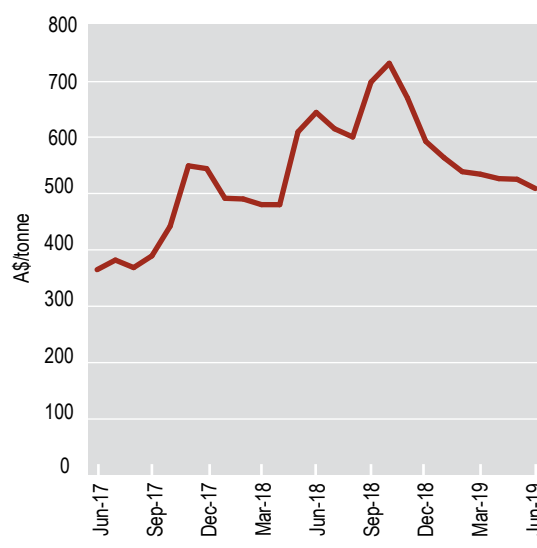


Figure 39 | Alumina price
Source: ABS

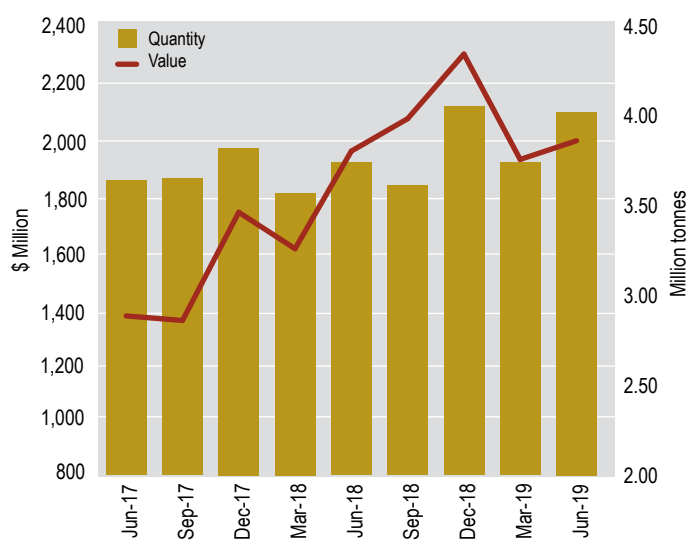


Figure 40 | Alumina and bauxite quantity and value by quarter
Source: DMIRS

Quantity and value

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

WA alumina and bauxite sales volumes have gradually increased year-on-year since 2010–11 to reach a record 15.4 Mt in 2018–19. The increase in annual sales volumes is due to an increase in bauxite sales, with alumina sales actually decreasing slightly year-on-year. Alumina sales were impacted by a shutdown at Worsley to undertake processing improvements.

The increase in volume, combined with the strong prices, resulted in an increase of almost 25 per cent to the value of the sector, up from \$6.6 billion in 2017–18 to \$8.3 billion in 2018–19.

Alumina is the State’s third most valuable mineral commodity, accounting for almost eight per cent of mineral sales value and six per cent of total mineral and petroleum sales for 2018–19.

Notable events

- The US Administration lifted tariffs on steel and aluminium imports from Canada and Mexico on 18 May 2019. Those imports accounted for over 39 per cent (or US\$9.4 billion) of US aluminium imports in 2018.
- South32 reached a domestic sales agreement with Chevron and Woodside Petroleum for the supply of natural gas for power and steam generation at the Worsley alumina refinery.

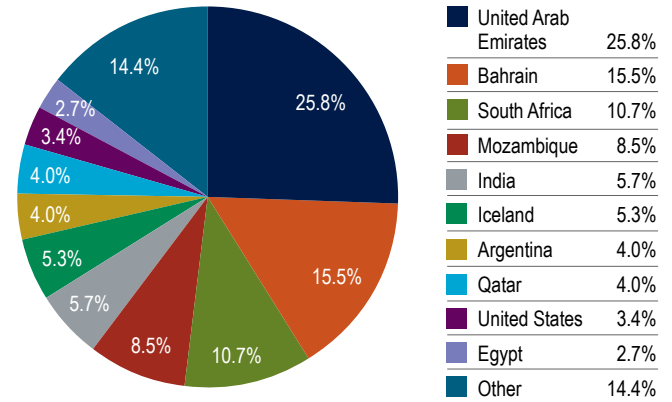


Figure 41 | **Alumina exports 2018–19**
\$9.5 Billion
 Source: DMIRS estimate

- Alcoa, the State’s largest private gas user (responsible for about 25 per cent of the State’s total usage), signed gas supply contracts with BHP, Chevron and Woodside to feed its alumina refineries. The contracts are expected to meet about 25 per cent of Alcoa’s gas needs.



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 WA by destination
- annual historic production in WA compared with the rest of Australia.

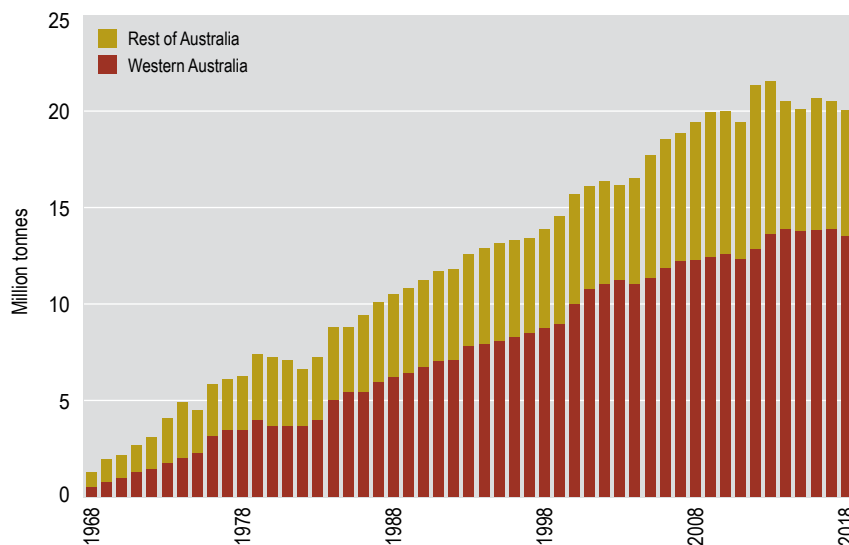


Figure 42 | **WA alumina production v rest of Australia**
 Source: DMIRS and DIIS

2.5 NICKEL

Pricing

Despite an ongoing deficit between nickel supply and demand, global nickel prices remained subdued during the reporting period. Weaker than expected global demand growth was the major contributing factor.

As a result, the average annual nickel price decreased one per cent from US\$12,463.13 per tonne in 2017–18 to US\$12,341.83 per tonne in 2018–19. However, the US and Australian-dollar exchange rate actually meant a seven per cent increase in the annual average nickel price in Australian dollar terms, increasing from \$16,103.81 to \$17,254.58 per tonne.

The strong run of cobalt prices finally came to an end with the average cobalt price declining more than 30 per cent in 2018–19 to US\$47,091.33 per tonne and \$65,578.65 per tonne.

Quantity and value

WA has some of the world's largest known reserves of nickel and some of the world's biggest and highest-grade nickel deposits.

After nickel sales volumes increased for the first time in three years in 2017–18, volumes fell again in 2018–19, down 5.6 per cent from 163,374 tonnes in 2017–18 to 154,219 tonnes. This was largely due to fire at Nickel West's Kalgoorlie smelter in September 2018.

The improvement in Australian prices meant that the value of nickel sales improved slightly year-on-year to \$2.66 billion, up from \$2.64 billion.

China, Japan, South Korea, and Taiwan were the State's top nickel customers. Malaysia accounted for the bulk of WA nickel exports in 2014–15 (\$1.3 billion). However, since then exports to the country have declined significantly, to just \$10.4 million in 2018–19.

Notable events

- Panoramic Resources re-started the Savannah mine with first sales achieved in the March 2019 quarter.
- Nickel West's Goliath and Six Mile Well open pits (previously known as the Yakabindie project) near Mt Keith are expected to start production in 2019 and have a 10-year mine life. The company's development of the Venus underground nickel mine is also predicted to go ahead following the grant of final State Government approvals.

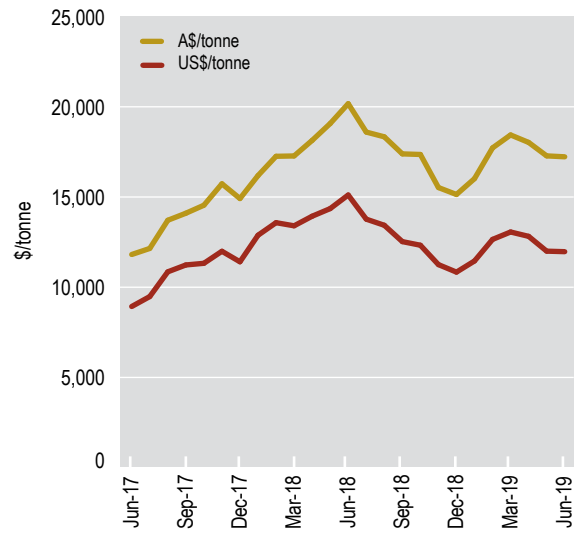


Figure 43 | **Nickel price**
Source: DMIRS and DIIS

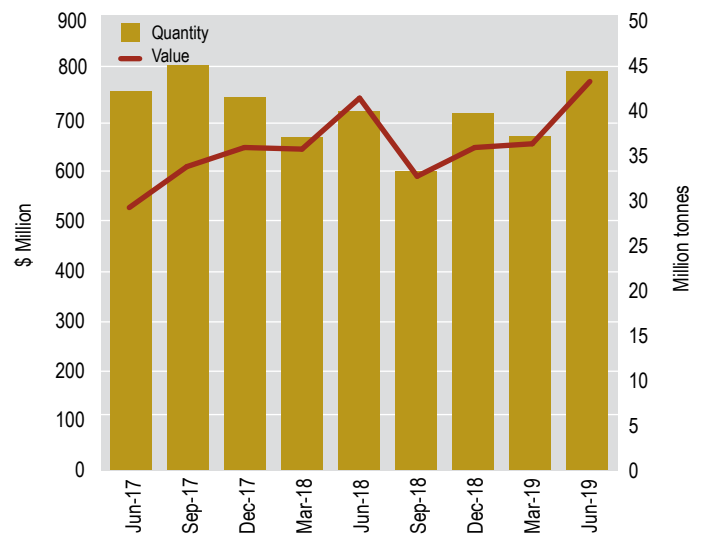


Figure 44 | **Nickel quantity and value by quarter**
Source: DMIRS

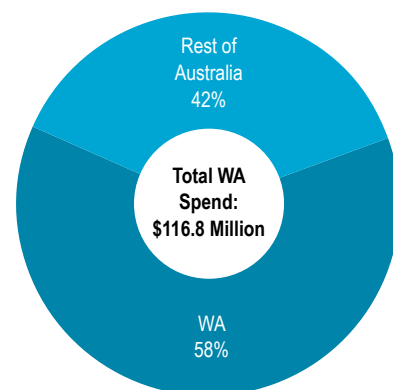


Figure 45 | **Nickel cobalt exploration expenditure 2018–19**
Total Australian spend \$202.7 Million
Source: ABS

- Independence Group announced it had trialled the production of nickel sulfate used in electric vehicle batteries and was considering building a chemicals plant in WA. A pre-feasibility study is expected by the second quarter of 2020.
- Mincor Resources purchased the Long nickel mine (currently on care and maintenance) from Independence Group. The mine is estimated to still host about 30,000 tonnes of nickel. Mincor is planning to present a definitive feasibility study in the December 2019 quarter that examines the integration of the Long mine with its operations in the Kambalda area which were shuttered in 2016. The company also completed a \$23 million capital raising and announced an ore-tolling agreement with Nickel West to facilitate a restart of the operations.
- First Quantum Minerals affirmed plans to restart the Ravensthorpe operation in early 2020 if market conditions for nickel (and to a lesser extent cobalt) continue to improve. A decision on a restart is expected by December 2019.

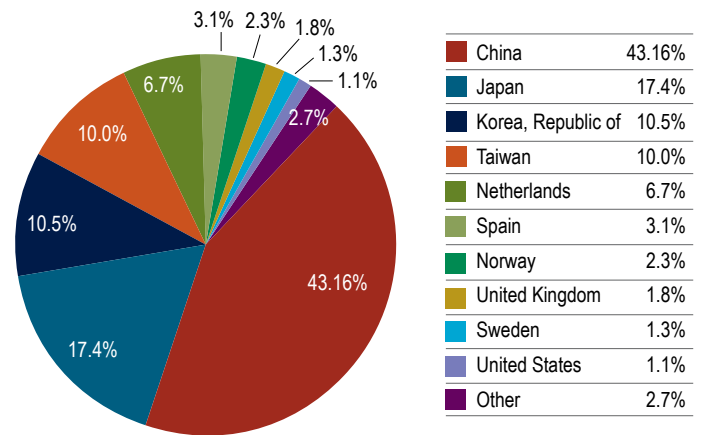


Figure 46 | **Nickel exports 2018-19**
\$2.7 Billion
Source: DMIRS



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 WA by destination
- annual historic nickel production in WA compared with the rest of Australia.

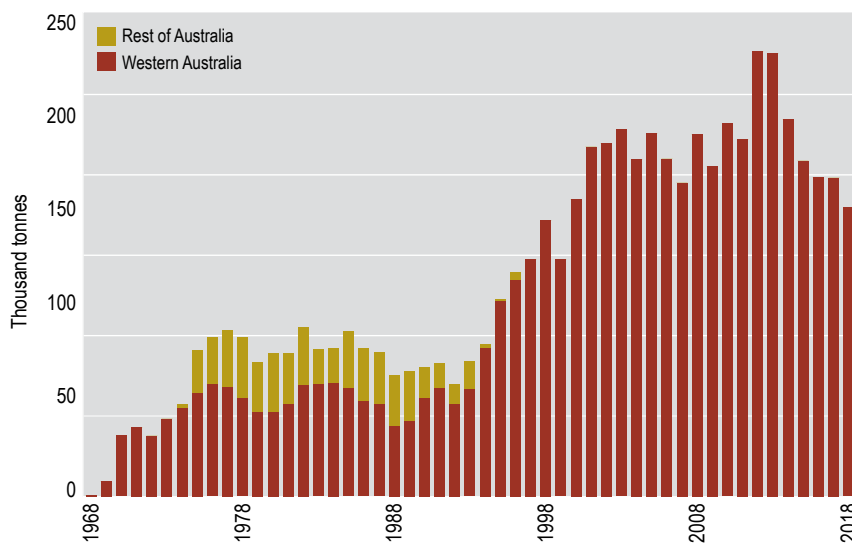


Figure 47 | **WA nickel production v rest of Australia**
Source: DMIRS and DIIS

2.6 BASE METALS

For the purposes of the Statistics Digest, “base metals” refers to copper, lead and zinc.

Pricing

Base metals proved to be the most sensitive commodity markets in relation to the US-China trade conflict. Prices rallied as negotiations started but collapsed when talks broke down.

Copper prices declined slightly more than one per cent over the period from an annual average of \$8706.91 per tonne in 2017–18 to \$8603.03 per tonne in 2018–19. In monthly prices, the average crept into the low \$9000’s briefly in March and April before declining again to finish out the financial year.

After the annual average lead price broke the \$3000 mark in 2017–18, the price of lead declined by 11 per cent to average \$2791.47 for the year.

The annual average zinc price also decreased following a positive year in 2017–18 down nine per cent from \$4106.30 per tonne to average \$3718.94 per tonne for the year. This is still above the five and 10-year annual averages.

Quantity and value

On the back of poorer price performance and lower sales volumes across the board, the value of base metals sold in 2018–19 decreased almost six per cent from \$1.69 billion in 2017–18 to just less than \$1.6 billion in 2018–19.

Copper accounted for 82 per cent (\$1.32 billion) while lead and zinc made up the remainder with one per cent (\$13.5 million) and 17 per cent (\$267.1 million) respectively.

Notable events

- Production from the Nifty project was impacted by a power outage as well as ongoing infrastructure legacy issues. Metals X released a plan in April that it hopes will improve Nifty’s performance and resolve legacy issues. The plan involves spending \$163 million, enabling annual production of 35,000 tonnes of copper in concentrate by the March 2021 quarter up from current annual production of 18,000 tonnes of copper in concentrate.
- OZ Minerals completed its 70 per cent earn-in at the West Musgrave project, 14 months ahead of schedule, after spending \$36 million on development studies and exploration.

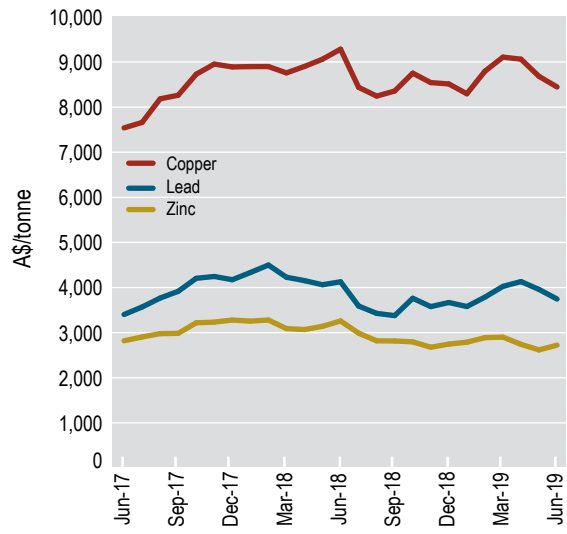


Figure 48 | **Copper, zinc and lead price**
Source: LME via Argus Metals

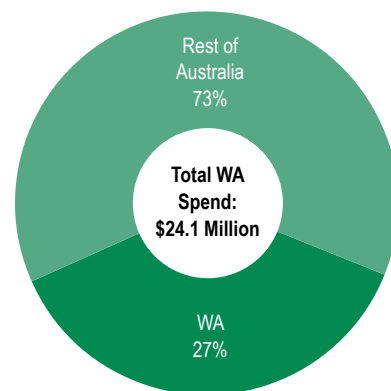


Figure 49 | **Silver, lead, zinc exploration expenditure 2018–19**
Total Australian spend \$89.3 Million
Source: ABS



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 WA by destination
- annual historic base metals production in WA compared with the rest of Australia.

2.7 LITHIUM

Price

In recent years, the price of lithium has been heavily influenced by the bottlenecks at Chinese processing facilities. Even though there was oversupply in the market, the price of lithium products stayed strong in 2017 and most of 2018. However, slower-than-expected battery factory expansions, as well as negative changes in Chinese policies and subsidies towards electric vehicles, has restricted demand.

Oversupply of raw materials is also affecting lithium chemical prices, with the premium for lithium hydroxide over lithium carbonate also diminishing due to delays in the introduction of high-nickel cathode chemistries in batteries that rely on lithium hydroxide.

In 2018–19, the average price for lithium carbonate equivalent in China averaged \$17,731.22 per tonne, down from \$22,092.58 per tonne.

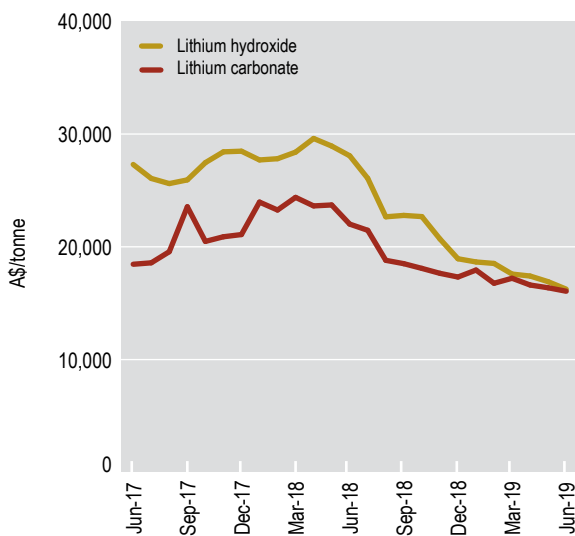


Figure 50 | **Lithium price**
Source: LME via Argus Metals

Quantity and value

The temporary market imbalance is being managed by miners through production curtailments and shipment delays:

- Pilbara Minerals is scaling back production and focusing on optimising operations to reduce costs at Pilgangoora while also deferring a Stage Two expansion.
- Galaxy Resources deferred a shipment from Mount Cattlin originally scheduled for June to July.
- Alita Resources (formerly Alliance Mineral Assets) did not ship any spodumene concentrate from Bald Hill in June or July.
- Conversely, Altura Mining’s fortunes improved with increased sales from its Pilgangoora operation as it overcomes processing plant problems and ramps-up towards capacity.

These events, combined with lower production at Mt Marion due to processing upgrades, resulted in a seven per cent fall in the volume of sales and an 11 per cent fall in the value of sales.

Overall, WA’s lithium sector was valued at \$1.55 billion, down slightly from \$1.59 billion in the year prior. This reflected the decrease in sales bought about by the above curtailments and shipment delays. Spodumene concentrate sales totalled 1.8 Mt in 2018–19, down from 2.1 Mt in 2017–18.

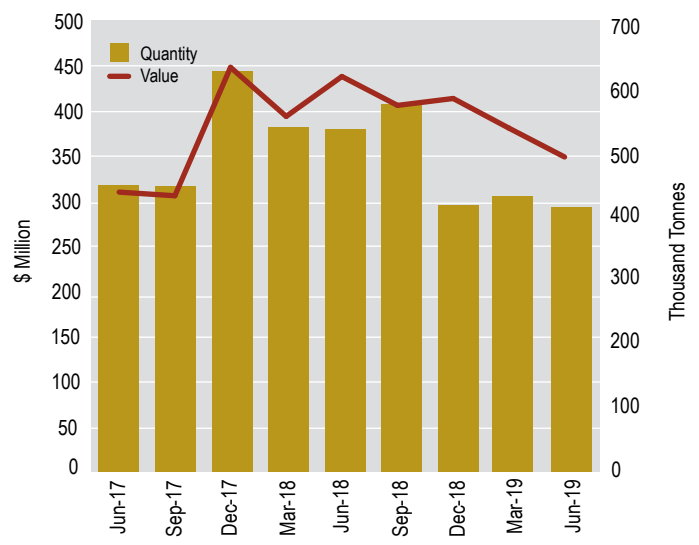


Figure 51 | **Spodumene concentrate quantity and value by quarter**
Source: DMIRS

Not all lithium is created equal

Lithium is a soft silver-white metal found in three main geological settings: brines, pegmatites (hard rock) and clays. WA has the largest resources of pegmatite-hosted lithium in the world. The process of extracting lithium from hard rock involves drilling, blasting and mining the lithium ore then concentrating that ore through a flotation and gravity separation process to produce a saleable lithium mineral (e.g. spodumene) concentrate.

Brine processing operations are less complex and require less energy than hard rock or clay processing plants, so they are generally cheaper to operate. However, the initial capital cost and time to develop a brine operation is much higher. This is where WA lithium producers have an advantage over brine and clay producers. WA's high-grade hard rock deposits lend themselves to relatively lower cost, quick start-up and production of high value lithium hydroxide for use in batteries.

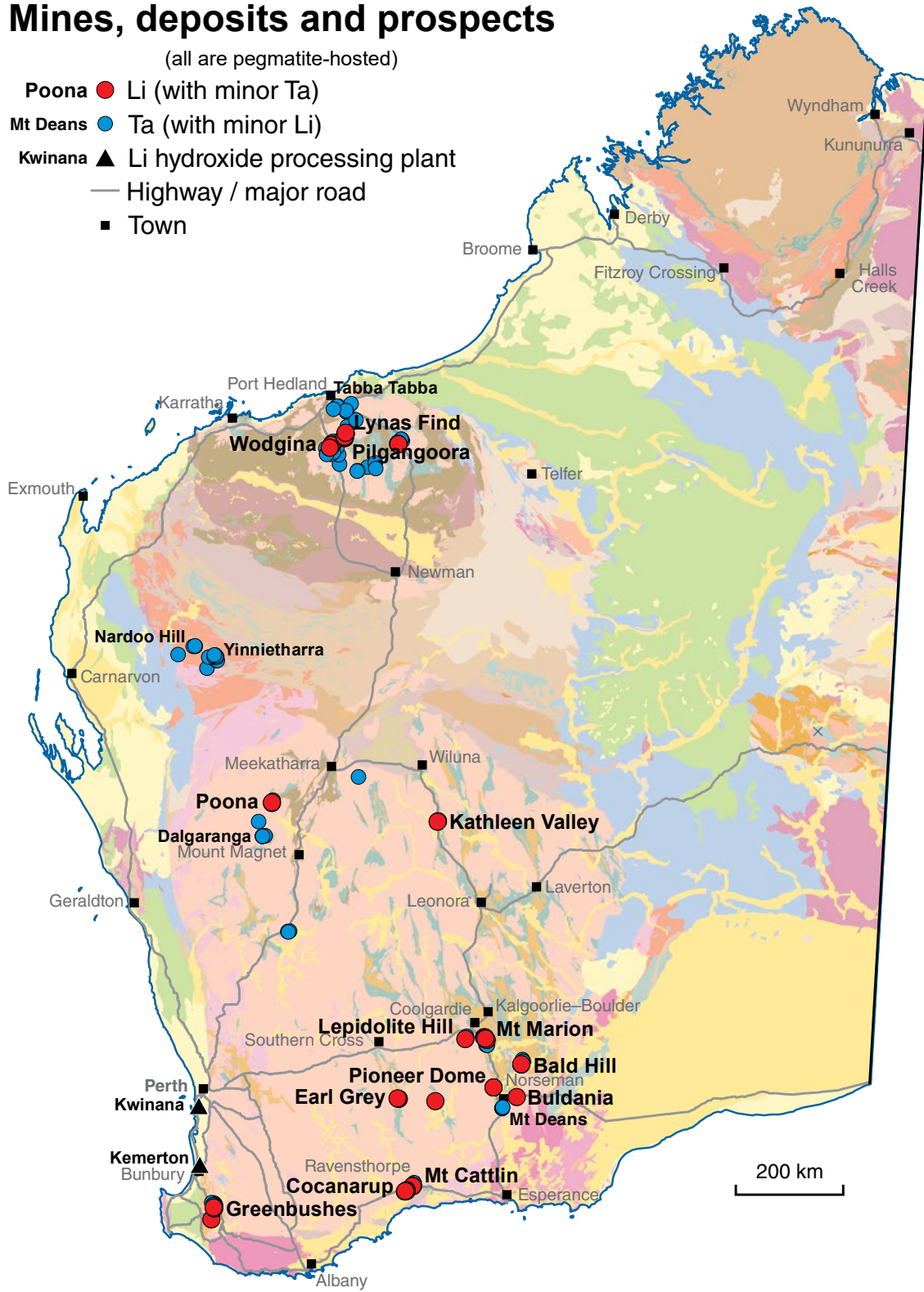
Notable events

- In January, the State Government released its *Future Battery Industry Strategy*. The Strategy aims to grow WA's future battery industry and transform it into a significant source of economic development, diversification, jobs and skills.
- Pilbara Minerals' Pilgangoora mine appears to have more potential than previously expected. In March, Pilbara released the results of a study suggesting that its planned phase three expansion will produce around 1.2 Mt of spodumene concentrate each year for about 15 years. Operating costs for the site are relative modest and estimated at US\$291 per tonne.
- Pilbara Minerals subsequently delayed a final investment decision on the stage two expansion of the project by six months and is considering options for staging the expansion. The company has also reportedly exercised an option to participate in the POSCO Joint Venture for a 40,000 tpa lithium chemical plant in South Korea.
- In February, in response to lower prices and expanding global supply, Sociedad Quimica y Minera de Chile SA (SQM) announced plans to hold back 17 per cent of its lithium carbonate production from the market in 2019.
- Wesfarmers lodged a \$776 million bid for Kidman Resources in May 2019. Kidman owns a 50 per cent interest in the Mt Holland lithium hydroxide project with SQM.
- The sale of Neometals' 13.8 per cent share in the Mount Marion project for \$103.8 million was completed, giving Mineral Resources and Ganfeng Lithium Company each a 50 per cent interest.
- Talison Lithium and Global Advanced Metals reached an agreement on tantalum rights in relation to the expansion of the Greenbushes projects.
- Under the terms of a revised joint venture announced in August 2019, Albemarle Corporation will take a 60 per cent stake in Wodgina (up from 50 per cent) while Mineral Resources will take a 40 per cent stake in the initial two phases of the Kemerton lithium hydroxide plant. Albermarle Corporation also deferred investments on additional capacity at Wodgina and at Kemerton.
- Alita Resources entered administration at the end of August 2019.
- Galaxy Resources is assessing Chinese partners in a lithium processing facility in China.

Mines, deposits and prospects

(all are pegmatite-hosted)

- Poona** ● Li (with minor Ta)
- Mt Deans** ● Ta (with minor Li)
- Kwinana** ▲ Li hydroxide processing plant
- Highway / major road
- Town



2.8 OTHER

Emergence of potash in WA

The range of products produced in WA continues to diversify with the emergence of several planned potash projects. Potash is a generic term covering a variety of potassium-bearing ores, minerals and refined products that are typically used in agriculture to help plants grow.

A review of company data reveals 27 identified potash projects across WA. Of these, 17 are considered active projects and are at various stages of development including target outline, exploration, reserves development, scoping/pre-feasibility and feasibility stages. However, only five of these are considered possible near-term potash projects. This assessment is based on the current level of activity the companies are undertaking to progress these projects i.e. scoping and feasibility studies and capital-raising activities.

The projects are owned by Agrimin Limited, Australian Potash Limited, Kalium Lakes Limited, Reward Minerals Limited and Salt Lake Potash. These companies are at various stages of development but all have completed a scoping study to demonstrate the potential viability of their projects.

Agrimin's Lake Mackay project comprises seven tenements covering a total area of 2560 sq km. The project covers the majority of Lake Mackay and contains the world's largest known mineral resource of brine-hosted sulphate of potash (SOP). In May 2018, Agrimin reported the results of a positive pre-feasibility study for the project. The study indicated SOP production of 426,000 tpa over a 20-year life at an average total cost of US\$222 per tonne. Agrimin anticipates financing and regulatory approvals by Q4 2020 and is targeting first production by the end of 2022.

Australian Potash's Lake Wells project, 180 km out of Laverton, is a substantial tenement package (over 500 sq km) in the northeast part of the Yilgarn Craton. A definitive feasibility study was released on 28 August 2019. The project currently has the largest indicated recoverable SOP resource in Australia with 12.7 Mt at 8,237mg/l SOP including some of the highest grade SOP samples reported in Australia. The targeted start date for the project is early 2020.

Kalium Lakes' Beyondie project comprises 15 granted exploration licences and a miscellaneous licence covering about 2400 sq km. The project is 160 km south-east of Newman in the Pilbara region and is on the verge of becoming Australia's first SOP producer.

Reward Minerals Lake Disappointment project is in the Little Sandy Desert about 320 km east of Newman. Reward completed a pre-feasibility study in May 2019 and is currently progressing a definitive feasibility study for the project.

Salt Lake Potash has an extensive portfolio of nine salt lakes in the Northern Goldfields totalling more than 4750 sq km. The Lake Way SOP project is 15 km south of Wiluna and will involve an initial 50,000 tpa demonstration plant, with a possible expansion to 400,000 tpa. Construction on the initial demonstration plant began in March 2019 and first SOP sales through the Port of Esperance are expected in late 2021.

Salt Lake's Lake Wells project is about 200 km north of Laverton. A positive scoping study at Lake Wells confirmed the potential of the project to produce low cost SOP by solar evaporation of lake brines for domestic and international fertiliser markets.

2.8.1 Coal

Pricing

Demand for coal in developed countries continues to decline in favour of natural gas, especially for electricity generation. This shift is expected to continue with environmental policies in China and India aimed at reducing air pollution.

Neither global nor Australian prices have a substantial effect on WA coal prices because 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 remainder is for metallurgical purposes in the mineral sands industry where it is used to transform ilmenite to synthetic rutile. A small amount is also used to reduce silica sand to silicon.

Quantity and value

WA's two black coal mines are in Collie, in the South-West. The amount of coal sold decreased from 6.7 Mt in 2017–18 to 6.3 Mt in 2018–19. Sales values also declined from \$332 to \$319 million.

2.8.2 Mineral sands

In WA, the mineral sands industry is primarily focused on titanium minerals such as ilmenite, which can be sold directly, or upgraded to synthetic rutile as well as zircon.

Pricing

The annual average price of rutile increased for the second consecutive year from \$1647 per tonne in 2017–18 to \$2168 per tonne in 2018–19, a 32 per cent increase year-on-year. Zircon prices also increased from \$1235 to \$1519 per tonne over the same period.

Quantity and value

The improved prices for mineral sands products, together with a small increase in sales volumes (three per cent), meant sales were valued at \$529 million for the period. This is up from the reported \$381 million the previous year.

The value of the sector has trended down in recent years, largely on the back of reduced sales volumes. In 2006–07 mineral sands sales were at around 2.7 Mt. In 2018–19, sales were down to 1.2 Mt.

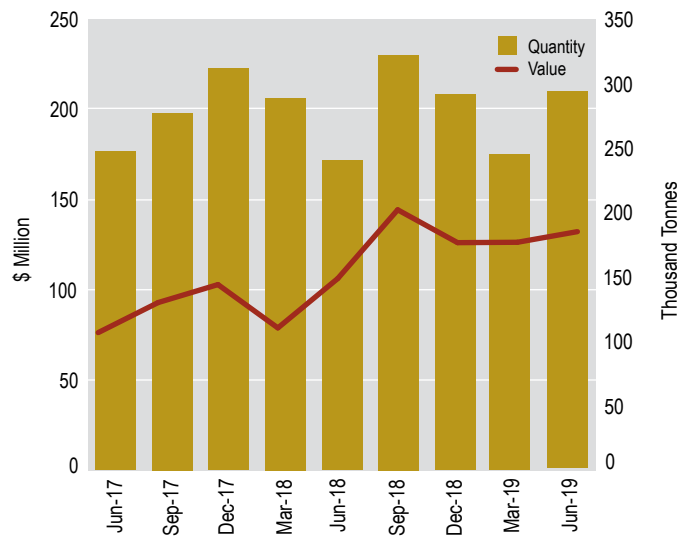


Figure 52 Mineral sands quantity and value by quarter
Source: DMIRS

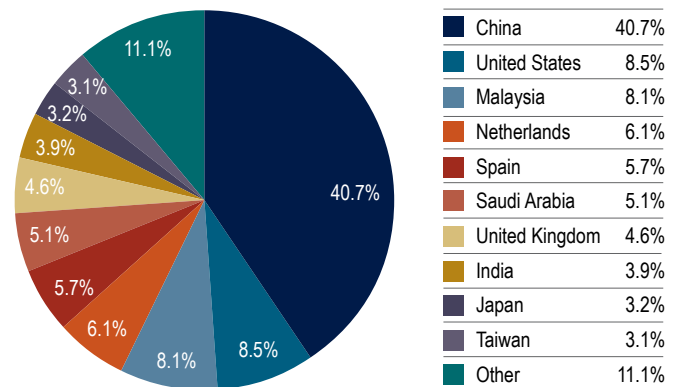


Figure 53 Mineral sands exports
\$1.5 Billion
Source: DMIRS estimate

Note: Exports include titanium dioxide and product sourced from private land, overseas and other states that is processed in WA.

Mineral sands exports from WA

WA export data shows exports of mineral sands that are significantly higher than mineral sand produced. This difference is largely attributable to the use of our local mineral sand refining and export capacity for products from other states. It is also the result of the export of mineral sand products from projects on Minerals to Owner land (i.e. land granted before 1899) that are not required to report sales or production to the department.

China remains the State's top customer for mineral sands products. However in 2018–19, the US overtook Malaysia to become the second largest purchaser. Together these three customers accounted for almost 60 per cent (\$859 million) of the State's mineral sands exports in 2018–19.

Notable events

- In October 2018, Image Resources started testing the processing facility at its Boonanarring mineral sands project in WA. The company made its first shipment in the March quarter of 2019. The project is expected to produce about 89,000 tonnes of ilmenite and 32,400 tonnes of zircon a year over its 10-year mine life. Annual production will also comprise 5400 tonnes of leucoxene and 9000 tonnes of rutile.
- In August 2018, Sheffield Resources Ltd was granted the environmental approval for its Thunderbird zircon mineral sands project in northern WA. More recently it has completed a positive bankable feasibility study returning capital costs of \$392 million and a 37-year mine life. Stage one is targeted for financial year 2022 and Sheffield is currently looking for a strategic partner to support the project.
- Tronox completed its acquisition of Cristal Mining, owner and operators of the Wonnerup mine, North Shore mineral separation plant, and Bunbury (Australind and Kemerton) pigment plant in April 2019.
- MZI Resources, owner and operator of the Keysbrook mine, entered administration in April 2019. It was subsequently announced in June that the Keysbrook mine was sold to Doral.
- In June 2019, Iluka Resources officially opened its Cataby mine, producing its first heavy mineral concentrates.

2.8.3 Salt

Pricing

The price received for salt increased 12 per cent over the reporting period to an average of \$33.04 per tonne across the local industry.

A note about salt pricing

Salt is not a standard product and its composition differs significantly for reasons such as 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 DMIRS reported salt price is the FOB price received by all WA salt producers and is based on information received from those 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 were 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

WA 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 65 per cent of the salt sold from WA by volume in 2018–19. Almost all of this was exported, making Dampier Salt the world's largest exporter of high-quality bulk solar salt.

Onslow Salt's operation at Onslow is WA's next-largest operation, with 23 per cent of production by volume. The remainder comes from smaller producers, including those focused primarily on domestic production.

In 2018–19, salt sales totalled 11.7 Mt, down from almost 13 Mt recorded in 2017–18, however improved prices meant that the value of the sector increased marginally from \$302.9 to \$303.6 million.

TABLE 3. WA salt projects				
Producer	Project	Mineral Field	LGA	Region
Dampier Salt (Operations) Pty Ltd	Dampier	West Pilbara	Karratha	Pilbara
Dampier Salt (Operations) Pty Ltd	Lake MacLeod	Gascoyne	Carnarvon	Gascoyne
Dampier Salt (Operations) Pty Ltd	Port Hedland	Pilbara	Port Hedland Town	Pilbara
Onslow Salt Pty Ltd	Onslow	Ashburton	Ashburton	Pilbara
Christopher John Meakins	Bulagin	South West	Wyalkatchem	Wheatbelt
Shark Bay Salt Pty Ltd	Shark Bay	Gascoyne	Shark Bay	Gascoyne
WA Salt Koolyanobbing Pty Ltd	Lake Deborah	Yilgarn	Yilgarn	Wheatbelt

Notable events

Following completion of a positive pre-feasibility study during the June 2018 quarter, BCI Minerals announced it has commenced a definitive feasibility study for its Mardie salt and potash project. Mardie is targeting 4 Mtpa of salt to be used as chemical feedstock and 100,000 tpa of SOP to be used as premium fertiliser. BCI continues to progress the approvals process and is working towards a target of securing primary environmental approvals by the end of 2019.

2.8.4 Diamonds

Diamond sales volumes in WA were 11.1 million carats in 2018–19, down from 15.3 million carats in 2017–18.

Rio Tinto announced the discovery of one of the largest white diamonds ever produced by the Argyle diamond mine in the east Kimberley region of WA. The octahedral-shaped 28.84 carat stone was named Argyle Octavia. The find was unexpected as the mine is on track for closure in 2020.

2.8.5 Manganese

Pricing

Globally, manganese ore prices have held above the US\$7 per metric tonne units for the last four years. This is despite additional supply from established

industry producers, including Australia. The strong price environment has been driven by China's market, specifically the phasing out of low grade local manganese ore supply and low grade products, and the closure of induction furnaces.

Quantity and value

Currently, all economic resources for manganese in Australia are located in WA and the Northern Territory. Groote Eylandt, a world-class manganese deposit in the Northern Territory, is the centre of most manganese-mining activity in Australia.

The volume of manganese sold in WA has been steadily increasing since the restart of operations at Woodie Woodie in late 2017. Manganese's sales totalling \$470 million were reported for 2018–19, a 66 per cent increase on 2017–18.

Notable events

- In July 2019, Mission New Energy Limited announced that it was entering into an agreement to acquire Pilbara Metals Group which aims to be the first producer of high purity manganese sulphate in Australia. Plans currently include 40,000 tonnes of manganese sulphate by 2020 with a plant located in the East Rockingham Strategic Industrial Area. The company has successfully completed initial test work for its high purity product and is seeking a global provisional patent.

2.8.6 Rare earth elements

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 for electric vehicles which need them for electric motors and wind turbines.

Quantity and value

WA's rare earths are mostly lanthanum, cerium, neodymium and praseodymium oxides. Lynas Corporation Ltd operates WA's only rare earths mine at Mount Weld. The mine started production in 2011 with an expected mine life of 25-years. The mine currently operates on a campaign mining basis.

In 2018–19, rare earth sales tonnages decreased by two per cent while sales values increased three per cent compared with 2017–18.

Notable events

- Northern Minerals announced that it produced the first rare earth carbonate through its Browns Range pilot plant project following the start of plant commissioning in June 2018. This is the first production of rare earth carbonate from xenotime ore outside China.
- More recently, Northern Minerals announced it has signed an offtake agreement with German raw material distributor Thyssenkrupp Materials Trading for the purchase of all heavy rare earth carbonate produced from its Browns Range pilot plant project near Halls Creek.
- The Environmental Protection Authority approved Hasting Technology Metals, Yangibana rare earths project which includes the development of five open pits, groundwater production bores, on-site ore processing, two tailings storage facilities, access roads and other related infrastructure such as an airstrip and power lines. Yangibana production is expected to average about 15,000 tpa of mixed rare earths carbonate and about 8,850 tpa of total rare earth oxides over a 10-year mine-life. The project has an estimated capital cost of \$427 million.

The importance of critical minerals

Geoscience Australia identifies critical minerals as metals, non-metals and minerals that are considered vital for the economic well-being of the world's major and emerging economies, yet whose supply may be at risk due to geological scarcity, geopolitical issues, trade policy or other factors. Among these important commodities are metals and semi-metals used in the manufacture of mobile phones and computers, flat screen monitors, wind turbines, electric cars, solar panels, rechargeable batteries, defence industry technology and products, and many other high-tech applications.

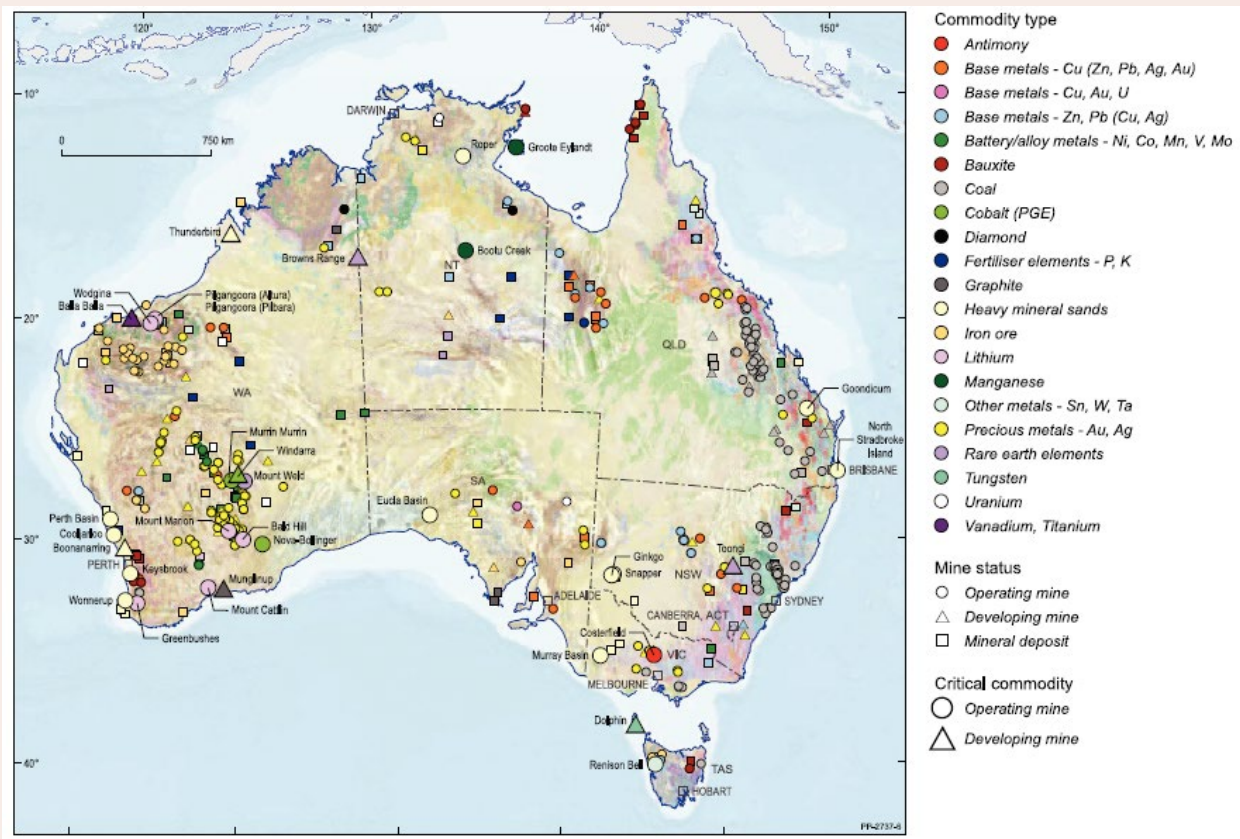
Criticality is a subjective concept and individual countries develop their own lists of critical minerals based on the relative importance of particular minerals to their industrial and strategic requirements. In May 2018, the US Government issued Executive Order 13817 which specified a final list of critical minerals for 2018. This list comprised 35 minerals, including rare-earth elements, and followed analysis by the USGS and public consultation.

While the US list is one of the most recent analyses of critical minerals, other strategic partners of Australia, including the European Union, France, Japan, Korea, India and the United Kingdom, have also produced similar lists.

The strategic importance of rare earth elements is indicated by their use in a number of emerging and diverse technologies of increasing significance in today's society. Applications range from routine (e.g. lighter flints, glass polishing mediums, car alternators) to high-tech (lasers, high-strength permanent magnets, batteries, fibre-optic telecommunication cables, medical treatments) to those with futuristic uses (high-temperature superconductivity, safe storage and transport of hydrogen for a post-hydrocarbon economy, environmental global warming and energy efficiency issues).

In recent times, global demand for rare earth elements has increased significantly with their dramatic expansion into high-tech, environmental and economic environments.

Australia, and in particular WA, is well endowed with a range of critical minerals. This can be seen in the below image.



Source: Critical mineral projects in Australia – Australian Trade and Investment Commission.

3 SUPPLEMENTARY INFORMATION

TABLE 4. Quick resources facts – 2018–19	
Output of minerals and energy	\$ million
Western Australia	\$145,131
Australia (DMIRS estimate only)	\$275,294
WA minerals	\$106,750
WA petroleum	\$38,381
Major Western Australian commodities	\$ million
Iron Ore	\$78,179
Petroleum	\$38,381
Gold	\$11,949
Alumina and Bauxite	\$8,279
Nickel	\$3,020
Crude oil and condensate	Million barrels
Western Australia	92
Australia	120
WA share	76%
Natural gas (inc. LNG feedstock and CSG)	PJ
Western Australia	2,934
Australia	5,083
WA share	58%
Merchandise exports	\$ million
Western Australia	\$161,852
Australia	\$372,097
WA share	43%
WA exports of minerals and energy as % share of all State Merchandise exports	94%
Mineral and energy exports	\$ million
Western Australia	\$152,166
Australia (DMIRS estimate only)	\$220,777
WA share	69%
Exploration expenditure (mineral)	\$ million
Western Australia	\$1,440
Australia	\$2,346
WA share	61%
Exploration expenditure (petroleum)	\$ million
Western Australia	\$734
Australia	\$1,261
WA share	58%
Private new capital investment	\$ million
Western Australia	\$24,269
Australia	\$122,119
WA share	20%
Mining investment	
Western Australia	\$16,961
Australia	\$33,371
WA share	51%
Economic impact	\$ million
Australia GDP 2016–17	\$1,851,516
Western Australian GSP 2016–17	\$261,001
Mining component of WA GSP *	58%

* Note: The ABS categorise alumina as manufacturing and is not included in the GSP mining component above. All data is for the 2018–19 financial year unless otherwise stated.

TABLE 5. Quantity and value of minerals and petroleum

COMMODITY	FINANCIAL YEAR 2017-18			FINANCIAL YEAR 2018-19	
	UNIT	QUANTITY	VALUE	QUANTITY	VALUE
ALUMINA INDUSTRY	t	14,786,790	6,643,523,276	15,427,487	8,279,414,945
BASE METALS					
Copper Metal	t	174,074	1,347,882,273	161,321	1,317,108,634
Lead Metal	t	7,397	22,799,223	4,890	13,478,653
Zinc Metal	t	70,810	323,504,398	70,810	267,118,032
TOTAL BASE METALS			1,694,185,894		1,597,705,319
CONSTRUCTION MATERIALS					
Aggregate	t	1,236,605	37,736,095	1,503,717	51,318,477
Gravel	t	155,354	1,069,398	157,234	2,208,537
Rock	t	267,164	4,415,604	258,671	3,839,832
Sand	t	4,098,732	28,278,225	2,015,745	28,014,833
Gypsum	t	895,502	16,787,214	987,741	18,931,587
TOTAL CONSTRUCTION MATERIALS			88,286,535		104,313,266
GEM & SEMI-PRECIOUS STONES	kg	204,227	443,041	124,407	446,414
GOLD	kg	212,053	11,420,303,407	211,382	11,949,148,901
INDUSTRIAL MINERALS					
Limesand-Limestone	t	3,943,155	25,997,500	4,298,172	27,758,167
Silica-Silica sand	t	974,445	18,775,811	992,208	21,269,502
Salt	t	12,963,778	302,930,944	11,729,482	303,646,875
TOTAL INDUSTRIAL MINERALS			347,704,255		352,674,544
IRON ORE	t	839,425,648	62,073,757,056	793,769,247	78,179,075,672
LITHIUM	t	2,131,687	1,586,046,109	1,823,292	1,549,541,469
MINERAL SANDS					
Garnet	t	379,724	n/a	388,470	n/a
Ilmenite	t	120,227	25,279,255	207,709	44,309,038
Leucoxene	t	14,287	13,031,604	14,996	17,908,218
Zircon	t	72,567	100,649,559	127,818	234,603,654
Other			241,852,298		232,087,423
TOTAL MINERAL SANDS			380,812,716		528,908,333

COMMODITY	FINANCIAL YEAR 2017-18			FINANCIAL YEAR 2018-19	
	UNIT	QUANTITY	VALUE	QUANTITY	VALUE
NICKEL INDUSTRY					
Cobalt	t	5,200	510,247,330	5,226	331,424,982
Nickel	t	163,374	2,635,829,872	154,219	2,660,504,029
Palladium and Platinum By-Product	kg	1,257	26,219,908	512	28,075,813
TOTAL NICKEL INDUSTRY			3,172,297,110		3,020,004,824
PETROLEUM					
Condensate	kl	7,115,286	3,304,673,707	11,367,113	5,749,335,865
Crude Oil	kl	4,899,360	2,349,268,417	3,211,963	1,741,806,924
LNG	t	37,893,517	18,920,841,693	43,556,544	28,971,105,181
LPG – Butane and Propane	t	451,242	331,271,410	447,229	324,318,533
Natural Gas	'000m ³	10,039,526	1,634,736,893	10,255,279	1,580,857,782
TOTAL PETROLEUM			26,540,792,120		38,367,424,284
SILVER	kg	163,698	105,307,583	137,683	84,315,603
OTHER (Includes Coal, Tin-Tantalum, Vanadium, Manganese, Rare Earths, Spongolite and Talc, Clays, Dimension stone)			1,633,754,066		1,941,294,928
TOTAL VALUE			115,306,400,452		145,425,360,169
<p>Note: Quantities used in this table only apply to Minerals and Petroleum covered by the <i>Mining Act 1978</i>, the <i>Petroleum and Geothermal Energy Resources Act 1967</i>, the <i>Petroleum (Submerged Lands) Act 1982</i>, the <i>Offshore Petroleum Act 2006</i> and relevant State Agreement Acts.</p> <p>n/a Breakdown not available.</p>					

TABLE 6. Quantity and value of selected major commodities

COMMODITY	UNIT	2011-12		2012-13		2013-14	
		Quantity	Value	Quantity	Value	Quantity	Value
ALUMINA INDUSTRY							
Alumina	t	12,424,860	4,010,219,382	13,530,752	4,027,810,217	13,717,952	4,295,348,699
Bauxite	t	-	-	-	-	-	-
TOTAL ALUMINA INDUSTRY			4,010,219,382		4,027,810,217		4,295,348,699
BASE METALS							
Copper	t	159,171	1,180,779,699	209,266	1,423,043,554	211,186	1,559,565,610
Lead	t	6,922	13,839,831	16,641	35,049,525	78,651	178,764,058
Zinc	t	63,503	121,984,210	55,848	103,867,913	54,060	118,261,576
TOTAL BASE METALS			1,316,603,740		1,561,960,992		1,856,591,245
CONSTRUCTION MATERIALS							
Aggregate	t	3,722,254	97,854,121	4,391,376	148,775,764	2,154,534	47,255,402
Gravel	t	283,899	2,454,938	561,135	3,947,125	51,853	338,431
Rock	t	509,983	6,262,935	1,109,761	27,142,818	402,652	10,070,061
Sand	t	6,286,702	54,502,065	5,415,504	62,093,160	3,796,749	28,420,888
Gypsum		334,178	4,690,980	1,575,769	7,027,903	532,919	9,496,857
INDUSTRIAL MINERALS							
Clay		75,091	1,663,209			5,139	345,148
Limestone – Limesand – Dolomite		4,157,630	21,403,515	4,091,849	24,239,571	3,116,623	23,378,197
Silica-Silica sand		498,232	16,886,756	449,587	15,847,051	483,809	17,927,564
Salt		12,807,461	353,776,447	12,389,643	381,652,888	12,992,042	410,097,847
IRON ORE		454,385,064	60,972,726,991	511,760,416	56,204,322,877	623,507,315	75,165,582,340
MINERAL SANDS							
Ilmenite	t	332,012	58,190,544	270,770	72,680,422	78,900	19,515,066
Leucoxene	t	22,231	16,691,847	29,071	31,231,788	29,268	26,205,650
Rutile	t	38,870	52,250,227	46,938	80,261,379	65,084	65,938,306
Zircon	t	180,429	219,219,649	215,831	189,547,782	212,068	114,307,405
Other mineral sands	t	540,074	458,168,418	475,411	372,123,979	335,684	176,168,377
TOTAL MINERAL SANDS	t	1,113,617	804,520,685	1,038,021	745,845,350	721,004	402,134,803
PETROLEUM							
Condensate	kl	5,888,608	3,842,111,571	6,116,968	3,922,032,524	5,559,221	4,032,961,171
Crude Oil	kl	11,121,616	7,676,633,459	8,609,425	5,972,058,200	7,303,854	5,724,962,343
LNG	t	15,610,570	9,495,543,132	19,804,919	12,147,214,397	20,049,826	14,804,193,332
LPG – Butane and Propane	t	835,271	734,484,653	752,910	634,052,635	630,636	586,349,207
Natural Gas	'000m ³	9,080,655	1,449,810,229	8,713,949	1,434,550,772	9,368,839	1,655,819,689
TOTAL PETROLEUM			23,198,583,045		24,109,908,528		26,804,285,741
PRECIOUS METALS							
Gold	kg	180,771	9,421,483,327	179,849	9,022,522,018	196,074	8,890,995,046
Silver	kg	120,080	115,704,896	123,740	100,560,679	137,180	93,414,212
Palladium and Platinum By-Product	kg	626	14,909,443	658	15,045,619	1,015	28,523,097
SPECIALITY METALS							
Spodumene	t	461,121	138,413,821	485,879	178,786,684	342,065	150,564,377
Tantalite	t	347	49,931,724	201	17,940,739	58	4,074,774
Tin Metal	t	62	1,372,580	193	2,703,339	-	n/a
STEEL ALLOY METALS							
Manganese		846,293	331,693,574	649,695	n/a	711,536	n/a
Cobalt		4,950	143,627,596	6,200	159,147,805	6,236	175,117,788
Nickel		209,370	3,721,964,396	227,463	3,511,711,762	209,710	3,419,023,118
OTHER (may inc Garnet, Diamonds, Chromite, Rare earths, Feldspar, Tin, Tanatlite and other)			793,636,192		413,284,232		1,228,014,351
TOTAL MINERAL AND PETROLEUM VALUE			105,594,886,357		101,488,122,472		123,060,999,987

2014-15		2015-16		2016-17		2017-18		2018-19	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
13,771,412	5,022,721,218	13,893,540	4,937,279,870	13,855,382	5,073,995,897	13,669,467	6,596,818,325	13,643,398	8,211,838,274
-	-	47,703	1,952,600	310,341	14,563,469	1,117,323	46,704,951	1,784,088	67,576,671
	5,022,721,218		4,939,232,470	14,165,722	5,088,559,366	14,786,790	6,643,523,276	15,427,487	8,279,414,945
184,495	1,283,046,797	190,275	1,183,262,087	170,730	1,240,528,049	174,074	1,347,882,273	161,321	1,317,108,634
59,248	136,949,662	5,988	14,810,595	3,507	10,146,717	7,397	22,799,223	4,890	13,478,653
77,831	197,040,406	82,676	195,494,453	82,943	204,161,259	93,373	323,504,398	70,810	267,118,032
	1,617,036,865		1,393,567,135		1,454,836,025		1,694,185,894		1,597,705,319
1,963,871	69,239,676	1,313,696	42,256,613	1,052,609	29,218,464	1,236,605	37,736,095	1,503,717	51,318,477
172,556	993,903	177,243	1,055,083	261,219	1,652,110	155,354	1,069,398	157,234	2,208,537
1,746,693	46,504,731	220,402	1,828,018	409,316	5,718,563	267,164	4,415,604	258,671	3,839,832
5,939,321	49,279,152	3,477,403	34,966,248	2,578,123	25,260,514	4,098,732	28,278,225	2,015,745	28,014,833
576,880	12,240,632	551,910	13,830,966	531,399	12,980,853	895,502	16,787,214	987,741	18,931,587
17,670	1,043,438	21,969	1,104,708	20,919	1,407,547	18,121	1,274,897	18,766	1,645,551
4,903,039	33,175,834	4,446,486	28,826,046	4,178,360	26,012,783	3,943,155	25,997,500	4,298,172	27,758,167
581,966	18,072,793	728,859	20,364,867	974,445	18,775,811	992,208	21,269,502	992,208	21,269,502
11,726,606	374,622,315	10,974,721	336,253,755	10,874,279	292,285,826	12,963,778	302,930,944	11,729,482	303,646,875
718,806,504	54,375,654,674	748,100,421	48,767,746,598	792,984,563	64,319,249,452	839,424,190	62,075,237,523	793,816,170	78,183,519,310
99,674	21,000,789	174,687	39,692,103	178,528	42,912,243	120,227	25,279,255	207,709	44,309,038
16,965	14,636,208	18,137	16,452,584	7,144	6,492,778	14,287	13,031,604	14,996	17,908,218
30,206	29,582,184	45,888	44,260,114	21,562	21,953,547	n/a	n/a	n/a	n/a
182,859	136,321,656	191,551	151,297,003	184,700	101,083,491	72,567	100,649,559	127,818	234,603,654
440,970	291,166,037	n/a	319,846,256	n/a	332,833,791	62,205	241,852,298	n/a	232,087,423
770,674	492,706,874	430,263	571,548,060	391,933	505,275,850	269,286	380,812,716	350,523	528,908,333
6,753,212	3,488,373,293	6,775,142	2,213,709,834	6,037,603	2,228,626,174	7,115,286	3,304,673,707	11,367,113	5,749,335,865
7,844,408	4,493,521,248	7,685,922	3,089,384,046	5,404,294	2,111,578,898	4,899,360	2,349,268,417	3,211,963	1,741,806,924
20,447,845	13,817,045,230	20,955,641	10,764,545,353	28,685,477	12,728,310,038	37,893,517	18,920,841,693	43,556,544	28,971,105,181
553,055	405,561,785	531,595	249,059,073	527,391	273,097,308	451,242	331,271,410	447,229	324,318,533
9,875,339	1,826,592,934	10,223,641	1,913,134,982	9,708,934	1,830,012,904	10,039,526	1,634,736,893	10,255,279	1,580,857,782
	24,031,094,489		18,229,833,288		19,171,625,322		26,540,792,120		38,367,424,284
193,162	9,107,167,942	195,968	10,104,514,299	203,003	10,859,574,221	212,053	11,420,303,407	211,382	11,949,148,901
150,581	95,972,011	155,292	104,786,546	142,868	98,465,480	163,698	105,307,583	137,683	84,315,603
464	13,380,730	687	16,656,441	n/a	n/a	1,257	26,219,908	512	28,075,813
489,074	245,874,387	417,286	241,996,770	887,408	589,513,148	2,131,687	1,586,046,109	1,823,292	1,549,541,469
70	n/a	183	n/a		n/a		n/a		n/a
14	n/a	22	n/a		n/a		n/a		n/a
800,985	n/a	425,303	146,188,090	236,565	n/a	378,889	n/a	571,351	n/a
6,036	210,567,512	5,479	174,846,826	4,759	239,639,935	5,200	510,247,330	5,226	331,424,982
183,315	3,169,605,001	175,752	2,202,734,451	157,564	2,094,500,242	163,374	2,635,829,872	154,219	2,660,504,029
	1,165,908,372		625,686,259		164,581,387		1,248,135,336		1,406,743,820
100,152,862,549		87,999,823,537		105,020,941,280		115,306,400,452		145,425,360,169	

TABLE 7. Value of minerals and petroleum by region by commodity (\$145,131,898,464)

REGION	2018–19 Value
Pilbara Region	
Iron Ore	76,818,826,919
Gold and Silver	945,273,692
Manganese Ore and Salt	639,278,327
Copper	242,444,949
Construction Materials	45,441,811
Other	272,065,889
Pilbara Total	78,963,331,587

Offshore Petroleum	
Crude Oil and Condensate	7,450,750,849
Liquefied Natural Gas	28,971,105,181
Natural Gas and LPG Butane and Propane	1,887,140,522
Offshore Total	38,308,996,551

Goldfields-Esperance Region	
Gold	7,721,098,751
Silver	26,300,105
Nickel and Cobalt	2,574,143,204
Copper and Zinc	210,564,809
Spodumene and Tantalum Pentoxide	642,347,960
Gypsum and Limesand Limestone	9,844,711
Construction Materials and Granite	16,833,585
Other	384,328,209
Goldfields-Esperance Total	11,585,461,334

Peel Region	
Gold, Silver and Copper	1,435,079,573
Peel Total	1,435,079,573

Mid West Region	
Gold and Silver	1,777,448,842
Iron Ore	963,286,108
Copper, Lead and Zinc	909,271,986
Mineral Sands	156,870,044
Natural Gas	18,035,793
Condensate and Crude Oil	26,219,562
Gypsum and Talc	15,494,184
Limesand Limestone	2,797,836
Clays	1,239,055
Manganese Ore and Sand	4,247,803
Gem and Semi Precious Stones	302,568
Mid West Total	3,875,215,301

REGION	2018–19 Value
Wheatbelt Region	
Iron Ore	18,486,045
Nickel and Copper	374,783,874
Mineral Sands	204,473,473
Gold and Silver	269,397,935
Salt and Silica and Silica Sand	12,747,790
Gypsum	6,859,941
Limesand Limestone Dolomite, Construction Materials and Clays	6,911,959
Wheatbelt Total	893,661,017

Kimberley Region	
Diamonds and Gem and Semi Precious Stones	219,221,184
Gold and Silver	77,652,957
Construction Materials	11,631,504
Crude Oil and Sandstone	28,521,561
Kimberley Total	432,162,688

South West Region	
Alumina, Sand and Aggregate	2,455,307,009
Coal	319,370,156
Tantalum Pentoxide, Spodumene and Tin Metal	701,164,795
Mineral Sands	167,564,816
Sandstone and Limesand Limestone	1,804,942
South West Total	3,645,211,958

Gascoyne Region	
Salt	84,285,971
Gypsum, Limesand Limestone and Spongolite	10,806,069
Construction Materials and Gem and Semi Precious Stones	1,240,002
Gascoyne Total	96,332,042

Perth Metropolitan Region	
Alumina and Bauxite	5,824,279,094
Construction Materials	8,985,265
Silica and Limesand Limestone	16,214,063
Perth Metropolitan Total	6,192,878,811

Great Southern Region	
Spongolite, Silica and Limesand Limestone	8,170,465
Great Southern Total	8,170,465

TABLE 8. Value of minerals and petroleum by region by local government area (\$145,131,898,464)

REGION	2018–19 Value
Pilbara Region	
East Pilbara	39,078,596,976
Ashburton	39,669,547,711
Port Hedland Town and Marble Bar	112,477,901
Karratha	102,273,672
Pilbara Total	78,963,331,587

Offshore Petroleum	38,308,996,551
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Goldfields-Esperance Region	
Coolgardie	3,418,087,046
Kalgoorlie-Boulder	2,051,269,360
Leonora	1,919,979,840
Laverton	2,605,983,116
Ravensthorpe and Dundas	883,284,841
Menzies and Esperance	706,857,131
Goldfields-Esperance Total	11,585,461,334

Peel Region	
Waroona/Murray and Boddington	1,435,079,573
Peel Total	1,435,079,573

Mid West Region	
Meekatharra and Morawa	1,077,069,759
Yalgoo	784,171,732
Wiluna and Three Springs	646,187,885
Cue, Coorow and Geraldton	247,610,224
Mullewa and Mt Magnet	233,210,202
Northampton and Perenjori	808,338,561
Irwin	46,126,737
Carnamah	32,500,201
Mid West Total	3,875,215,301

Great Southern Region	
Albany, Denmark and Plantagenet	8,170,465
Great Southern Total	8,170,465

REGION	2018–19 Value
Wheatbelt Region	
Yilgarn	154,822,357
Kondinin	375,293,955
Dandaragan	151,953,588
Lake Grace and Westonia	141,719,071
Gingin and Koorda	61,558,941
Moora and Wyalkatchem	6,376,732
Dalwallinu, Northam and Kellerberrin	1,936,373
Wheatbelt Total	893,661,017

Kimberley Region	
Derby-West Kimberley	64,093,482
Wyndham-East Kimberley	221,647,228
Halls Creek	137,350,277
Broome	9,071,701
Kimberley Total	432,162,688

South West Region	
Collie	2,774,506,007
Bridgetown-Greenbushes and Bunbury	738,070,718
Capel and Dardanup	103,097,839
Harvey and Busselton	27,732,212
Donnybrook-Balingup, Manjimup and Augusta-Margaret River	1,805,182
South West Total	3,645,211,958

Gascoyne Region	
Carnarvon	52,175,663
Exmouth, Shark Bay and Upper Gascoyne	44,156,379
Gascoyne Total	96,332,042

Perth Metropolitan Region	
Kalamunda, Swan and Mundaring	16,944,323
Wanneroo	2,507,523
Cockburn, Kwinana and Rockingham	6,173,426,965
Perth Metropolitan Total	6,192,878,811

TABLE 9. Average annual employment in the WA mineral sector				
Primary Commodity	2017–18 Nol*	2018–19 Nol*	2017–18 FTE*	2018–19 FTE*
Barite	1	–	–	–
Bauxite – Alumina	6,850	7,395	6,482	6,969
Base Metals	2,535	2,626	2,147	2,255
Chemicals	160	165	58	58
Clays	96	72	35	37
Coal	1,153	1,139	754	711
Construction Materials	2,622	2,736	766	762
Diamond	824	903	789	861
Diatomite – Spongolite	2	2	2	2
Dimension Stone	239	237	61	59
Dolomite	1	1	–	–
Gem & Semi-Precious Stones	3	4	–	–
Gold	29,273	31,422	23,782	25,690
Gypsum	73	72	18	19
Mineral Sands	2,311	3,083	1501	2,052
Iron Ore	53,712	60,122	42,035	45,161
Limestone – Limesand	757	788	136	136
Manganese Ore	391	487	380	497
Nickel	5,474	6,062	5,588	6,218
Phosphate	180	172	162	157
Potash	2	26	2	32
Rare Earths	299	326	291	298
Salt	978	1,039	567	614
Silica – Silica Sand	678	571	294	298
Silver	12	11	3	3
Talc	108	95	44	40
Tin – Tantalum – Lithium	2,471	3,596	3,320	4,876
Vanadium – Titanium	8	9	6	6
Other	825	848	635	626
Grand Total	112,036	124,010	89,857	98,438

* **Nol:** Number of Individuals (Average on-site) **FTE:** Full time equivalents

Please note: Slight discrepancies are expected between annual employment figures on a site by site basis and an overall commodity basis. This is due to variations associated with rounding when averaging employee numbers throughout the year, and data collection methodology generally. Discrepancies are anticipated to be very small, <0.1%.



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.

TABLE 10. Principal mining projects 2018–19

Company	Project	Comments
Base metals		
EMR Capital Pty Ltd Level 2, 150 Collins Street, Melbourne VIC 3000 (03) 9669 9999 www.emrcapital.com	Golden Grove	
Metals X Ltd Level 3, 18-32 Parliament Place, West Perth WA 6005 (08) 9220 5700 www.metalsx.com.au	Nifty	
Round Oak Minerals Pty Ltd Round Oak Road, Cloncurry QLD 4824 (07) 47421344	Jaguar	CopperChem Pty Ltd changed its name to Round Oak Minerals Pty Ltd in 2018.
Sandfire Resources NL Level 1, 31 Ventnor Avenue, West Perth WA 6005 (08) 6430 3800 www.sandfire.com.au	DeGrussa	
Bauxite		
Alcoa Corporation 181–205 Davy Street, Booragoon WA 6154 (08) 9316 5111 www.alcoa.com/australia	Huntly, Willowdale	Huntly and Willowdale are owned by a joint venture of Alcoa Corporation (60%) and Alumina Limited (40%)
South32 Ltd Level 35, 108 St Georges Tce, Perth WA 6000 (08) 9324 9000 www.south32.net	Boddington	Boddington is a joint venture of South32 Limited (86%) Sojitz Corporation (9%), and Press Metal Bintulu (5%).
Caesium		
Pioneer Resources Limited 72 Kings Park Road, West Perth WA 6005 (08) 9322 6974 www.pioneerresources.com.au	Pioneer Dome	New project. Sales of caesium ore commenced in the March quarter 2019.
Coal		
Griffin Coal Mining Company Pty Ltd 1st Floor, 677 Murray Street, Perth WA 6005 (08) 6188 2200 www.griffincoal.com.au	Griffin	
Yancoal Australia Limited Level 26, 363 George Street, Sydney NSW 2000 (02) 8583 5300 www.yancoal.com.au	Premier	
Construction Materials		
Aggregate		
Boral Resources (WA) Ltd 63-69 Abernethy Road, Belmont WA 6104 (08) 9333 3400	Mt Regal, Pilbara Area, Seven Mile Hill, Kununurra	
Holcim (Australia) Pty Ltd 200 Adelaide Terrace, East Perth WA 6004 (08) 9212 2000 www.holcim.com.au	Newman, Nickol Bay, Turner River	

Company	Project	Comments
MLG OZ Pty Ltd 22 Coath Road, West Kalgoorlie WA 6433 (08) 9022 7746 www.mlgoz.com.au	Tarmoola	
Gravel		
MLG OZ Pty Ltd 22 Coath Road, West Kalgoorlie WA 6433 (08) 9022 7746 www.mlgoz.com.au	Eight Mile Rock Hole, Jonah Bore	
Norwest Sand & Gravel Pty Ltd Lot 5 Wilson Way, Wickham WA 6720 (08) 9187 1488	Cossack, Mt Welcome, Nickol River	
Rock		
Holcim (Australia) Pty Ltd 200 Adelaide Terrace, East Perth WA 6004 (08) 9212 2000 www.holcim.com.au	Golden Mile Rock	
Sand		
Holcim (Australia) Pty Ltd 200 Adelaide Terrace, East Perth WA 6004 (08) 9212 2000 www.holcim.com.au	Baldivis, Turner River Dune, Widgiemooltha	
Hanson Constructions Pty Ltd Level 1, 35 Great Eastern Highway, Rivervale WA 6103 (08) 9311 8811 www.hanson.com.au	Gnangara, Jandabup	
Diamonds		
Rio Tinto Ltd Argyle Diamond Mine Lissadell Road, East Kimberley WA 6740 (08) 9168 4900 www.riotinto.com	Argyle	
Gold		
Adaman Resources Pty Ltd Level 3, 140 St Georges Terrace, Perth WA 6000 (08) 6216 9900 www.adamanresources.com.au	Corinthia	Re-opened project. Adaman Resources Pty Ltd acquired the project in 2017 and started mining in 2018 for first sales in October 2018.
AngloGold Ashanti Limited Level 13, 44 St Georges Terrace, Perth WA 6000 (08) 9425 4600 www.anglogoldashanti.com	Tropicana, Sunrise Dam	Tropicana is a joint venture of AngloGold Ashanti Limited (70%) and Independence Group NL (30%).
Billabong Gold Pty Ltd Level 1, 30 Richardson Street, West Perth WA 6005 (08) 6324 0000 www.superior-gold.com	Hermes, Plutonic	Billabong Gold Pty Ltd is a subsidiary of Superior Gold Inc. Mining activities concluded in May 2019, but processing is expected to continue to the end of 2019.
Dacian Gold Limited Level 2, 1 Preston Street, Como WA 6152 (08) 6323 900 www.daciangold.com.au	Mt Morgans	
Evolution Mining Limited Level 15, 37 St Georges Terrace, Perth WA 6000 (08) 6216 9700 www.evolutionmining.com.au	Mungari	

Company	Project	Comments
Gascoyne Resources Limited Office Level 1, 41-47 Colin Street, West Perth WA 6005 (08) 9481 3434 www.gascoyneresources.com.au	Dalgaranga	New project. Achieved first gold pour in May 2018. The project continued to operate despite Gascoyne Resources Limited being placed into voluntary administration in June 2019.
Gold Fields Limited Level 5, 50 Colin Street, West Perth WA 6005 (08) 9211 9200 www.goldfields.com.au	Agnew, Granny Smith, St Ives	
Kalgoorlie Consolidated Gold Mines Pty Ltd Black Street, PMB 27, Kalgoorlie WA 6433 www.superpit.com.au	Super Pit / Mt Charlotte	Kalgoorlie Consolidated Gold Mines Pty Ltd is the management company for joint venture owners Barrick Gold Corporation and Newmont Gold Corp Corporation.
Matsa Resources Limited Suite 11, 139 Newcastle Street, Perth WA 6000 (08) 9230 3555	Lake Carey	Mining of the Red Dog was completed in December 2018, with mining of the Red October mine commencing in February 2019.
Minjar Gold Pty Ltd Level 3, 66 Kings Park Road, West Perth WA 6005 (08) 9212 8900 www.minjargold.com.au	Golden Dragon, Southern Cross	Minjar Gold Pty Ltd is a subsidiary of Tianye Sxo Gold Mining Pty Ltd
Newcrest Mining Limited 234 Railway Parade, West Leederville WA 6007 (08) 9270 7070 www.newcrest.com.au	Telfer	
Newmont GoldCorp Corporation Level 2, 388 Hay Street, Subiaco WA 6008 (08) 9423 6100 www.newmont.com	Boddington	
Northern Star Resources Ltd Level 1, 388 Hay Street, Subiaco WA 6008 (08) 6188 2100 www.nsr ltd.com	Jundee, Kanowna Belle, Kundana, South Kalgoorlie	
Norton Gold Fields Ltd Level 36, Exchange Plaza, 2 The Esplanade, Perth WA 6000 www.nortongoldfields.com.au	Paddington	
Ora Banda Mining Ltd Level 2, 220 St Georges Terrace, Perth WA 6000 (08) 6365 4548 www.orabandamining.com.au	Davyhurst	Eastern Goldfields Ltd entered administration in November 2018 and was recapitalised as Ora Banda Mining Ltd in June 2018.
Pantoro Limited 1187 Hay Street, West Perth WA 6000 (08) 6263 1110	Halls Creek	
Ramelius Resources Ltd Level 1, 130 Royal Street, East Perth WA 6004 (08) 9202 1127 www.rameliusresources.com.au	Edna May, Mt Magnet, Vivien	
Red 5 Limited 35 Ventnor Avenue, West Perth, WA 6005 (08) 9322 4455 www.red5litimited.com	Darlot, King of the Hills	
Regis Resources Ltd Level 1, 1 Alvan Street, Subiaco WA 6008 (08) 9442 2200 www.regisresources.com.au	Duketon	

Company	Project	Comments
RNC Minerals Corporation	Beta Hunt, Higginsville	Beta Hunt was previously classified as a nickel project. Higginsville was acquired by RNC Minerals Corporation from Westgold Resources Limited in June 2019.
Saracen Mineral Holdings Ltd Level 11, 40 The Esplanade, Perth WA 6000 (08) 6229 9100 www.saracen.com.au	Carosue Dam, Thunderbox	
Silver Lake Resources Ltd	Deflector, Andy Well, Mt Monger	Silver Lake Resources Ltd and previous owner Doray Minerals Limited merged in April 2019.
St Barbara Mines Ltd 7 Rheola Street, West Perth WA 6005 (08) 9476 5555 www.stbarbara.com.au	Gwalia	
Westgold Resources Limited Level 6, 197 St Georges Tce, Perth WA 6000 (08) 9462 3400 www.westgold.com.au	Meekatharra, Cue, Fortnum	Fortnum is a recently re-opened project
Iron ore		
Atlas Iron Limited Level 18, Raine Square, 300 Murray Street, Perth WA 6000 (08) 6228 8000 www.atlasiron.com.au	Mt Webber	Atlas Iron Limited was acquired by Redstone Corporation Pty Ltd, a subsidiary of Hancock Prospecting Pty Ltd, in December 2018.
BCI Minerals Limited Level 1, 15 Rheola Street, West Perth WA 6005 (08) 6311 3400 www.bciron.com.au	Iron Valley	Operated by a subsidiary of Mineral Resources Limited.
BHP 125 St Georges Terrace, Perth WA 6000 1300 55 47 57 www.bhpbilliton.com	Jimblebar / Wheelara, Mining Area C, Newman, Yandi	Newman comprises the Eastern Ridge, Mt Whaleback / Orebody 20 / 30 / 35, and Orebody 18 mines.
CITIC Pacific Mining Management Pty Ltd 45 St Georges Terrace, Perth WA 6000 (08) 9226 8888 www.citicpacificmining.com	Sino Iron	
Fortescue Metals Group Ltd Level 2, 87 Adelaide Terrace, East Perth WA 6004 (08) 6218 8888 www.fmgil.com.au	Chichester Hub, Solomon Hub	Chichester comprises the Christmas Creek and Cloudbreak mines. Solomon comprises the Firetail and Kings mines.
Hancock Prospecting Pty Ltd 28-42 Ventnor Avenue, West Perth WA 6005 www.hancockprospecting.com.au	Roy Hill	
Karara Mining Limited Level 8 216 St Georges Terrace, Perth WA 6000 (08) 6298 2400 Kararamining.com.au	Karara	Karara Mining Limited is wholly owned by Anshan Iron and Steel Group following its takeover of Gindalbie Metals Ltd completed in July 2019.
Mineral Resources Limited 1 Sleat Road, Applecross WA 6153 (08) 9329 3600 www.mineralresources.com.au	Carina, Koolyanobbing,	Carina sales of stockpiled materials continued in 2018–19. Koolyanobbing mining recommenced in August 2018.

Company	Project	Comments
Mount Gibson Iron Limited Level 1, 2 Kings Park Road, West Perth WA 6005 (08) 9426 7500 www.mtgibsoniron.com.au	Koolan Island, Mid West	Re-opened project. Sales recommenced in the June quarter 2019. Mid West comprises the Iron Hill and Extension Hill mines. Final sales from Iron Hill were completed in February 2019, with shipments of stockpiled low-grade materials from Extension Hill commencing in early June 2019
Rio Tinto Ltd	Hope Downs, Marandoo, Mt Tom Price, Robe Valley, West Angelas, Yandicoogina	
Limesand-Limestone		
Aglime of Australia Suite 1, 110 Robinson Avenue, Belmont WA 6104 (08) 9277 5529 www.aglime.com.au	Dongara-Denison, Lancelin, Jurien Bay	
Archistone Pty Ltd 27 Jandakot Road, Jandakot WA 6164 (08) 9417 2444 www.archistone.com.au	Moore River, Yanchep Reconstituted Stone	
Cockburn Cement Ltd Lot 242, Russell Road, Munster WA 6166 (08) 9411 1000 www.cockburncement.com.au	Cockburn, Coogee, Denison, Ledge Point, Wesco Rd	
FQM Australia Nickel Pty Ltd 1/24 Outram Street, West Perth WA 6005 (08) 9346 0100 www.first-quantum.com	Ravensthorpe Limestone	
Lime Industries Pty Ltd 43 Hector Street, Osborne Park WA 6017 (08) 9241 1100 www.limeindustries.com.au	Boranup Limesand	
Minara Resources Level 10, Alluvion, 58 Mounts Bay Road, Perth WA 6000 (08) 9212 8400 www.minara.com.au	Mt Zephyr Calcrete	
WA Limestone 401 Spearwood Avenue, Bibra Lake WA 6163 (08) 9434 7777 www.walimestone.com	Postans	
Lithium		
Alita Resources Limited Level 3, 20 Parkland Road, Osborne Park WA 6017 (08) 9489 2600	Bald Hill	Alliance Mineral Assets Limited and Tawana Resources NL merged in December 2018. Alliance Mineral Assets changed its name to Alita Resources Limited in July 2019.
Altura Mining Limited Level 2, 23 Barrack Street, Perth WA 6000 (08) 9488 5100 www.alturamining.com	Pilgangoora	New project. First sales of spodumene concentrate achieved in the December quarter 2018.
Galaxy Resources Limited Level 4 / 21 Kintail Road, Applecross WA 6153 (08) 9215 1700 www.gxy.com	Mt Cattlin	

Company	Project	Comments
Mineral Resources Limited 1 Sleaf Road, Applecross WA 6153 (08) 9329 3600 www.mineralresources.com.au Wodgina	Mount Marion, Wodgina	Mineral Resources Limited and Ganfeng Lithium Company acquired Neometals' 13.8% interest in Mount Marion on 18 March 2019. Mineral Resources (40%) and Albemarle Corporation (60%) entered into a joint venture agreement for the Wodgina project in August 2019. Sales of unprocessed ore were completed in the September 2018 quarter.
Pilbara Minerals Limited Level 2, 88 Colin Street, West Perth WA 6005 (08) 6266 6266 www.pilbaraminerals.com.au	Pilgangoora	Sales of unprocessed ore were completed in the September 2018 quarter with sales of spodumene concentrate commencing in the December quarter 2018.
Talison Lithium Australia Pty Ltd	Greenbushes	Talison Lithium Australia Pty Ltd is a joint venture of Tianqi Lithium Pty Ltd (51%) and Albemarle Corporation (49%).
Manganese		
Consolidated Minerals Pty Ltd	Woodie Woodie	
Mineral sands		
Doral Pty Ltd	Yoongarillup mine and Picton dry separation plant	
GMA Garnet Pty Ltd	Port Gregory	
Iluka Resources Limited	South West	Active operations comprised the Capel dry plant, the North Capel mineral separation plant, and one of two synthetic rutile kilns at North Capel.
Iluka Resources Limited	Mid West	The only active operation was the Narngulu mineral separation plant with the Eneabba mine and Narngulu synthetic rutile plant both on care and maintenance. First production from the Cataby mine was achieved in the June quarter 2019.
MZI Resources Ltd	Keysbrook	MZI Resources Ltd entered administration on 16 April 2019. An agreement to sell the Keysbrook project to Doral Pty Ltd was announced on 28 June 2019.
Tronox Limited	Cooljarloo mine and Chandala mineral separation plant	
Tronox Limited	Wonnerup mine and North Shore mineral separation plant	Tronox Limited completed its acquisition of Cristal Mining Australia Ltd on 10 April 2019.
Nickel		
BHP	Leinster	Includes the Cliffs and Leinster underground mines and the Rocky's Reward open-pit.
BHP	Mt Keith	
Independence Group NL	Nova	
Minara Resources Ltd	Murrin Murrin	Minara Resources Ltd is a subsidiary of Glencore Plc.

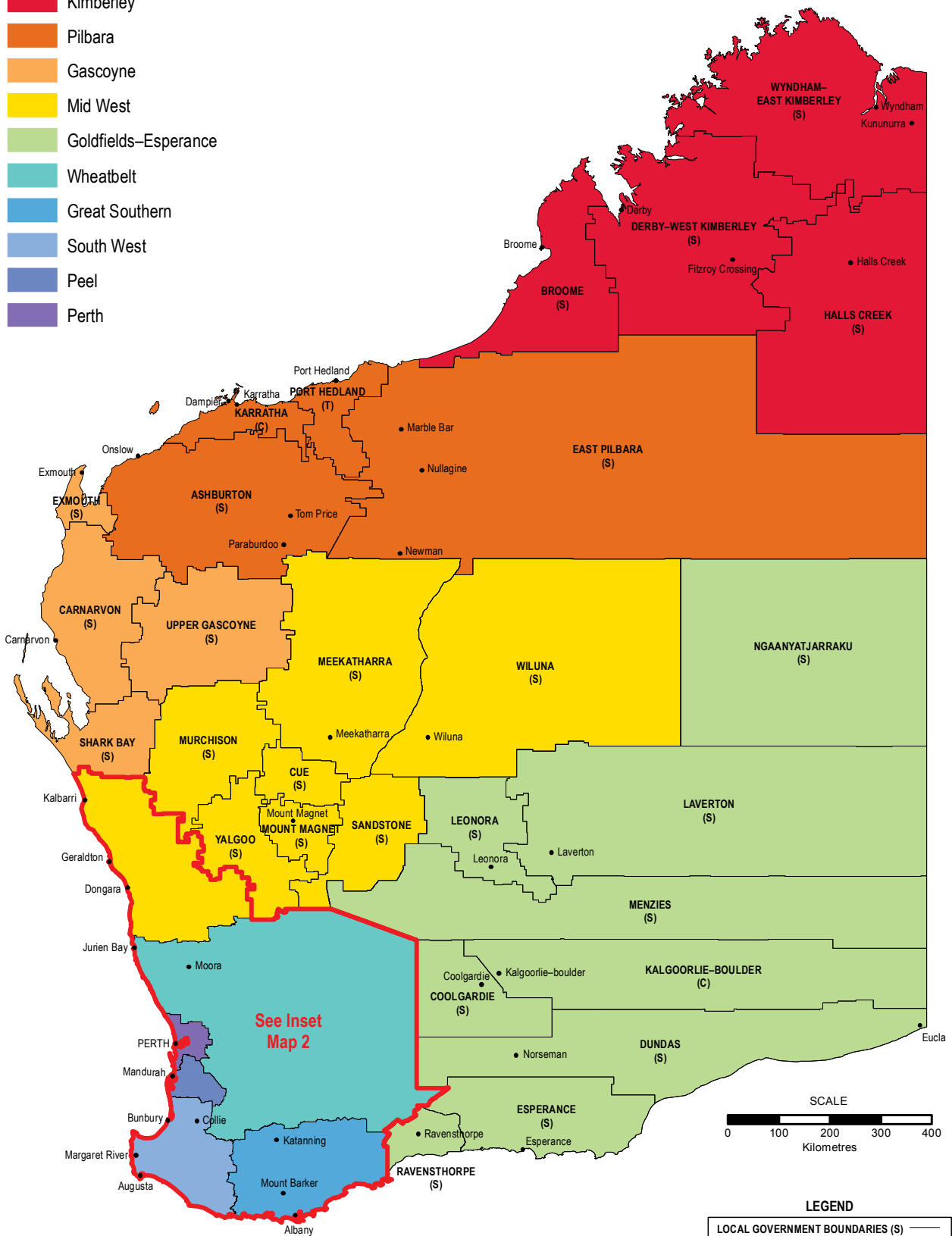
Company	Project	Comments
Panoramic Resources Ltd	Savannah	Re-opened project. Sales recommenced in the March quarter 2019, having previously being suspended in May 2016.
Western Areas Ltd	Forrestania	
Rare earths		
Lynas Corporation Ltd	Mt Weld	
Salt		
Dampier Salt Ltd	Dampier	Dampier Salt Ltd is a joint venture of Rio Tinto (68%), Marubeni Corporation (22%) and Sojitz Corporation (10%).
Dampier Salt Ltd	Lake MacLeod	
Dampier Salt Ltd	Port Hedland	
Onslow Salt Pty Ltd	Onslow	
Shark Bay Salt Pty Ltd	Shark Bay	
WA Salt Koolyanobbing Pty Ltd	Lake Deborah	
Silica sand		
Hanson Australia Pty Ltd Level 1, 35 Gt Eastern Hwy, Rivervale WA 6103 (08) 9311 8811 www.hanson.com.au	Ghangara	
Simcoa Operations Pty Ltd 973 Marriott Road, Wellesley WA 6232 (08) 9780 6666 www.simcoa.com.au	Moora	
AustSand Mining Suite 5, 363-367 Albany Hwy Victoria Park WA 6100, (08) 9361 6288 www.austsandmining.com.au	Mindijup	
Talc		
Imerys Talc Australia Pty Ltd 21 Glyde Street, Three Springs WA 6519 (08) 9954 1427 www.imerystalc.com	Three Springs	
Tantalum & Tin		
Global Advanced Metals Pty Ltd Level 3, Centrepoint Tower, 123B Colin Street, West Perth WA 6005 (08) 6217 2500 www.globaladvancedmetals.com	Greenbushes	

TABLE 11. Principal petroleum projects

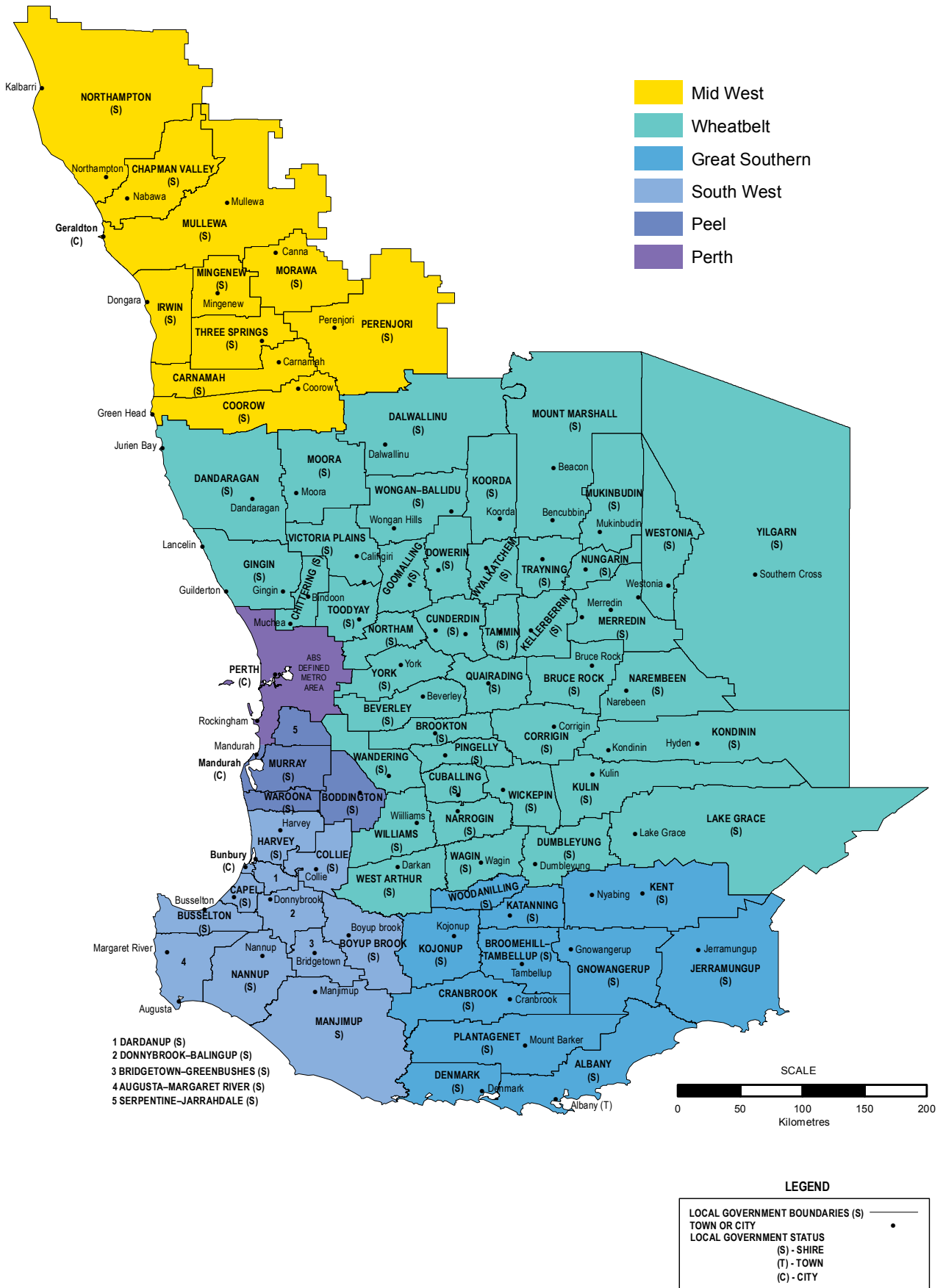
Operator	Project	Field(s)	Type	Area	Comments
Exxon Mobil	Athena	Athena	Gas and condensate	Offshore	
Chevron Corporation	Barrow Island	Barrow Island	Oil	Onshore	
Beach Energy	Beharra Springs	Redback, Redback South	Gas	Onshore	
ENI	Blacktip	Blacktip	Gas and condensate	Offshore	
Tamarind Management	Cliff Head	Cliff Head	Oil	Offshore	
Mitsui & Co	Dongara Area	Dongara	Gas	Onshore	
Woodside Petroleum	Enfield	Enfield, Vincent	Oil and gas	Offshore	Production from the Enfield field ceased on 7 November 2018.
Chevron Corporation	Gorgon	Jansz-Io, Gorgon	Gas and condensate	Offshore	
RMCA Group	Jingemina	Jingemina	Oil	Onshore	RMCA replaced Cyclone Energy as the operator of the project on 9 April 2018
INPEX Corporation	Ichthyis	Ichthyis	Gas and condensate	Offshore	Production commenced on 1 October 2018
BHP	Macedon	Macedon	Gas and condensate	Offshore	
Santos	Ningaloo Vision	Coniston, Novara, Van Gogh	Oil and gas	Offshore	Quadrant Energy was acquired by Santos in November 2018.
Woodside Petroleum	North West Shelf	Angel, Goodwyn, North Rankin, Persephone, Perseus, Searipple, Tidepole, Wanaea, Cossack, Hermes, Lambert, Dockrell, Keast, Lady Nora, Pemberton, Rankin, Sculptor	Oil, gas, and condensate	Offshore	Production from the Dockrell, Keast, Lady Nora, Pemberton, Rankin and Sculptor fields commenced on 24 October 2018. These fields were part of the Greater Western Flank Phase 2 project.
Woodside Petroleum	Pluto	Pluto, Xena	Gas	Offshore	

Operator	Project	Field(s)	Type	Area	Comments
Shell	Prelude	Prelude	Gas	Offshore	Production commenced on 26 December 2018
BHP	Pyrenees	Crosby, Moondyne, Ravensworth, Stickle	Oil and gas	Offshore	
Santos	Reindeer	Reindeer	Gas	Offshore	
Jadestone Energy	Stag	Stag	Oil	Offshore	
Buru Energy	Ungani	Ungani	Oil	Onshore	
Santos	Varanus Island	Agincourt, Bambra, Halyard, John Brookes, Lee, Rose, Spar	Oil, gas and condensate	Offshore	Production from the Rose field ceased on 31 December 2018. Quadrant Energy was acquired by Santos in November 2018.
Mitsui & Co	Waitsia	Waitsia, Xyris South	Gas	Onshore	
Vermillion	Wandoo	Wandoo	Oil	Offshore	
Chevron Corporation	Wheatstone	Iago, Wheatstone, Brunello	Gas and condensate	Offshore	Note that Woodside Petroleum operates the Brunello field.

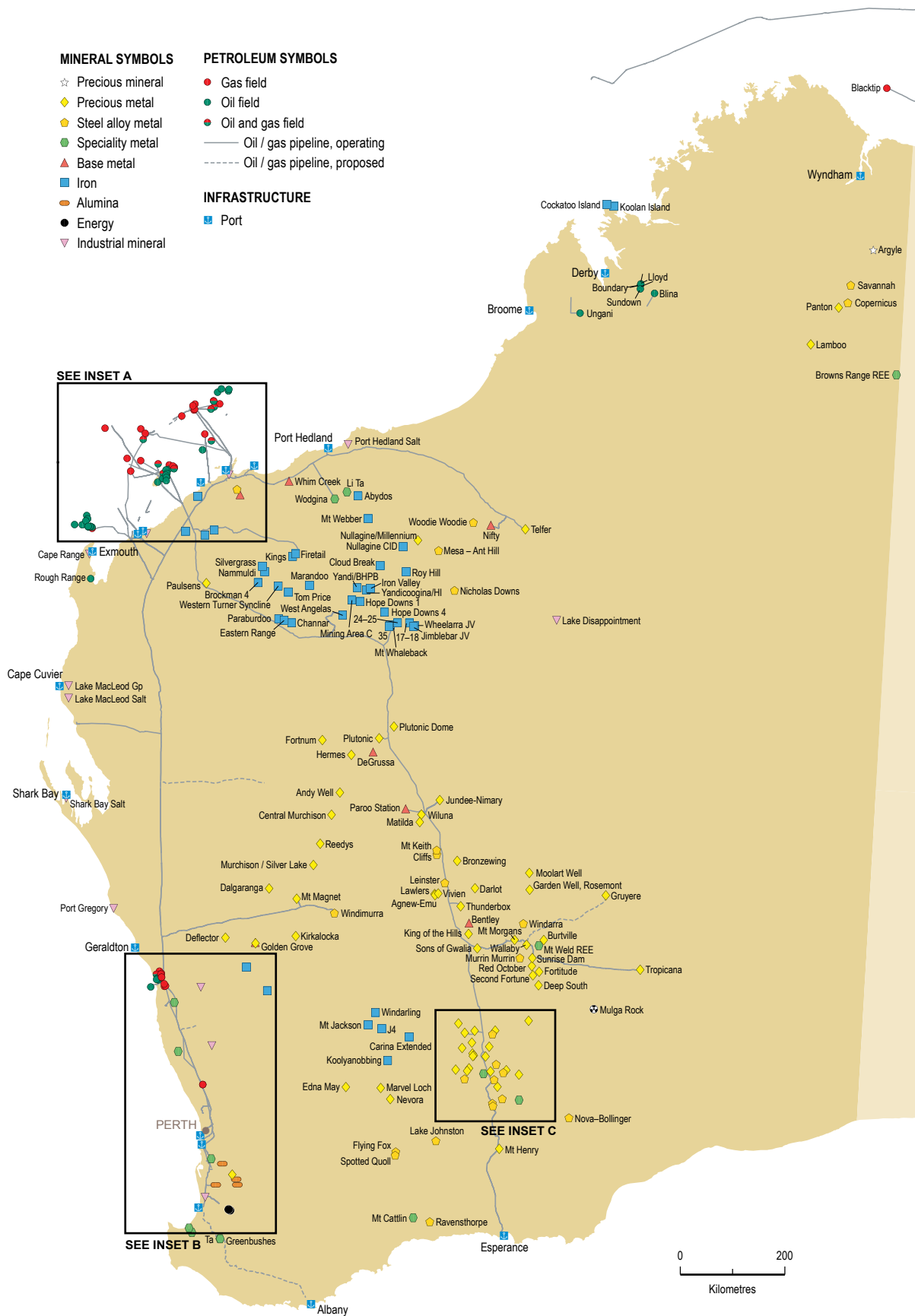
- Kimberley
- Pilbara
- Gascoyne
- Mid West
- Goldfields–Esperance
- Wheatbelt
- Great Southern
- South West
- Peel
- Perth



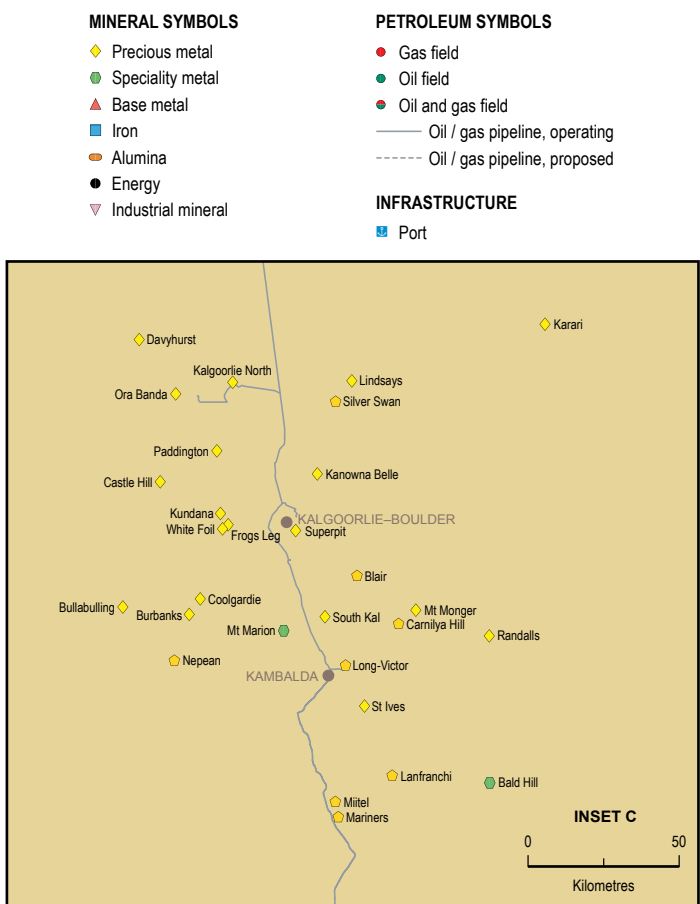
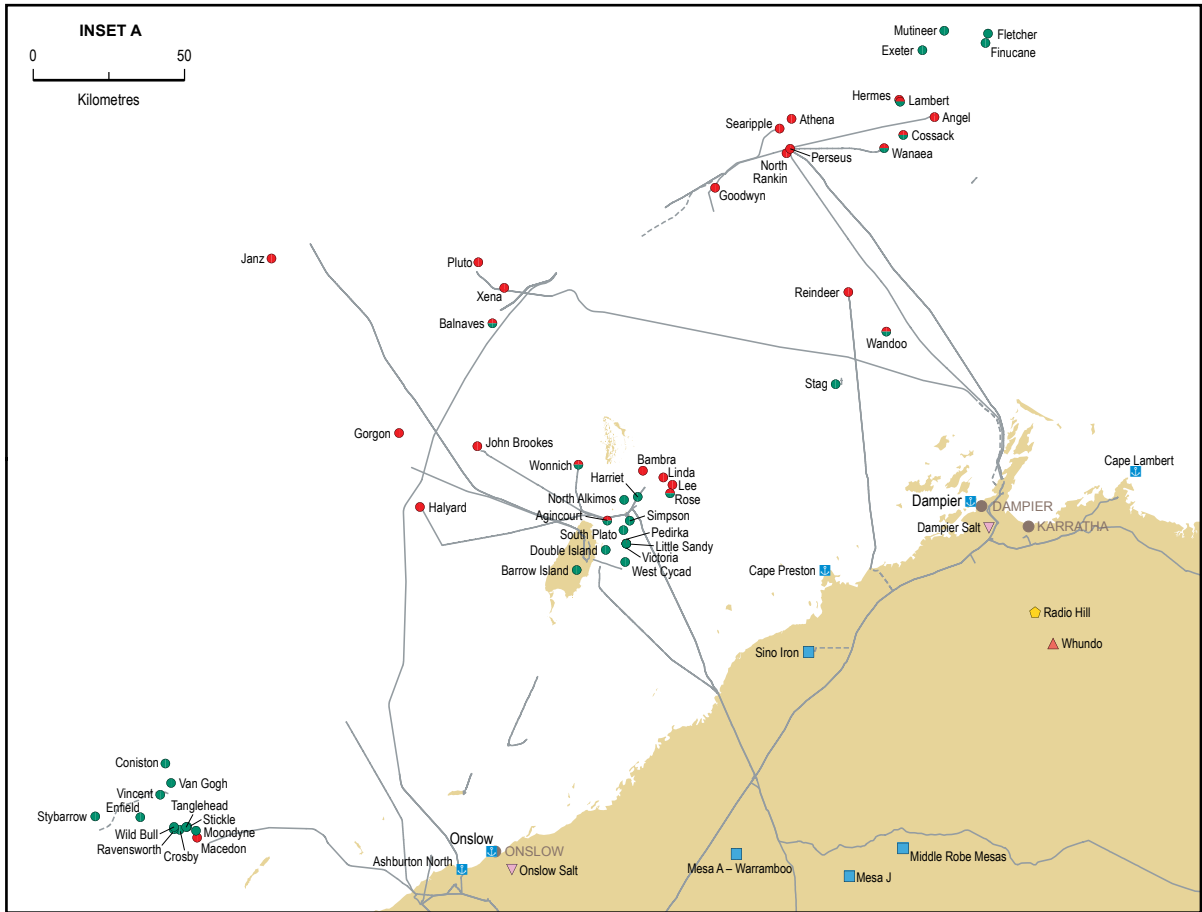
Map 1. Local Government and Regional Boundaries



Map 2. Local Government and Regional Boundaries Insert



Map 3. Major Mineral and Petroleum Projects in Western Australia



MINERAL SYMBOLS

- ◆ Precious metal
- Speciality metal
- ▲ Base metal
- Iron
- Alumina
- Energy
- ▽ Industrial mineral

PETROLEUM SYMBOLS

- Gas field
- Oil field
- Oil and gas field
- Oil / gas pipeline, operating
- - - Oil / gas pipeline, proposed

INFRASTRUCTURE

- Port

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

ABBREVIATIONS

A\$	Australian dollar	Mct	million carats
ABS	Australian Bureau of Statistics	Mha	million hectares
bbbl	barrels of oil	MMbbl	million barrels
bbbl/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	Mtpa	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
ha	hectares	PJ	petajoules
kl	kilolitres	RBA	Reserve Bank of Australia
km	kilometres	t	tonne
sq kms	square kilometres	tpa	tonnes per annum
kt	thousand tonnes	Tcf	trillion cubic feet
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

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