Commodity forecasts for Western Australia to 2030

A report for the
AUSTRALIAN ENERGY MARKET OPERATOR (AEMO)

Prepared by the
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Western Australian commodity forecasts

1. Introduction and background

This section presents commodity forecasts for selected commodity groups or types extending out 10 years to 2030 on a calendar year basis. The forecasts were prepared for Western Australia and for base, high and low scenarios.

1.1 Mineral resource production and COVID-19

Mining production across the world in 2020 has been adversely affected by the outbreak of the COVID-19 pandemic. Globally, there has been:

- limited impacts in Australia, the United States and the Commonwealth of Independent States (CIS economies); but
- more significant impacts in Latin America, Asia and the African continent.

The direct impact of COVID-19 includes mine closures in some countries such as Brazil (iron ore mines). In June 2020, Vale was ordered to close three mines following the outbreak of COVID 19 infections amongst its workforce.

In Australia, the impact of COVID-19 appears to have been limited, although many companies suspended exploration activities. State border restrictions have also required some mine operators to modify workforce arrangements, including securing accommodation for interstate employees.

The indirect impacts of the COVID-19 pandemic on minerals production in Australia and across the world is only starting to be played out. The intermediate and final demands for resource related products could fall sharply in some countries as construction and manufacturing activity declines.

The COVID-19 pandemic led to a sharp fall in some commodity prices in the March quarter 2020, although many had recovered somewhat by the June quarter 2020. The pandemic has certainly introduced more volatility into world commodity prices over 2020.

1.2 Commodity outlook scope of works

By 31 December each year, AEMO is required to publish a WA Gas Statement of Opportunities (GSOO). A significant proportion of Western Australian gas demand is driven by the outlook for commodity production for specific metals and minerals. AEMO therefore requires commodity production forecasts for its base, high and low gas demand forecasts.

Mining projects in Western Australia are usually located off the South West Interconnected System (SWIS), often in remote areas. Gas usage at these mines can include power generation for process use at the mine site and sometimes generation for the township of mine employees.

The commodity forecasts in this section are based on production for each commodity group or type. The commodity outlooks covered include the following:

- iron ore;
- alumina;
- gold;

- nickel;
- lithium;
- copper;
- zinc;
- lead;
- cobalt; and
- mineral sands.

The commodity production outlooks were forecast by considering the following:

- a consensus of commodity price outlooks;
- future project expansions/closures;
- world market developments and conditions;
- historical production/price movements;
- the impact of emerging new technologies; and
- the world, national and state economic outlooks, including impacts of COVID-19 as captured in NIEIR's economic forecast models.

The short-term outlooks for each commodity were largely based on expected levels of activity at existing and new mining projects. For the medium-term to long-term, the commodity production outlooks were shaped more by the world and Australian economic outlooks and trends within each respective commodity market.

Following a brief review of recent commodity production trends in Western Australia, the remaining sections discuss the outlook for each commodity. Forecasts of commodity production for the base, high and low scenarios to 2030 are presented at the end of this report.

2. Mining commodity production in Western Australia – value and quantities mined

Western Australia mining commodity production by type is shown in Table 1 for 2014-15 to 2018-19. These are reported as values in Australian dollars. The table also shows the percentage change in the value of each commodity produced between 2014-15 and 2018-19.

Table 1 Nominal value of Western Australian mining commodities produced – 2014-15 to 2018-19

	Value by year					Average per cent change 2014-15 to 2018-19 (%)	Per cent share 2018-19 (%)
	2014-15 (A$m)	2015-16 (A$m)	2016-17 (A$m)	2017-18 (A$m)	2018-19 (A$m)		
Iron ore	54376	48768	64319	62074	80545	10.3	53.9
LNG	13817	10765	12728	18921	29006	20.4	19.4
Gold	9107	10105	10860	11436	11958	7.0	8.0
Alumina	5023	4937	5074	6597	8212	13.1	5.5
Condensate	3529	2214	2229	3728	6678	17.3	4.5
Nickel	3170	2203	2095	2636	2700	-3.9	1.8
Crude oil	4568	3089	2112	2467	1976	-18.9	1.3
Spodumene	246	261	595	1699	1653	61.0	1.1
Natural gas	1820	1913	1830	1657	1613	-3.0	1.1
Copper metal	1283	1181	1241	1348	1320	0.7	0.9
Mineral sands	493	572	583	550	703	9.3	0.5
Cobalt	211	175	240	510	332	12.1	0.2
LPG – butane and propane	406	249	273	331	328	-5.2	0.2
Coal	307	336	338	332	319	1.0	0.2
Salt	375	336	292	303	304	-5.1	0.2
Zinc metal	197	195	204	324	263	7.5	0.2
Diamonds	342	354	268	250	182	-14.6	0.1
Construction materials	163	80	63	72	86	-14.9	0.1
Silver	96	105	98	105	85	-3.0	0.1
Lead metal	137	15	10	23	13	-44.1	0.0
Other commodities	609	438	411	813	1103	16.0	0.7
Total	**100272**	**88290**	**105864**	**116175**	**149379**	**10.5**	**100.0**

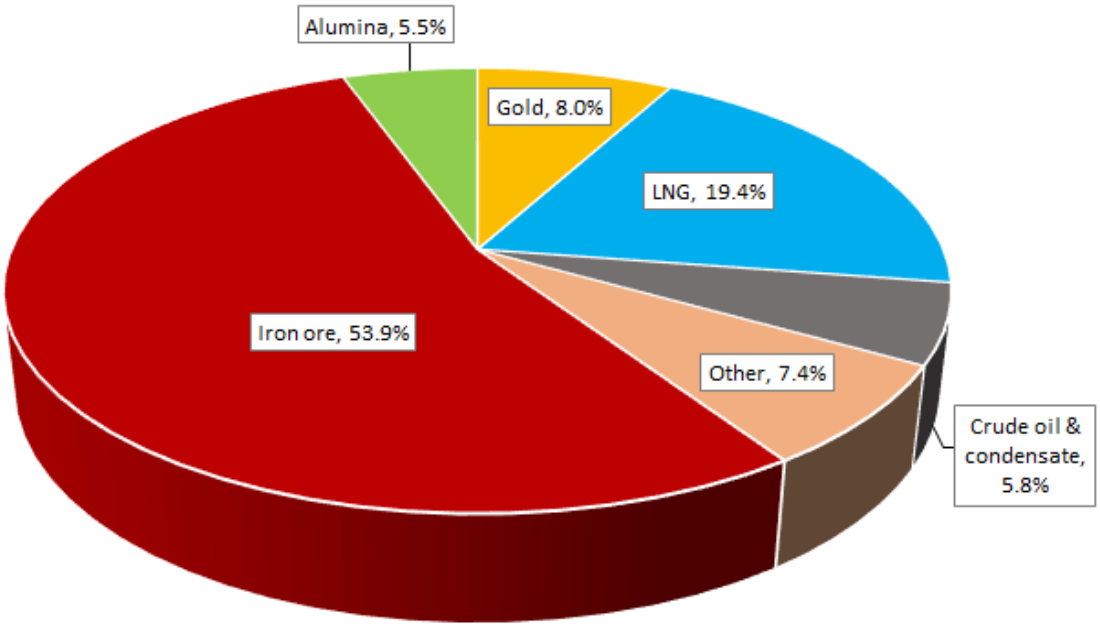
Source: Department of Mines, Industry Regulation and Safety, Western Australia (DMIRS (WA)), 2019, Major Commodities Resources Data.

The total value of mining commodities produced declined in 2014-15 and 2015-16, mainly reflecting a decline in commodity prices over this period. Rising actual production quantities for some commodities (such as iron ore) and improved prices led total Western Australian commodity production to reach AUS$1.5 billion in 2018-19.

Whilst Western Australia's overall mining commodity production is diverse, over 90 per cent of production values were concentrated in five groups in 2018-19. These were:

- iron ore (53.9 per cent);
- LNG (19.4 per cent);
- gold (8.0 per cent);
- alumina (5.5 per cent); and
- crude oil and condensate (5.8 per cent).

Figure 1: Value of commodity production, Western Australia, 2018-19 – Main commodities

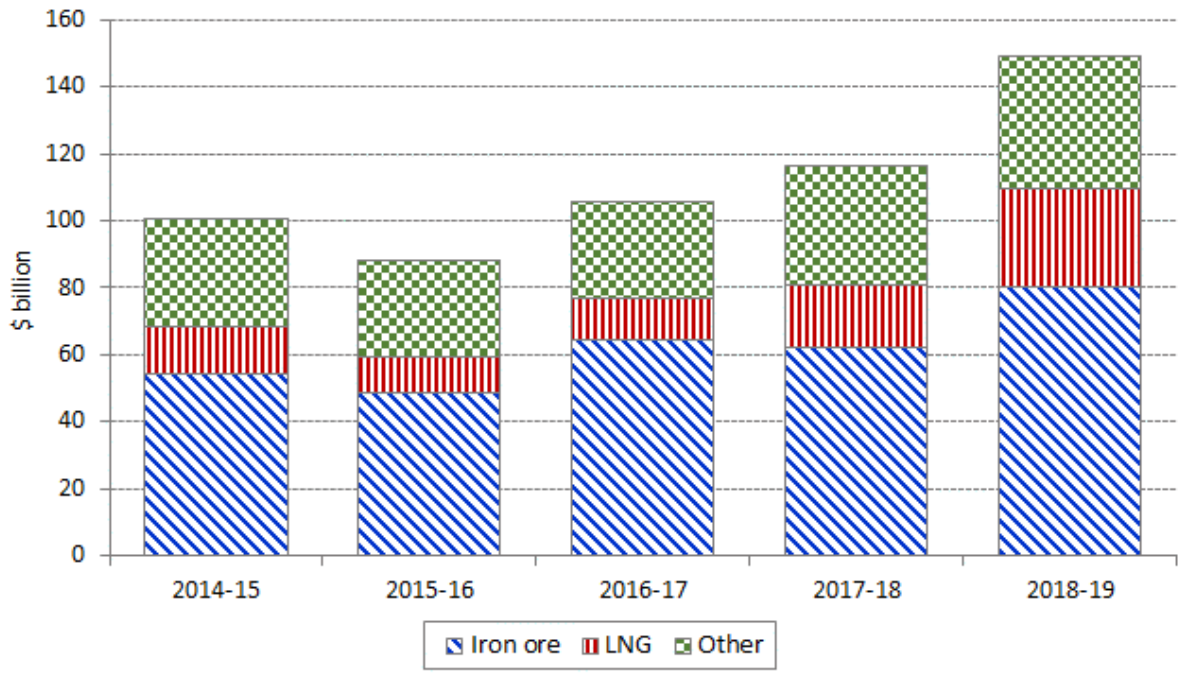


Source: DMIRS (WA), 2019, Major Commodities Resources Data.

In terms of the value of production, the fastest growing commodity production groups in Western Australia between 2014-15 and 2018-19 in terms of average per cent change per anum were:

- LNG (20.4 per cent);
- gold (7.0 per cent);
- alumina (13.1 per cent);
- spodumene(a Lithium ore mineral)-(61.0 per cent);
- cobalt (12.1 per cent);
- zinc (7.5 per cent); and
- iron ore (10.3 per cent).

Figure 2: Value of Western Australian mining commodities produced 2014-15 to 2018-19 ($ billion)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

The Australian dollar value of Western Australian mining commodities produced is often significantly impacted by commodity prices and the US$ exchange rate. The data in Table 1 does not give an accurate picture of the volume of Western Australian commodity production, which, notwithstanding a fall in crude oil and condensate production, has increased significantly over recent years. In volume terms, crude oil and condensate production in Western Australia peaked in 2010, however has declined since then. The iron ore price peaked in 2011, but fell sharply until 2015. This had a significant impact on Western Australian production values for iron ore over this period.

Table 2 shows quantities of mining commodities produced in Western Australia by type from 2010-11 to 2018-19. As indicated in Table 2, there have been some large production increases over the last eight years in Western Australia. These include the following commodities:

- iron ore (9.0 per cent per annum);
- gold (1.8 per cent per annum)
- LNG (12.3 per cent per annum)
- silica-sand (11.0 per cent per annum); and
- spodumene (21.6 per cent per annum).

Table 2 Quantities of principal mining commodities produced in Western Australia – 2010-11 to 2018-19											
	Unit	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Average % change 2010-11 to 2018-19
Alumina	kt	12281	12425	13531	13718	13771	13894	13855	13669	13643	1.3
Copper metal	kt	150	159	209	211	184	190	171	174	162	1.0
Lead metal	kt	41	7	17	79	59	6	4	7	5	-23.4
Zinc metal	kt	71	64	56	54	78	83	83	93	71	0.2
Coal	kt	7234	6986	7494	6275	6553	6891	6806	6680	6275	-1.8
Aggregate	kt	1935	3722	4391	2155	1964	1314	1053	1237	1504	-3.1
Gravel	kt	231	284	561	52	173	177	261	155	156	-4.8
Rock	kt	298	510	1110	403	1747	220	412	267	260	-1.7
Sand	kt	4818	6287	5416	3797	5659	3435	2581	4099	2029	-10.2
Diamonds	ct '000	10122	8690	9609	11611	10388	13870	12607	15281	11150	1.2
Gem & semi-precious stones	kt	292	228	198	310	721	243	335	204	129	-9.7
Gold	kg '000	184	181	180	196	193	196	203	221	212	1.8
Gypsum	kt	587	334	1576	533	577	552	531	896	988	6.7
Garnet	kt	227	302	317	357	299	251	566	380	388	7.0
Ilmenite	kt	394	332	271	79	100	175	179	120	225	-6.8
Leucoxene	kt	26	22	29	29	17	18	7	14	15	-6.5
Rutile	kt	50	39	47	65	30	46	22	21	24	-8.8
Zircon	kt	299	180	216	212	183	192	185	73	134	-9.5
Iron ore	kt	397604	454385	511760	623507	718806	748100	792985	839424	794652	9.0
Limesand-limestone-dolomite	kt	3721	4158	4092	3117	4903	4446	4178	3943	4305	1.8
Manganese ore	Kt	873	846	650	712	801	425	237	379	573	-5.1
Cobalt	T	3767	4950	6200	6236	6036	5479	4759	5200	5228	4.2
Nickel	Kt	194	209	227	233	183	176	158	163	154	-2.8
Palladium and platinum by-product	kg	440	626	658	1015	464	687	783	645	512	1.9
Condensate	Kt	6882	5889	6117	4399	6753	6775	6038	7114	11730	6.9
Crude oil	kl '000	13925	11122	8609	6867	7952	7686	5404	4877	3245	-16.6
LNG	kl '000	17290	15611	19805	19826	20448	20956	28685	37894	43635	12.3
LPG – butane and propane	Kt	924	835	753	390	553	532	527	451	447	-8.7
Natural gas	million m3	8981	9081	8714	8218	9875	10224	9709	10175	10410	1.9
Salt	Kt	12247	12807	12390	12992	11727	10975	10874	12964	11729	-0.5
Silica – silica sand	Kt	430	453	498	450	484	582	729	974	992	11.0
Silver	kg '000	84	120	124	137	151	155	143	163	130	5.7
Spodumene	Kt	352	461	486	342	489	466	914	2138	1688	21.6

Source: DMIRS (WA), 2019, Major Commodities Resources Data.

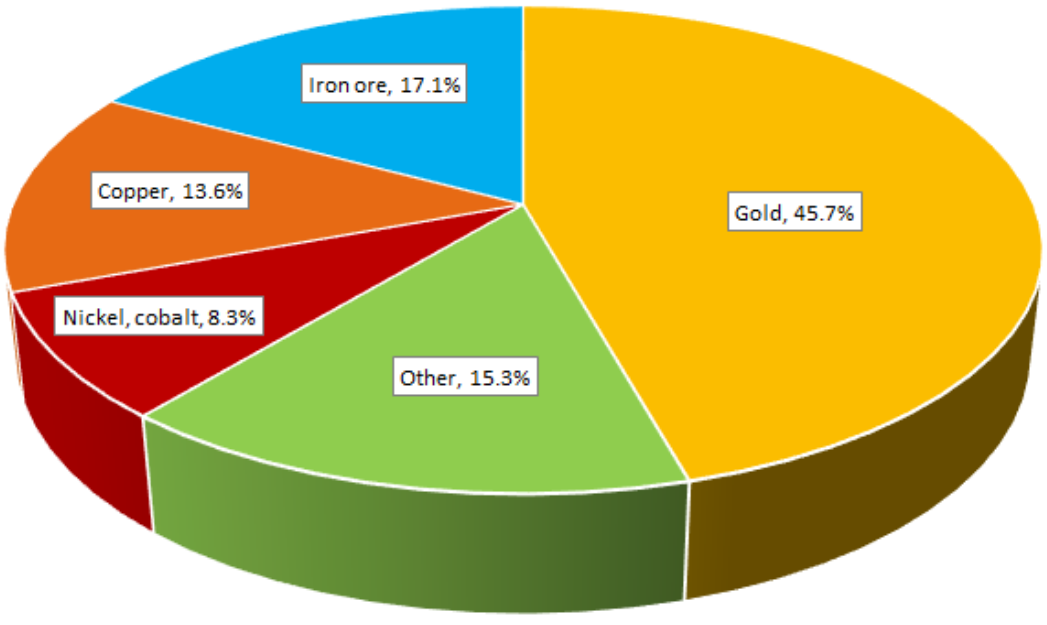
Australian metals and other minerals private exploration expenditure over the last 10 years is shown in Table 3. During the previous mining boom, exploration expenditure reached nearly A$3 billion in 2011-12. There was a significant fall in expenditure on exploration in Australia between 2012 and 2017. In 2015-16 exploration expenditure was only $1.2 billion.

With the increase in base metals prices over 2018 and 2019, exploration expenditures have risen quite significantly in Australia. Compared to 2016-17, large increases in Australian exploration expenditure occurred for copper, gold, nickel, cobalt, lead, silver, zinc and for mineral sands. Iron ore exploration expenditure has remained flat at around $300 million per year since 2015-16. Total exploration expenditure in Australia was $2.5 billion in 2019-20. Gold exploration over the last five years has accounted for 46 per cent of total Australian private metals and other mineral exploration expenditure.

Table 3	Australian metals and other minerals private exploration expenditure, Australia 2008-09 to 2019-20 ($ million)								
	Copper	Diamonds	Gold	Iron ore	Mineral sands	Nickel, cobalt	Silver, lead and zinc	Other	Total metals and other minerals
2008-09	179	10	438	589	31	260	81	154	1741
2009-10	202	4	575	524	16	204	52	166	1742
2010-11	323	1	652	665	6	271	76	224	2218
2011-12	443	3	768	1151	20	265	88	227	2965
2012-13	319	6	662	1011	38	165	80	161	2442
2013-14	177	8	434	711	21	99	46	170	1666
2014-15	144	5	396	448	27	83	52	131	1286
2015-16	130	4	548	291	20	51	50	115	1209
2016-17	136	2	689	291	20	81	55	150	1423
2017-18	193	8	810	292	27	200	103	177	1811
2018-19	329	9	967	324	36	203	89	195	2151
2019-20	450	6	1138	352	36	216	69	222	2490
5 year average	248	6	830	310	28	150	73	172	1817
Per cent share	13.6	0.3	45.7	17.1	1.5	8.3	4.0	9.5	100.0

Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

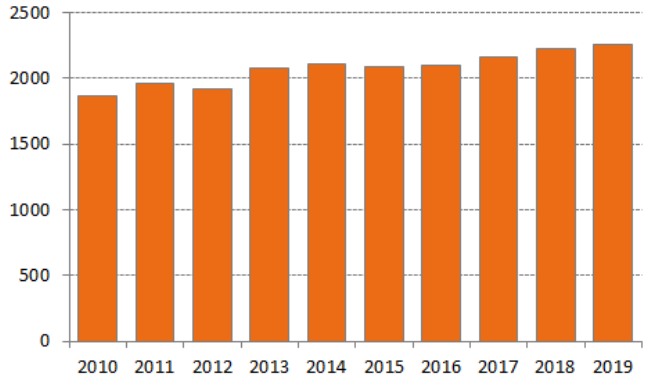
Figure 3: Australian minerals exploration expenditure – percentage share by group, 2019-20 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

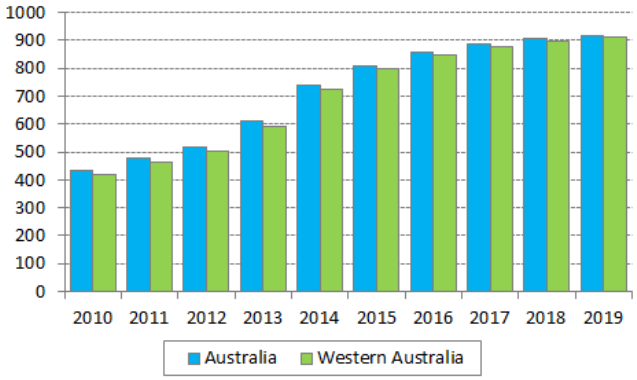
3. Iron ore

Figure 4: Iron ore production – World (Mt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 5: Iron ore production – Australia and Western Australia (Mt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

World iron ore production in 2019 was 2,258 million tonnes. Production of iron ore in Australia in 2019 was 918.7 million tonnes, or just under 41 per cent of total world production.

The other major producers of iron ore are Brazil (19.3 per cent, 2018) and China (13.6 per cent, 2018). The spread of COVID-19 in Brazil has led Miner Vale to close some of its mining operations in 2020. Iron ore prices rose to US$110 per tonne in mid-July 2020. Brazil is the second largest producer of iron ore in the world, and also exports huge volumes to China. With the rapid recovery in China post COVID-19, Australia has temporarily taken market share from Brazil.

Iron ore is mainly used for steel production. Steel is used in the following applications:

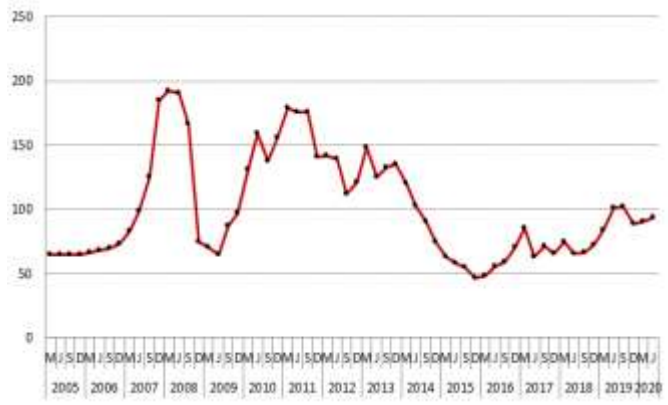
- building and engineering infrastructure;
- mechanical equipment and the automotive sector; and
- other transport, domestic appliances and electrical equipment.

The largest producer of steel in the world is China, which produced 996.3 million tonnes in 2019. China's production represented 53.3 per cent of world steel production in 2019 (World Steel Association, World Steel Figures 2020). In 2019, Australian exports of iron ore to China represented 82.3 per cent of total Australian iron ore exports.

Australia has large reserves of iron ore located mainly in the Pilbara region of Western Australia.[1] In 2018, accessible Economic Demonstrated Reserves (EDR) were some 49.6 billion tonnes, around 30 per cent of total world reserves of iron ore. Australian reserves have increased steadily since 2010.

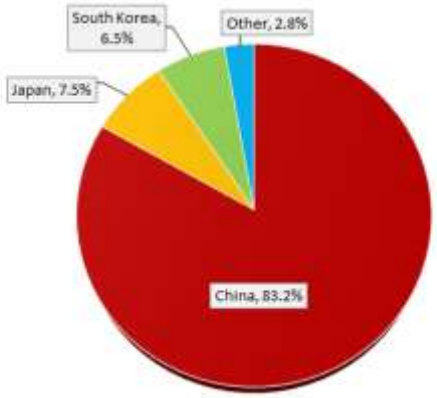
[1] Geoscience Australia, Australia's Identified Mineral Resources, 2019, Table 1, p. 10.

Figure 6: Iron ore nominal price ($/dmtu)



Source: World Bank, August 2020.

Figure 7: Percentage share of Australian iron ore exports by destination, 2019 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Australia's major producers of iron ore are BHP Ltd, Rio Tinto Ltd and Fortescue Metal Group Ltd, all located in Western Australia's Pilbara. Production of iron ore has increased substantially over recent years in Australia, mainly reflecting exports, especially to China. Ore production increased from 432.7 million tonnes in 2010, to 809.9 million tonnes in 2015, to 918.7 million tonnes in 2019. All three producers, encouraged by some strengthening in the iron ore price, have recently embarked on expansions and new developments.

The iron ore price has risen steadily over the last five years from around $58 in June 2015 to nearly $95 in June 2020. This is against the backdrop of expansions and new developments by Australia's major iron ore producers. Chinese demand for iron ore for steel making has been resilient. The price has been partly supported by supply disruptions in Brazil since 2019, including the tailings dam collapse and now in 2020 with the outbreak of COVID-19.

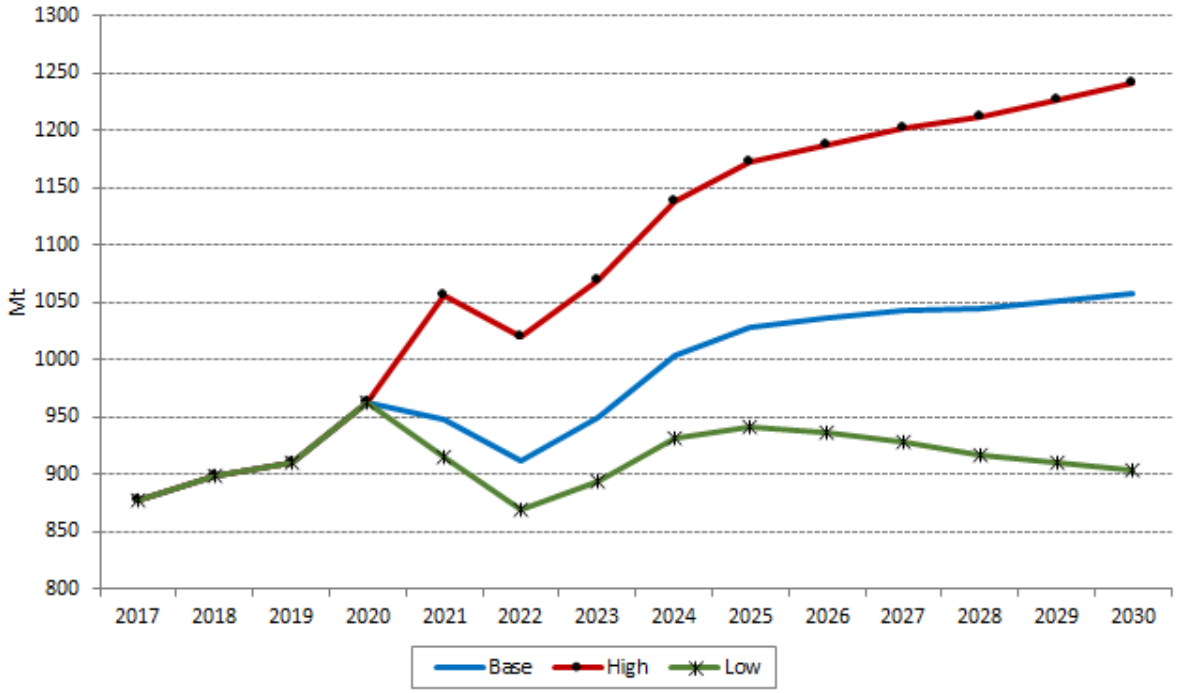
Iron ore exports from Australia in 2019 were valued at $96.1 billion, representing the largest resource export of Australia and 57 per cent of the total value of resource exports. In volume terms, iron ore exports from Australia were 835.5 million tonnes in 2019, compared to only 401.9 million tonnes in 2010. China accounted for 83.2 per cent of these exports in 2019.

Australian iron ore production is expected to increase in 2023 and 2024 as Australia's major producers expand capacity. Major projects include BHP's South Flank deposit by 2021, Fortescue's Eliwana mine and rail project, Fortescue's Iron Bridge project and Brockman's Marillana mine near Newman. Excluding the South Flank deposit, the Eliwana, Iron Bridge and Marillana mines will add nearly 60 million tonnes to capacity by 2022. The South Flank deposit will mainly replace the BHP Yandi mine as it depletes over the mid-2020s.

Aside from the short-term outlook for iron ore, the ongoing impact of COVID-19 on the world economy is likely to flatten the outlook for steel production and iron ore production in Australia. This will depend, in part, on whether governments across the world are able to fund stimulus packages in engineering and non-residential construction. By 2022, there is a risk that Brazil regains some market share of exports to China as impediments to mine production are removed in Brazil.

Figure 8 shows the forecasts for iron ore production for Western Australia to 2030 by scenario.

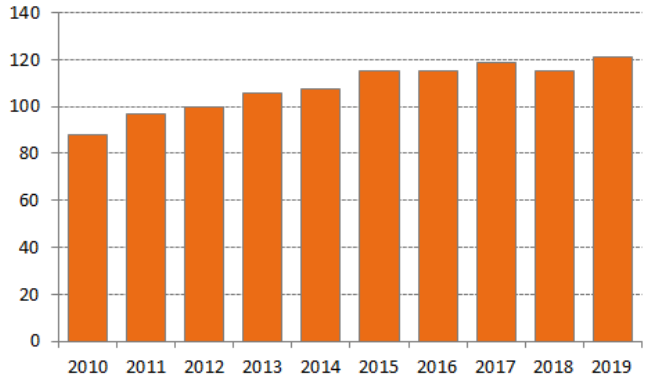
Figure 8: Western Australian iron ore production to 2030 by scenario (Mt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

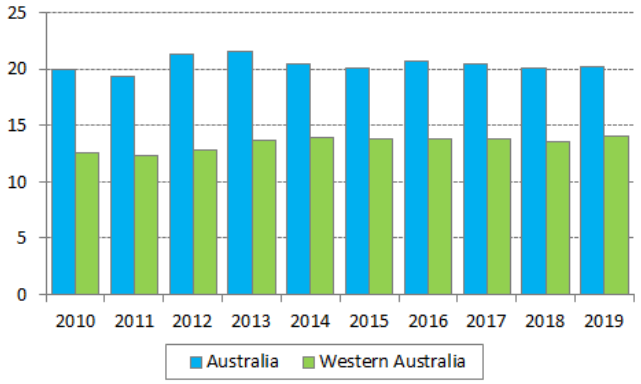
4. Alumina

Figure 9: Alumina production – World (Mt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 10: Alumina production – Australia and Western Australia (Mt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

World alumina production in 2019 was 121 million tonnes. World production has expanded slowly since 2010, from 88 million tonnes in 2010 to 115 million tonnes in 2015 and to 121 million tonnes in 2019. Australian production of alumina in 2019 was 20.2 million tonnes, or around 17 per cent of world production.

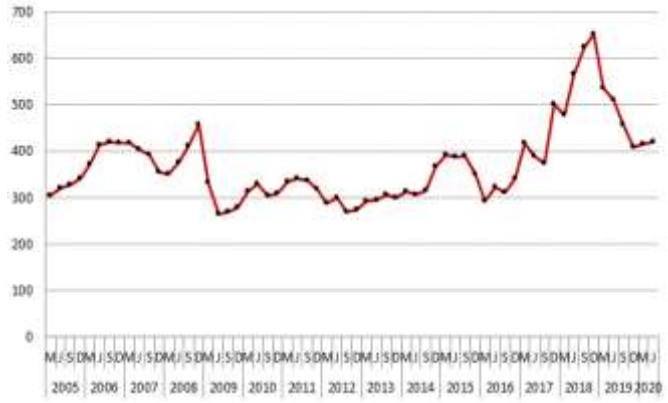
Alumina is a refined product made from bauxite, which is mined in Western Australia, Queensland and the Northern Territory. Alumina is then refined into aluminium. The alumina and aluminium refinery industries are both very energy intensive. Aluminium is a light-weight metal that is extensively used in transport applications (e.g. aircraft), construction and packaging applications. Western Australia has an established alumina refining industry but at this stage has no aluminium smelting industry.

Australia is the largest producer of bauxite in the world, accounting for 30 per cent of total world production in 2018. Australia has 17 per cent of world reserves of bauxite. An increasing share of bauxite ore is being exported from Australia rather than being refined into alumina. Exports of bauxite represented 12 per cent of production in 2010. By 2019, mine exports of bauxite were over 37 per cent of total Australian production.

Australian production of alumina has remained relatively flat since 2010 at around 20 million tonnes. Plant expansions in Western Australia and Queensland have been offset by the closure of Rio Tinto's Gove alumina plant in 2014 in the Northern Territory.

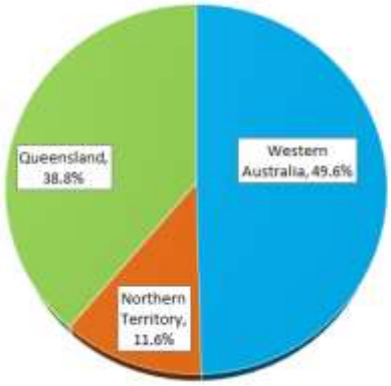
Australian exports of alumina in 2019 were valued at some A$8.5 billion. This represents a significant improvement on export values in 2010 of A$5.2 billion and 2015 values of A$6.6 billion. The increase in export values in 2019 largely reflect prices movements, rather volume increases in exports. Export volumes in 2019 from Australia were 17.8 million tonnes, around 88 per cent of Australian production.

Figure 11: Alumina export value (A$/t)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 12: Shares of Australian bauxite production by State, 2019 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020

Production of alumina in Australia is concentrated in Western Australia and Queensland. Queensland has major alumina refineries in Gladstone (Queensland Alumina Ltd) and Yarwun (Rio Tinto) located close to Gladstone. Total alumina refining capacity in Queensland is some 7.4 million tonnes. Western Australia, however, has four major alumina refineries located in the South West, namely:

- Kwinana (Alcoa, 2.2 mt);
- Pinjarra (Alcoa, 5.0 mt);
- Wagerup (Alcoa, 2.6 mt); and
- Worsley (South 32, 4.7 mt).

Total alumina refining capacity in Western Australia in 2020 is some 14.5 million tonnes per annum. Refinery production of alumina in 2019 was just over 14 million tonnes, so relatively close to nameplate capacity.

Export prices for Australian alumina rose sharply over 2017 and 2018, rising from around A$320 per tonne to over A$650 per tonne in December 2018. Since this peak, however, alumina prices have fallen by over 35 per cent and were A$420 per tonne in the June quarter 2020.

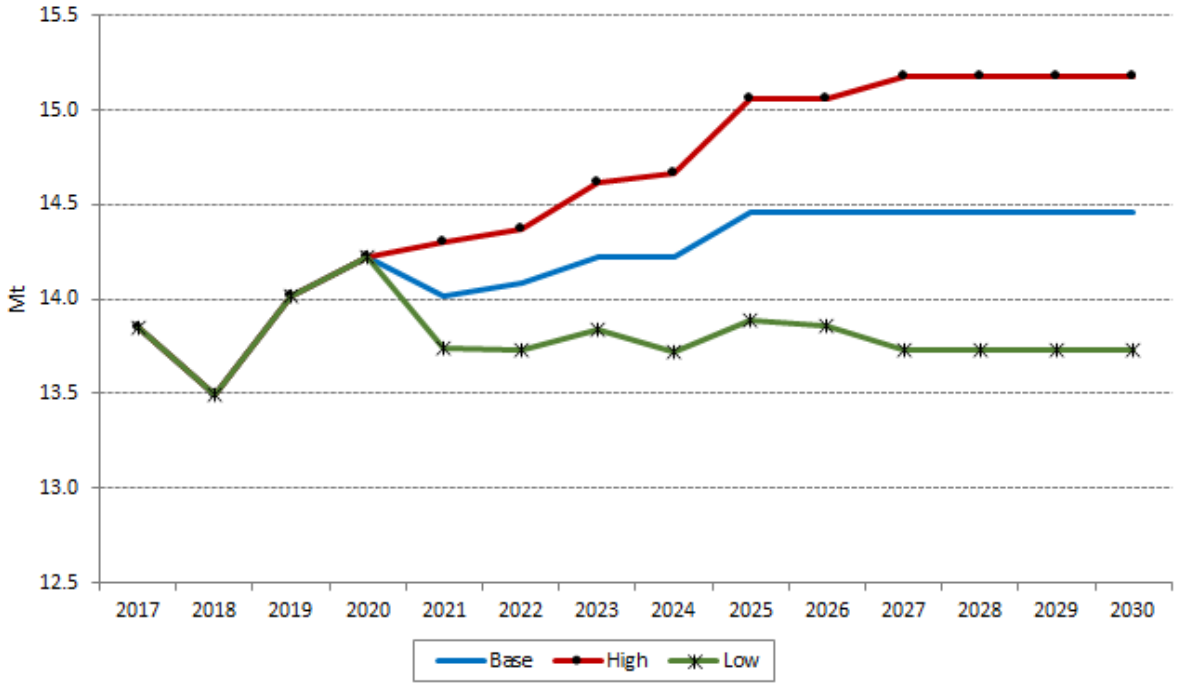
Alcoa Australia was reported to have deferred expansion plans for Pinjarra and Wagerup alumina refineries in April 2020. Applications with Western Australia's Environmental Protection Authority include:

- an expansion in Pinjarra from 5.0 to 5.25 million tonnes per annum; and
- an expansion of Wagerup to 3.3 million tonnes and then to a maximum capacity of 4.7 million tonnes per annum.

The expansion to 4.7 million tonnes at Wagerup refinery would require construction of a third production unit on the site. The expansion at Wagerup is included in the high scenario, however, beyond 2024.

Figure 13 shows the forecasts for alumina production for Western Australia to 2030 by scenario.

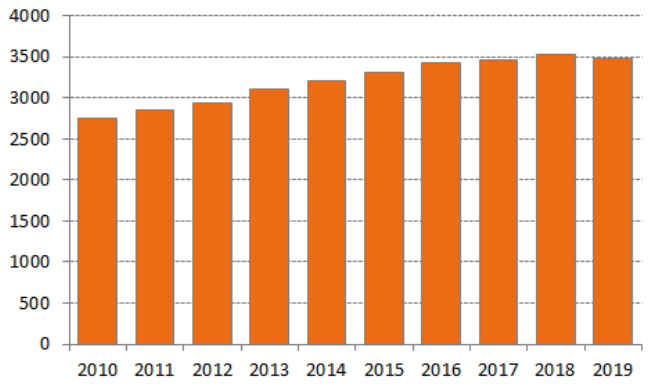
Figure 13: Western Australian alumina production to 2030 by scenario (Mt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

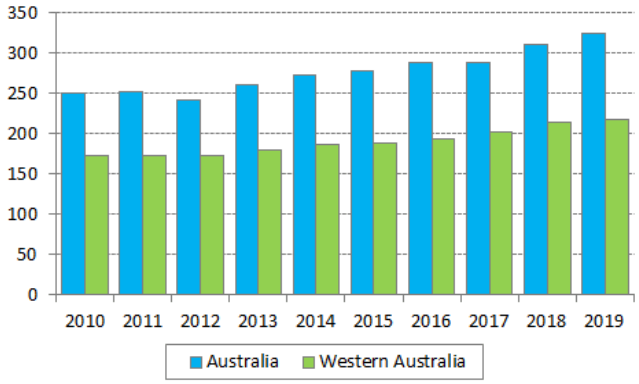
5. Gold

Figure 14: Gold production – World (tonnes)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 15: Gold production – Australia and Western Australia (tonnes)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

World production of gold in 2019 was 3,480 metric tonnes, a similar volume of production to 2018. World gold production has increased by 731 metric tonnes, or 27 per cent, since 2009. In 2018, the largest gold producers in the world were China (12 per cent), Australia (9 per cent), Russia (8 per cent) and the United States (7 per cent).[2]

The gold price rose sharply over 2020, reflecting the impact of the COVID-19 pandemic. Interest rate cuts have driven bond yields lower, encouraging investment into gold and driving up the gold price. The gold price reached a high of US$2,072 per ounce in August 2020, compared to only US$1,479 per ounce in December 2019. The average price of gold over 2019 was US$1,392 per ounce. Speculative activity has also driven up the gold price, with huge profit taking in August 2020 leading to the gold price falling by 5 per cent to US$1,910 per ounce.

The high gold price throughout the COVID-19 pandemic will support increased mine production over 2020 and 2021. As the world economy recovers from the pandemic, gold prices are expected to ease backwards.

Australian gold reserves in 2018 were 10,165 metric tonnes, 19 per cent of total world reserves of gold.[3] Gold resources in Australia are concentrated in Western Australia (44 per cent), New South Wales (16 per cent) and South Australia (25 per cent).

Gold is a precious metal as well as being a very rare metal. Gold is used in jewellery (50 per cent), coins and bars (20 per cent), by central bank reserves as currency support, and in electronics, industrial and medical applications.

Gold exports from Australia in 2019 were valued at A$23.3 billion. In 2018-19, gold accounted for 13 per cent of the value of Australia's mineral exports. In 2019, refined and unrefined gold bullion exports went to the United Kingdom (50 per cent), Hong Kong China (18 per cent), China (14 per cent) and Singapore (8 per cent). Refined gold in Australia is processed by the Perth Mint. The Perth Mint refinery can process up to 800 tonnes of gold per annum from gold sourced from Australia and Asia.

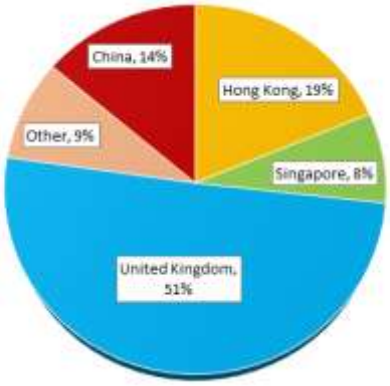
[2] World Bank Statistics, 2020.

[3] Geoscience Australia, Australia Identified Mineral Resources, 2019, p. 10.

Figure 16: Gold nominal price (US$/troy oz)

Source: World Bank, August 2020.

Figure 17: Percentage share of Australian gold exports by destination, 2019 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Australian gold production was 323 metric tonnes in 2019, 9.3 per cent of world production. Since 2009, Australian gold production has increased by 73 metric tonnes, or nearly 30 per cent. Western Australian gold production was 218 metric tonnes in 2019, or 67 per cent of total Australian production.

In Western Australia, gold mines are located around Kalgoorlie, as well as mines in the Pilbara region and South of Perth. In South Australia, BHP's Olympic Dam is the major producer, with 145,972 ounces produced in 2019-20. In New South Wales, the Cadia mine near Orange, operated by Newcrest, produced 843,338 ounces in 2019-20. Newcrest also operates the Telfer mine in Western Australia which produced 393,164 ounces in 2019-20. Newmont's Boddington mine in Western Australia is one of Australia's largest gold mines. It produces both copper and gold. In 2019, Newmont's Boddington mine produced 703 koz of gold. Other major mines in Western Australia are the Super Pit at Kalgoorlie and the Tropicana Gold mine. The super pit is owned by Northern Star Resources and Saracen Mineral Holdings who are joint owners of Kalgoorlie Consolidated Gold Mines.

The high gold price throughout the COVID-19 pandemic will undermine a significant expansion in gold production in Australia and Western Australia in 2021 and 2022. There are a large number of proposed expansions and new gold mine developments proposed in Western Australia, New South Wales and Queensland. Significant expansions have been proposed at the Cadia mine in New South Wales and the Super Pit in Kalgoorlie.

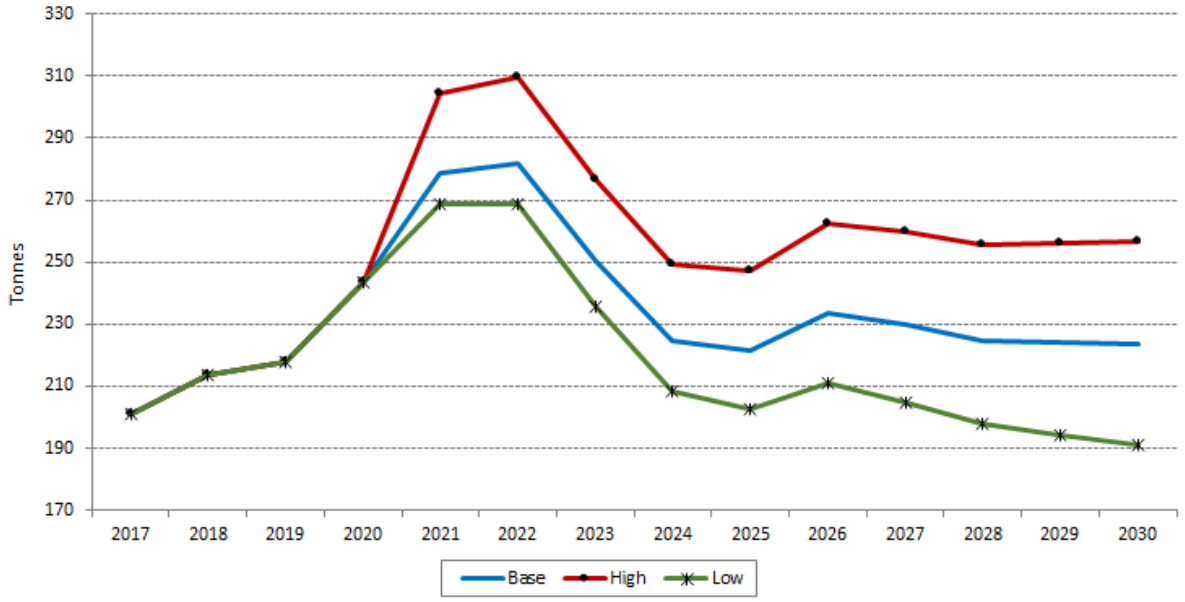
Post 2022, an expected fall in the gold price will lead to a sharp fall in world and Australian production of gold. Under the base scenario, Western Australian production falls by 31 tonnes in 2023.

Amongst some of the gold projects proposed in Western Australia, include:

- St Barbara's Gwalia extension with capacity of 255 koz;
- the Gold Pike cutback proposed by Kalgoorlie Consolidated Gold Mines with a total resource estimated at around 2.2 million ounces; and
- Capricorn Metals Karlawinda mine which will have a capacity of 97 koz.

Figure 18 shows the forecasts for gold production for Western Australia to 2030 by scenario.

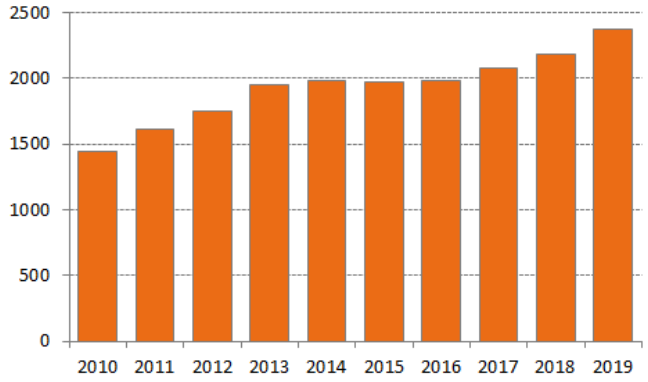
Figure 18: Western Australian gold production to 2030 by scenario (tonnes)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

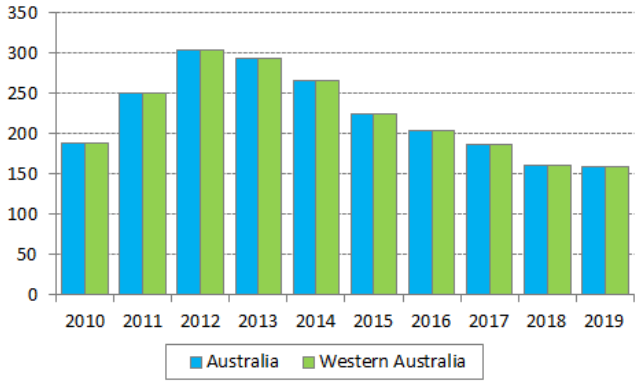
6. Nickel

Figure 19: Nickel production – World (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 20: Nickel production – Australia and Western Australia (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

In 2019, world nickel mine production was 2.4 million tonnes. World production has increased from 1.4 million tonnes in 2010, to 2.0 million tonnes in 2015, and to 2.4 million tonnes in 2019. The five largest producers of nickel by country in 2018 were:

- Indonesia (24.2 per cent);
- Philippines (15.3 per cent);
- Russia (9.7 per cent);
- New Caledonia (9.6 per cent); and
- Canada (8.0 per cent).

Australia was ranked the 6th largest producer in the world in 2018.

Nickel production in Australia was 150 kt in 2019, some 30 per cent below the production levels in 2015. This partly reflects lower nickel prices and lower export volumes. All Australian nickel mined is in Western Australia. In 2018, Geoscience Australia estimated that 91 per cent of Australia's nickel reserves are in Western Australia.[4] Nickel reserves in Australia in 2018 were some 19.7 million tonnes, or 22 per cent of world reserves.

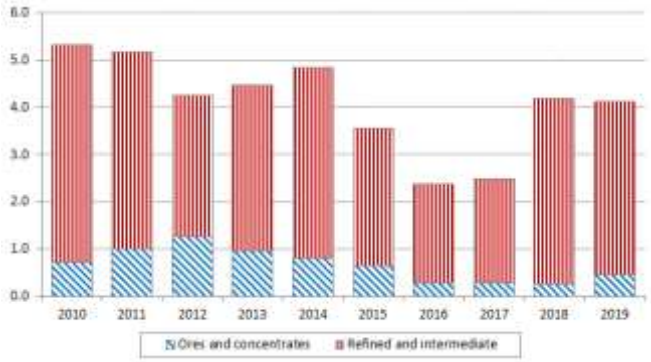
The largest uses for nickel are in stainless steel (e.g. cutlery), coinage, batteries and as a component in metal alloys. Nickel is mixed with other metals and used extensively by industries, such as construction, motor vehicles, household goods and medical and scientific equipment. The most positive element in the outlook for nickel is in the growing demand for nickel sulphate in batteries.

[4] Australia's Identified Mineral Resources 2019, Geoscience Australia, p. 10.

Figure 21: Nickel nominal price (US$/tonne)

Source: World Bank, August 2020.

Figure 22: Australian nickel exports by class (A$ billion)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

The largest producer of nickel in Australia is BHP's Nickel West. Nickel West's operations in Western Australia encompasses the following:

- ore mine at Mt Keith open cut and ore from the underground Cliffs and Leinster mines;
- a concentrator and dryer at Leinster as well as a concentrator at Kambalda which processes ore from third parties;
- a smelter at Kalgoorlie which converts nickel concentrate to nickel matte; and
- a nickel refinery in Kwinana which converts nickel matte into premium grade nickel powder and briquettes.

Over 75 per cent of Nickel West's output is now sold to global battery material suppliers. BHP is also building a 100 kt nickel sulphate plant in Kwinana which will be used in lithium-ion batteries that power electric vehicles (due to be commissioned in 2020).

Australian exports of nickel were A$4.1 billion in 2019. Around 90 per cent of Australian exports are refined and intermediate nickel, with the remaining 10 per cent representing ores and concentrates.

Post-2022, nickel production in Australia is expected to increase reflecting stronger world growth and increasing demands from batteries. Nickel West commissioned the Yakabindie mine in early 2020, with a capacity of 50 kt.

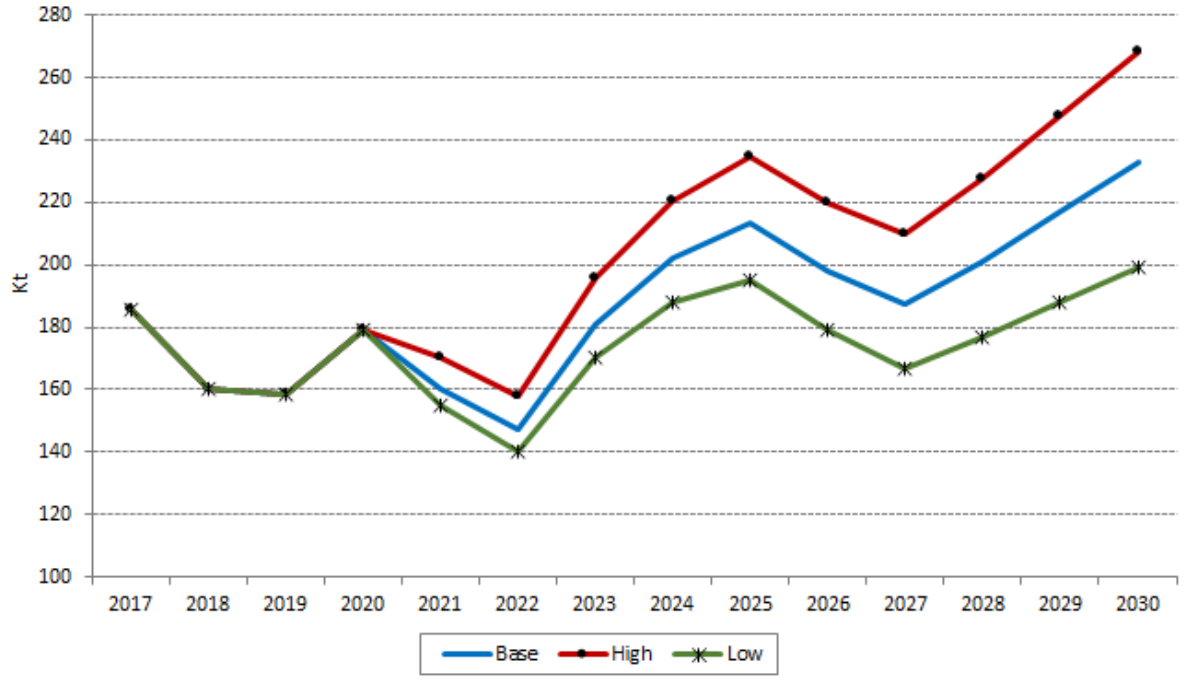
First Quantum also re-commissioned the Ravensthorpe mine in Western Australia in the first half of 2020. The re-commissioning of Ravensthorpe could add up to 20 kt of nickel ore per year. Poseidon Nickel has a number of mines under care and maintenance.

Mincor is also considering re-commissioning the Cassini, Durkin North and Long mines. A final investment decision is expected by September 2020.

The COVID-19 pandemic is, however, expected to have a material impact on world production of products that use nickel. World nickel prices fell by 20 per cent between December 2019 and June 2020. Australian nickel mine re-starts could be scaled back over 2020-21. Nickel production rises strongly between 2022 and 2025, however, increasing stocks and falling nickel prices lead to a reduction in nickel production in 2026 and 2027.

Figure 23 shows the forecasts for nickel production for Western Australia to 2030 by scenario.

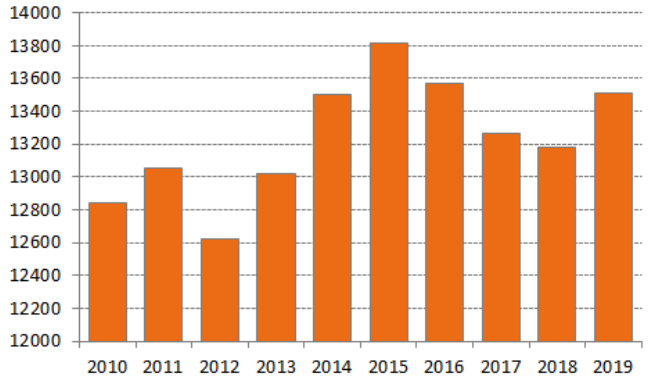
Figure 23: Western Australian nickel production to 2030 by scenario (kt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

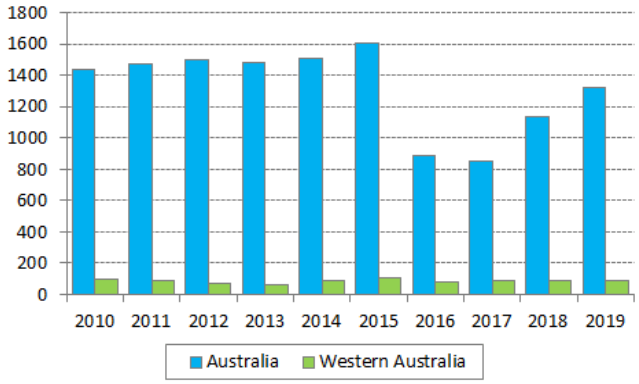
7. Zinc

Figure 24: Zinc production – World (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 25: Zinc production – Australia and Western Australia (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

World zinc production in 2019 was 13.5 million tonnes, up from around 13.2 million tonnes in 2017 and 2018. In 2018, Australia was ranked the third largest zinc producer in the world at 8.8 per cent, behind China (33 per cent) and Peru (12 per cent).[5] Australia, however, has the largest share of world zinc resources at 29 per cent in 2018.[6]

Australian zinc production in 2019 was 1,325 kt. Up until 2015 mine closures led to Australian production falling from 1,610 kt in 2015 to 885 kt in 2016. Mine closures were at the Century and Mt Isa deposits in Queensland and Glencore also cut production in Northern Australia. These mines re-opened over 2018 and 2019, increasing Australian mine production of zinc.

World zinc prices rose sharply following mine closures and peaked at US$3,415 per tonne in March quarter 2018. Since then prices have eased substantially, falling to US$2,709 in the March quarter 2019 and US$1,968 in the June quarter 2020.

Australian zinc production is concentrated in Queensland and the Northern Territory. In 2019, Queensland and the Northern Territory accounted for 78 per cent of total Australian zinc production. Western Australia's share of domestic production was 7 per cent. Zinc ore is also produced in New South Wales at Elura and Woodlawn, and Rosebery in Tasmania.

In Western Australia, the Golden Grove mine, owned by EMR Capital, consists of two underground mines, Gossan Hill and Scuddles. Mining operations produce copper, zinc, lead, silver and gold. As at June 2019, the mine owners reported a total resource of 22.2 million tonnes of zinc ore. The estimated mine life is 12 years. Exploratory drilling may increase the resource and extend the mine life.

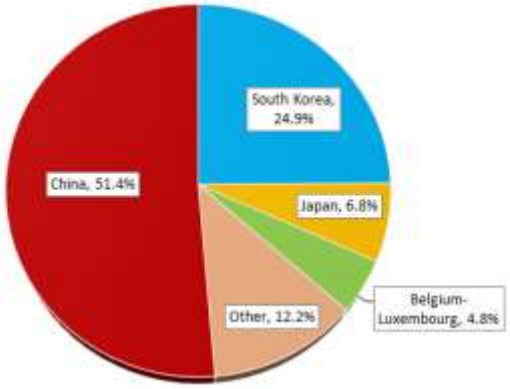
[5] World Bank Statistics.

[6] Geoscience Australia, Australia's Identified Mineral Resources, 2019, p. 10.

Figure 26: Zinc nominal price (US$/mt)

Source: World Bank, August 2020.

Figure 27: Percentage share of Australian zinc concentrate exports by destination, 2019 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

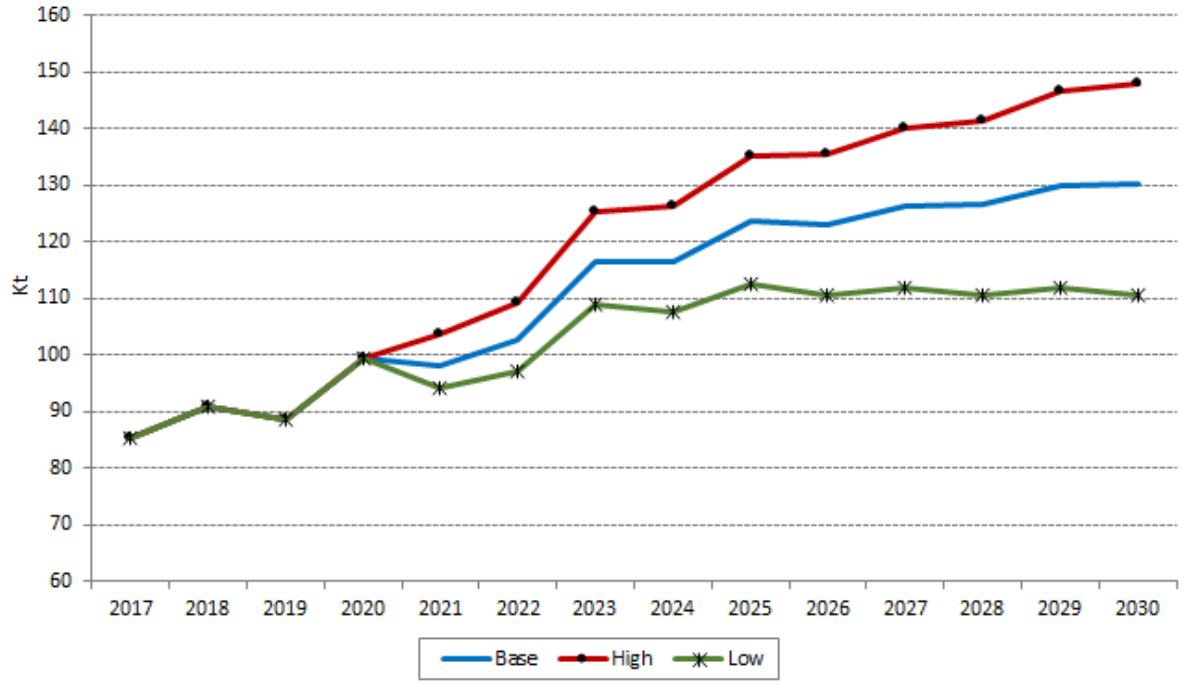
The main uses for zinc are in galvanising steel, diecasting and making brass and bronze alloys. These alloys are used in automobiles, electrical components and household fixtures. Zinc oxide is also used in many other products such as paints, cosmetics, pharmaceuticals, rubber and soaps. Zinc is also used in batteries and on-going battery developments could lead to increased demands for zinc. Zinc is used in the zinc-carbon battery, zinc-bromide battery and the newer zinc-nickel power cell battery.

Australian exports of zinc concentrates and refined zinc totalled $3.8 billion in 2019. Zinc is refined in Australia by Nyrstar at Risdon in Tasmania and by Sun Metals in Townsville, Queensland. The major markets for zinc concentrate are China (51 per cent) and South Korea (25 per cent). The main refined zinc export markets in 2019 were China (33 per cent), Chinese Taipei (15 per cent) and Indonesia (11 per cent). Rising exchange rates in 2021 and 2022 could lead to falling export earnings despite increased production.

Australian mine production is expected to increase by 2022. This partly reflects the ramp up of production at the Century zinc mine in Queensland (which has experienced production difficulties) and production from Woodlawn. COVID-19 has had some direct impacts on zinc ore production in 2020 with the delayed commissioning of Woodlawn in New South Wales and the Mount Garnet mine in Queensland being placed under care and maintenance.

Figure 28 shows the forecasts for zinc production for Western Australia to 2030 by scenario.

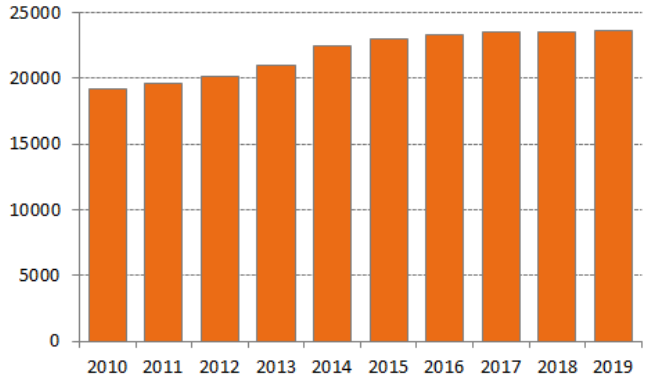
Figure 28: Western Australian zinc production to 2030 by scenario (kt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

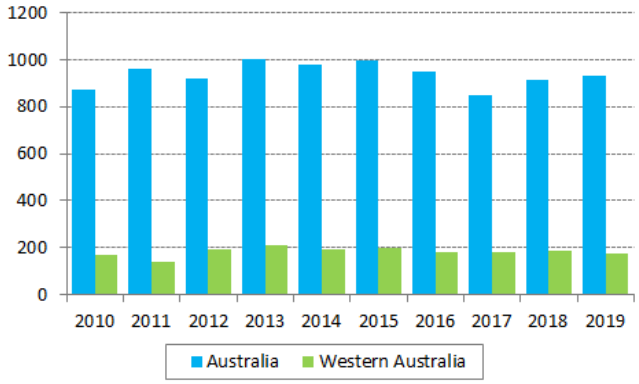
8. Copper

Figure 29: Copper production – World (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 30: Copper production – Australia and Western Australia (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

World production of copper was 23.7 million tonnes in 2019. Copper production in the world rose strongly between 2010 and 2015, however, it has flattened out at around 23.5 million tonnes since 2015. The largest producers of copper in the world in 2018 were Chile (29 per cent), Peru (12 per cent), China (8 per cent), the United States (6 per cent) and Australia (5 per cent).[7]

World copper prices have fallen significantly with the onset of the COVID-19 pandemic, falling to US$5,350 per tonne in June 2020. In early 2018, copper was trading at above US$7,000 per tonne before easing down to around US$5,700 per tonne in late 2019. In April 2020, with the worsening COVID-19 crisis, copper prices reached as low as US$5,050 per tonne.

In 2018, Australia's reserves of copper were estimated at 88.2 million tonnes, around 11 per cent of total world copper reserves.[8] Reserves are distributed across the States with South Australia (66 per cent), New South Wales (15 per cent), Queensland (12 per cent), Western Australia (6 per cent) and Tasmania (1 per cent). Copper is commonly produced at copper/gold mines.

Copper is used extensively in electrical equipment, such as wiring and motors. Copper conducts heat and electricity well. In construction, copper is used in cabling and pipes. Copper is also used in jewellery and coinage and also used in industrial equipment, heating and cooling systems as well as telecommunications applications.

Australian copper production was 934 kt in 2019. Copper production in Australia has been between 900 and 1,000 kt over the last 10 years. Western Australia produced 173 kt of copper in 2019, or 19 per cent of total Australian production. Like other precious metals, the recycling industry is active in copper recycling in Australia.

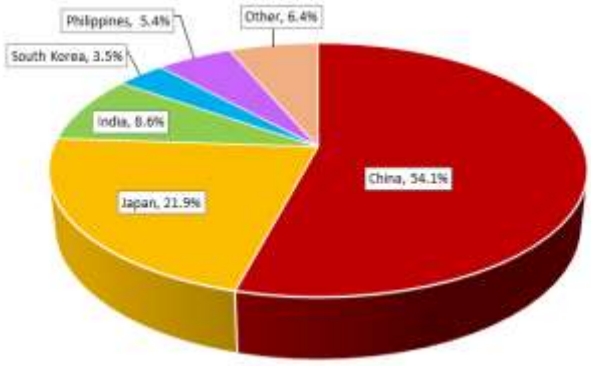
[7] World Bank Statistics, 2020.

[8] Geoscience Australia, Australia's Identified Mineral Resources, 2019, p. 31.

Figure 31: Copper nominal price (US$/tonne)

Source: World Bank, August 2020.

Figure 32: Percentage share of Australian copper ore and concentrate exports by destination, 2019 (%)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Exports of copper from Australia in 2019, including copper ore and concentrates and refined copper, were $10.1 billion. The major markets for copper ore and concentrates in 2019 were China (54 per cent), Japan (22 per cent) and India (9 per cent). The major markets for refined copper were China (41 per cent), Malaysia (33 per cent) and Chinese Taipei (14 per cent).

Copper production in Australia is dominated by BHP's Olympic Dam mine in South Australia and OZ Minerals' Prominent Hill and Carrapateena mines. Production in 2019-20 from these mines in South Australia will be around 270 kt. Future major expansions are likely to be met by Olympic Dam with BHP flagging a possible 100 – 150 kt brownfield expansion.

Queensland and New South Wales accounted for 47 per cent of copper ore and concentrate production in 2019. In Queensland, copper mines are predominantly located around the Mt Isa region. Mines in this region include Ernest Henry, Mount Gordon and Mount Isa. Major copper mines in New South Wales include North Parkes, Cobar, Cadia East and Marsden. Copper production at Newcrest's Cadia mine in New South Wales was 96 kt in 2019-20, around 10 per cent of total Australian production. Victoria had no recorded copper production in 2019.

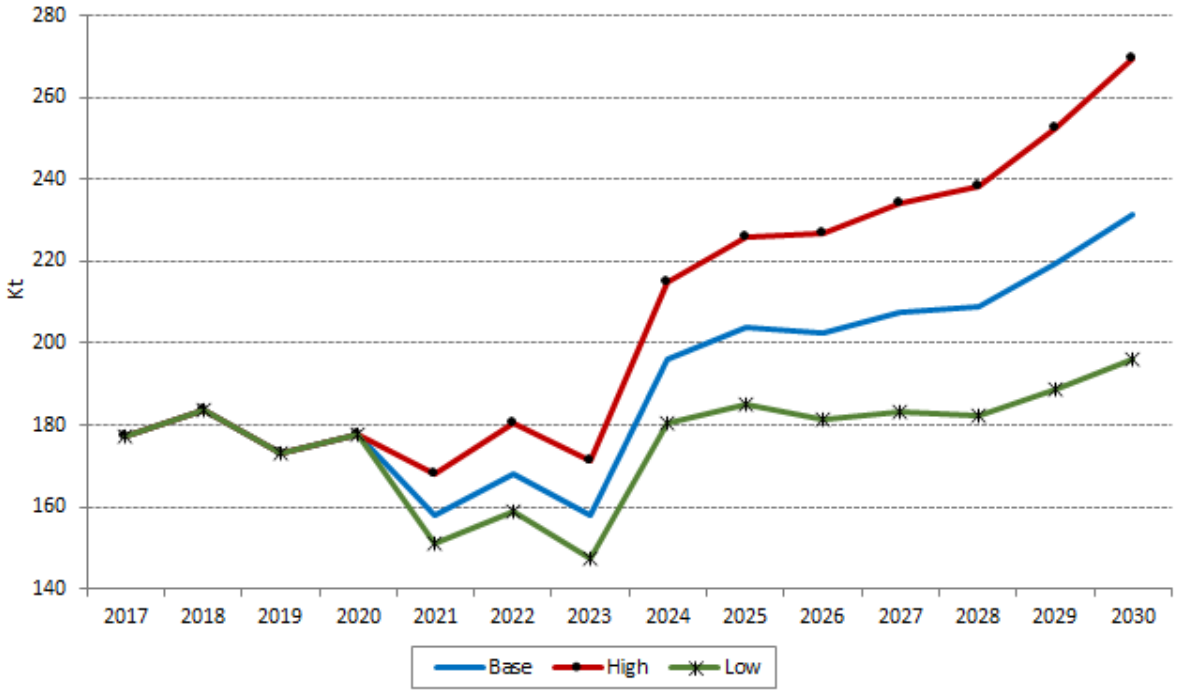
Western Australia accounted for nearly 19 per cent of Australian copper ore and concentrate production in 2019. Western Australia has a number of gold-copper mines, as well as copper mines, including Degussa, Nifty, Telfer, Boddington and Golden Grove. The Degussa mining operation, operated by Sandfire Resources, produced 72.2 kt of copper in 2019-20, around 40 per cent of total Western Australian production. Sandfire's Monty mine also contributes to the Degussa copper-gold mining operation. Newcrest operates the Telfer mine in Western Australia which produced 16.3 kt of copper in 2019-20. The Metals X Nifty copper mine suspended operations in November 2019.

There are a number of prospective copper projects in Western Australia, including:

- the OZ Minerals' West Musgrave project, a copper-nickel mine with possible capacity of 25 kt per annum;
- the Caravel copper project near Calingiri which is a Greenfields project with an initial capacity of 40 kt per annum; and
- the Sulphur Springs project proposed by Venturex Resources which would be a copper-zinc-silver mine.

Figure 33 shows the forecasts for copper production for Western Australia to 2030 by scenario.

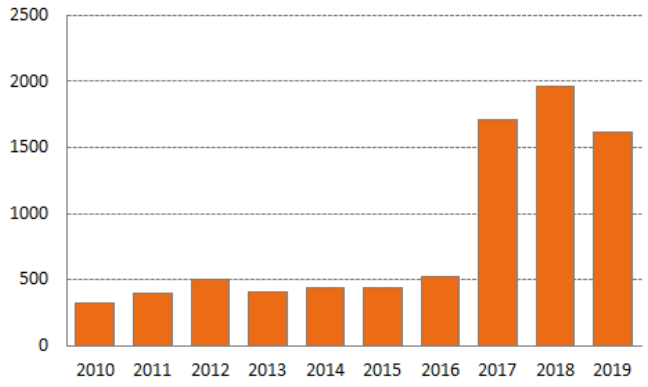
Figure 33: Western Australian copper production to 2030 by scenario (kt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

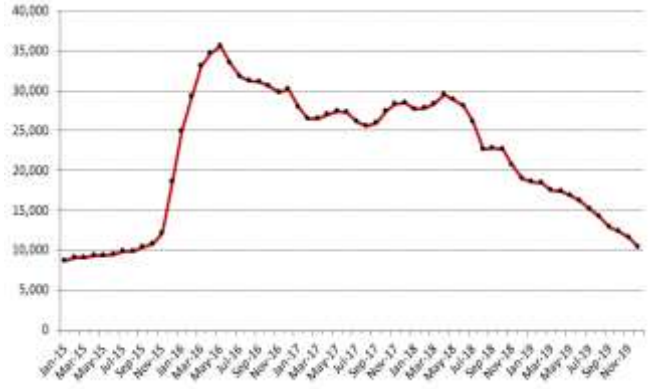
9. Lithium

Figure 34: Lithium spodumene concentrate production – Western Australia (kt)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

Figure 35: Lithium carbonate nominal price – (A$/tonne)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

The outlook for lithium remains positive, with demand to increase with rising electric vehicle sales.

World lithium production in 2019 was 495 kt (lithium carbonate). Electric vehicle sales are expected to increase rapidly across the world over the next decade. China increased its target for electric vehicle sales to 25 per cent of new vehicle sales by 2025. India is also establishing an electric vehicle industry chain. Manufacturers are also beginning to ramp up production, including Volkswagen, Tesla and BMW to name a few.

Australian production of lithium was 1,617 kt (lithium spodumene) 2019, down nearly 350 kt on production in 2018 of 1,966 kt. Over-supply by 2019 and falls in the lithium price led to production cutbacks in Australia. A number of mines in Australia ceased production, and were placed under care and maintenance.

Australian reserves of lithium were 4,718 kt in 2018, representing 34 per cent of total EDR world reserves.[9] Chile also has significant reserves of lithium. Australia's lithium deposits are located in Western Australia at Greenbushes' Wodgina, Pilgangoora and Earl Grey mines. Other resources are at Mount Marian, Mount Catlin and Bald Hill in Western Australia. The Northern Territory also has the Finniss project.

Lithium's main use is in battery production (56 per cent), however, it is also used in ceramics and glass, and lubricating greases. The growth in lithium consumption over recent years for batteries reflects growing markets for portable electronic devices, electric vehicles, electric tools, other equipment and grid storage applications.

Lithium carbonate prices rose sharply over 2015 and 2016. Prices averaged $10,592 per tonne in 2015, rising to $31,323 per tonne buy 2016. Lithium prices remained relatively solid over 2017 and 2018 at around $26,000 per tonne. By late 2018, prices began to fall sharply reflecting an over-supply of lithium product. Prices averaged $15,166 per tonne in calendar year 2019 and were $10,366 in December 2019.

[9] Geoscience Australia, Australia's Identified Mineral Resources, 2019, p. 10.

Australia's first lithium mine was the Greenbushes' mine in Western Australia, owned by Tianqi Lithium and Albemarle. It is the world's largest lithium mine and is operated by Talison Lithium. The mine contains the highest grade hard rock lithium in the world. The operators have announced a two-stage expansion at Greenbushes. First, an increase in annual production capacity from 650 to 1,350 tonnes per annum completed in 2019. The third lithium processing plant has been delayed at Greenbushes. The increased production levels at Greenbushes will be processed by lithium hydroxide processing plants to be built at Kemerton and Kwinana.

The Kemerton lithium hydroxide plant being developed by Albemarle will have a capacity of 100,000 tonnes per year. The Kwinana plant, being developed by Tianqi Lithium, has a capacity of 24,000 tonnes per annum (commissioned early 2019) with stage-two expanding this to 48,000 tonnes per annum of lithium hydroxide.

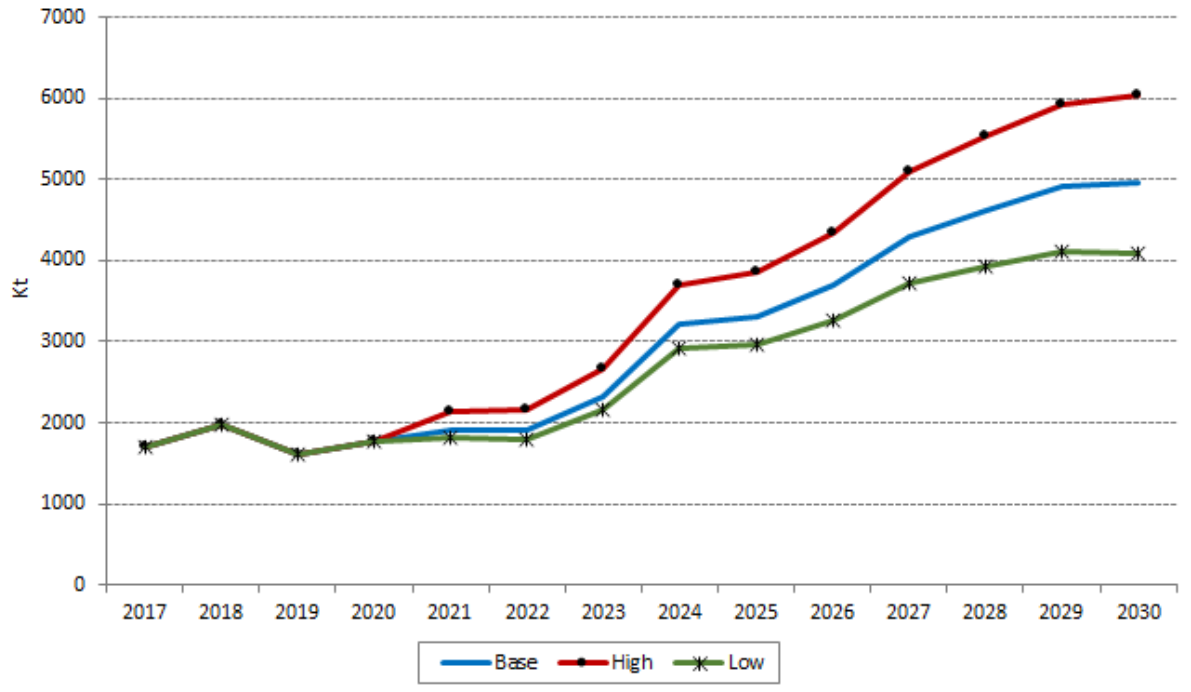
The sharp fall in the lithium price in 2019 and excess production led to a number of new mines and expansions at existing mines being cancelled in Australia. Recent developments over 2019 and 2020 include the following.

- Mineral Resources Australia (MRA) placed its Wodgina lithium mine under care and maintenance. The Wodgina mine was to proceed in three stages – first, export of ore, second, construction of a spodumene concentration plant, and third, construction of a lithium hydroxide plant. MRA, however, has continued production at Mount Marion, with 496 kt produced in 2019-20;
- The Mt Holland lithium project, another major project, was deferred in January 2020. The weak lithium market has led to the final investment decision to be delayed until 2021. This project included a mine and concentrator at Mt Holland and a refinery at Kwinana. This would result in production of 45 kt per annum of battery grade lithium hydroxide.
- Galaxy Resources operates the Mt Catlin lithium mine in Western Australia. Galaxy has reduced its annual production guidance by 50 per cent, to 90,000 – 105,000 dmt, in response to market developments.
- Alita Resources in late 2019 suspended operations at its Bald Hill lithium mine and placed it under care and maintenance. The company subsequently entered into voluntary administration.
- Pilbara Minerals commissioned its Pilgangoora Lithium-Tantalum project in April 2019. The mining and processing operation will produce up to 330 kt per annum of spodumene concentrate. The mine is operating at below capacity with shipments in 2019-20 of around 117 kt of spodumene concentrate.
- The Altura lithium mine was commissioned in 2019 and is located at Pilgangoora in Western Australia. The mine produced 181,264 wmt of high grade lithium concentrate in 2019-20, which equates to 80 per cent of capacity.

The short-term outlook for lithium production remains weak. The medium-term to long-term prospects remain positive with projected growth in electric vehicles, portable devices and other equipment. Production is expected to increase over the 2023 to 2026 period in Australia driven largely by the rechargeable battery market.

Figure 36 shows the forecasts for lithium production for Western Australia to 2030 by scenario.

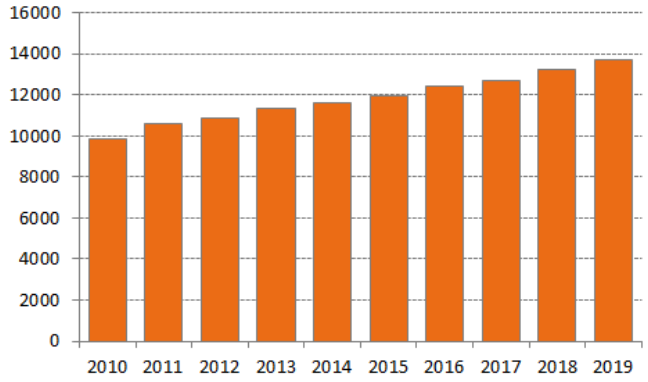
Figure 36: Western Australian lithium production to 2030 by scenario (kt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

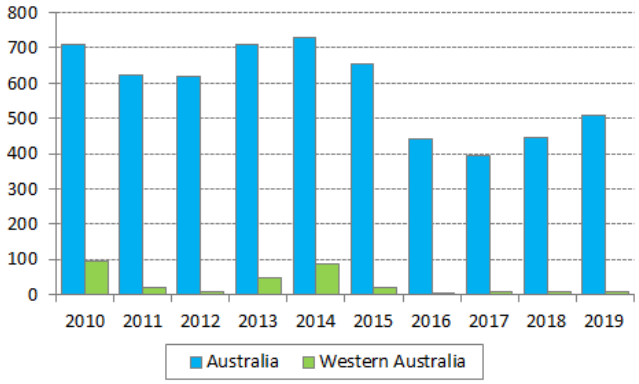
10. Lead

Figure 37: Lead production – World (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Figure 38: Lead production – Australia and Western Australia (kt)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

Global lead production was 13.7 million tonnes in 2019. World lead production has risen by over 2 million tonnes over the last five years. Lead is typically extracted from base metal mining operations which can also yield copper, silver and zinc.

World production of lead is dominated by China which, in 2018, produced 44 per cent of the world's lead production. Second ranked in 2018 was Australia at 9.3 per cent, followed by the United States (6 per cent) and Mexico (5 per cent).[10] Australia has the largest reserves of lead in the world, representing 38 per cent of the world's economic resources.[11] The main use of lead is in lead-acid batteries, principally for motor vehicles and other transport equipment. Lead is also used in many other applications, including construction, cabling, pigments, ammunition, weights and other lead alloys.

Lead recycling, like copper, is a major source of lead and lead alloy production. This represents an important constraint on world and Australian lead production. Lead can be recycled indefinitely.

Australian production of lead in 2019 was 509 kt, some 3.7 per cent of world production. Australian production of lead is well down from levels of over 700 kt per annum in 2013 and 2014. Lead production in Australia is concentrated in Queensland which produced 59 per cent of Australian production in 2019. New South Wales produced around 19 per cent of Australian lead production in 2019, while Tasmania and the Northern Territory were both around 10 per cent. Western Australia only produced around 1.5 per cent, or 7 kt in 2019.

World lead prices rose to over US$2,500 in March 2018, however, they have since retreated. The lead price fell to US$2,035 in March 2019 and with the outbreak of COVID-19 fell heavily again. The average lead price in the June quarter 2020 was US$1,676, about 35 per cent below the March 2018 price.

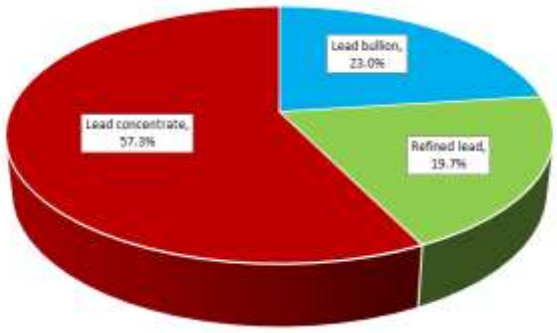
[10] World Bank Statistics.

[11] Geoscience Australia, Australia Identified Mineral Resources, 2019, p. 39.

Figure 39: Lead nominal price (US$/mt)

Source: World Bank, August 2020.

Figure 40: Percentage share of Australian lead exports by type, 2019 (%)



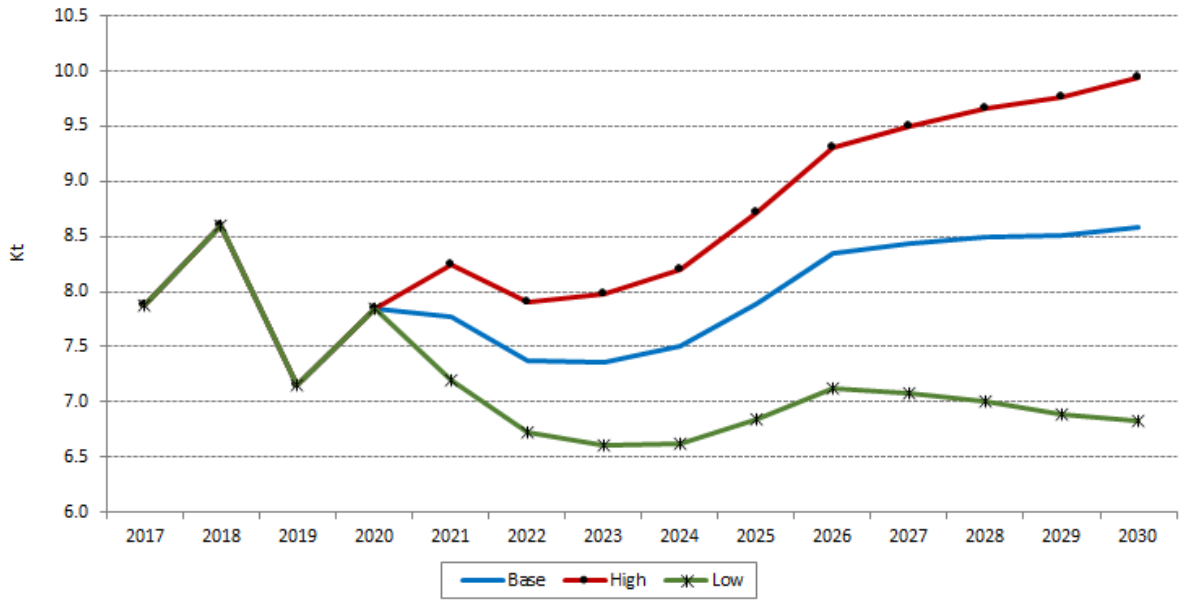
Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020.

The total value of Australian lead exports in 2019 was $1.7 billion. This includes exports of lead concentrate, lead bullion and refined lead. In volume terms, the dominant markets for Australian lead concentrate exports in 2019 were China (67 per cent), South Korea (22 per cent) and Japan (10 per cent).

Western Australia has a number of prospective base metals projects that include mined lead ore. This includes the Galena Mining Abra lead-silver project that has a capacity of 1.2 mtpa. Two other lead-silver mines are the Rosslyn Hill Mining's Paroo Station mine and the Pacifico's Sorby Hills mine.

Figure 41 shows the forecasts for lead production for Western Australia to 2030 by scenario.

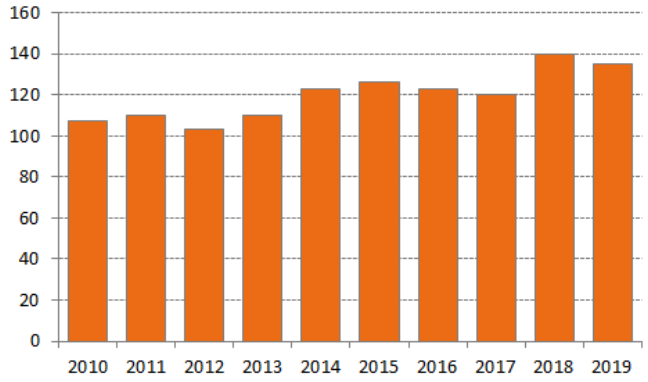
Figure 41: Western Australian lead production to 2030 by scenario (kt)



Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

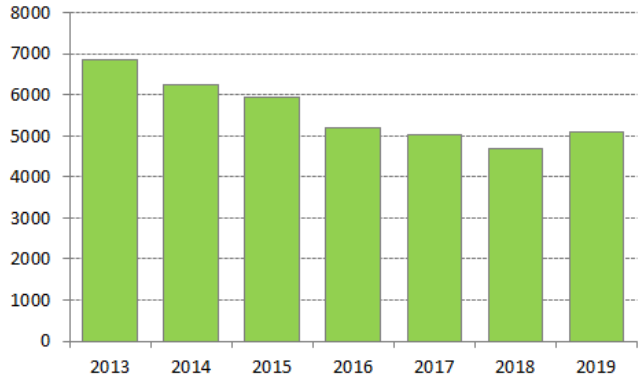
11. Cobalt

Figure 42: Cobalt production – World (metric tonnes '000)



Source: Statista, 2020.

Figure 43: Cobalt production – Australia (metric tonnes)



Source: Statista, 2020.

World production of cobalt in 2019 was around 135 metric tonnes (mt). World production has increased steadily over the last decade from 107,000 mt in 2010 to 126,000 mt in 2015 and peaking in 2018 at 140,000 mt.

The world's largest producer of cobalt is the Democratic Republic of Congo (DRC), accounting for around 70 per cent of global production. Mining activities in the DRC have been linked to human abuse, including child labour. Cobalt mines in the DRC have been under scrutiny for years, with claims that miners are exposed to dangerously high levels of toxic pollution.

Australia is around the third largest producer of cobalt in the world, producing 5,100 mt in 2019. Cobalt produced in Australia is a by-product of copper and nickel mining. Australia's nickel mines are situated in Western Australia, around Kalgoorlie, and Leonora. Nickel West produced 775 tonnes of cobalt in 2019-20.

Australian reserves of cobalt in 2018 were 1,353 kt, with around 70 per cent of these reserves in Western Australia. Significant reserves of cobalt are also located in Queensland (17 per cent) and New South Wales (14 per cent).[12]

Cobalt has applications in rechargeable batteries, electronics, inks and pigments, alloys, catalysts and healthcare. Around 50 per cent of all cobalt produced is used in rechargeable batteries. Rechargeable batteries are used in:

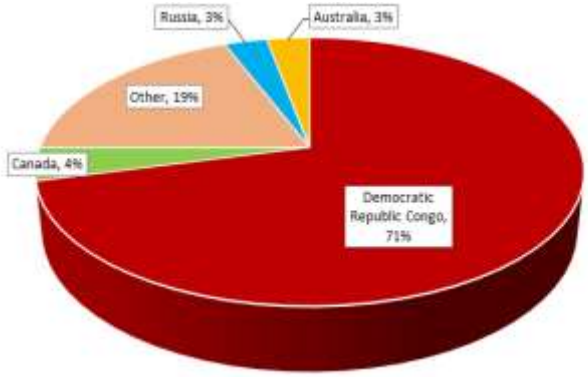
- portable devices, such as mobile phones, laptops and tablets;
- electric vehicles and other transport equipment; and
- stationary applications, such as home energy storage and renewable power stations.

[12] Geoscience Australia, 2019, p. 29.

Figure 44: Cobalt nominal price (US$/mt)

Source: DMIRS (WA), 2019, Major Commodities Resources Data.

Figure 45: Percentage share of cobalt production by major country, 2018 (%)



Source: World Bank, 2020.

The lithium-ion battery is one of the most common type of battery with cobalt being found in the cathode. Cobalt is also used in nickel-cadmium batteries and nickel-metal hydride batteries. In June 2020, Tesla announced it would source cobalt for its new lithium-ion battery plants from Glencore mines in the DRC.

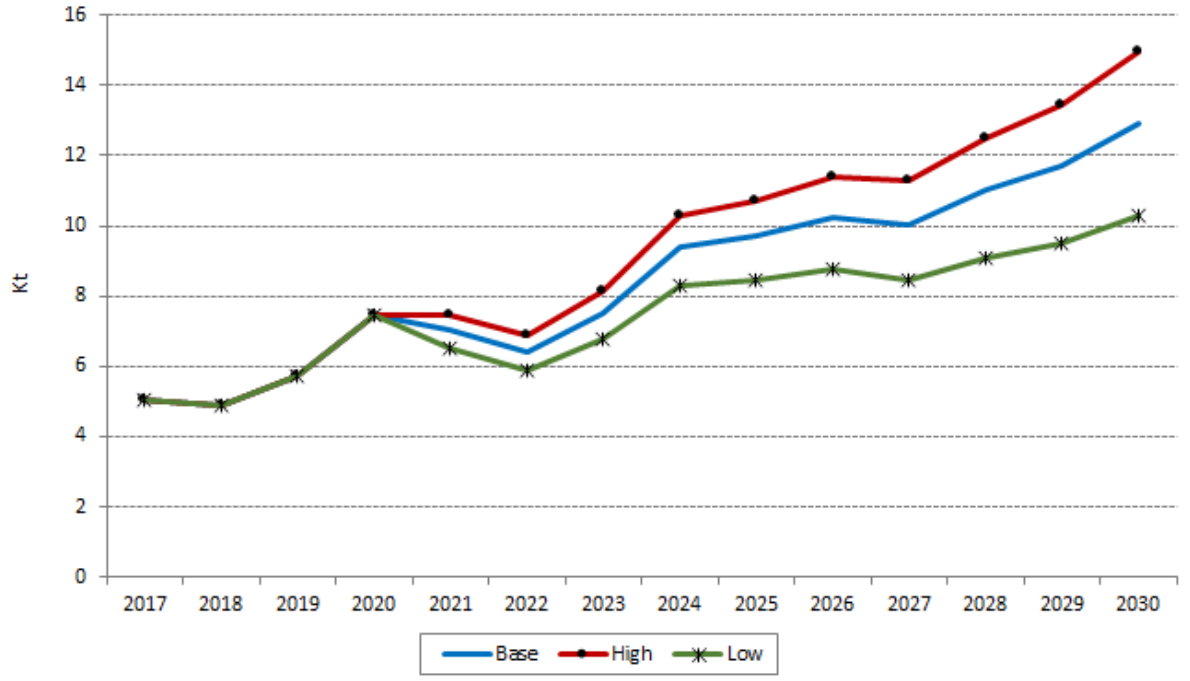
The surge in interest in cobalt over 2017 and 2018 was driven by expectations about the take-up of electric vehicles and a sharp increase in the cobalt price. The cobalt price rose from US$25,600 per tonne in 2016 and peaking at around US$87,700 per tonne in the June quarter 2018. The cobalt price has since retreated by 60 per cent to be just under US$35,000 per tonne in 2019.

A large number of prospective mining developments emerged over the course of 2018 and 2019 in Australia. Most of these were copper-cobalt or nickel-cobalt deposits in Western Australia, Queensland and New South Wales. Recently announced projects include the Australian Mines' Flemington project and the Thackaringa project for Cobalt Blue, both located in New South Wales.

In Western Australia, the Mt Thirsty mine, owned by Barra Resources, has a prospective cobalt resource of 19.1 kt. Another prospective development in Western Australia is the Wingellina Nickel-Cobalt project proposed by Metals X Ltd. The Wingellina mine has a reserve of 1.6 mt of Nickel and 123,000 tonnes of cobalt. As battery prices continue to fall, the take-up of electric vehicles should increase post-2025 and Australian cobalt production should rise significantly.

Figure 46 shows the forecasts for cobalt production for Western Australia to 2030 by scenario.

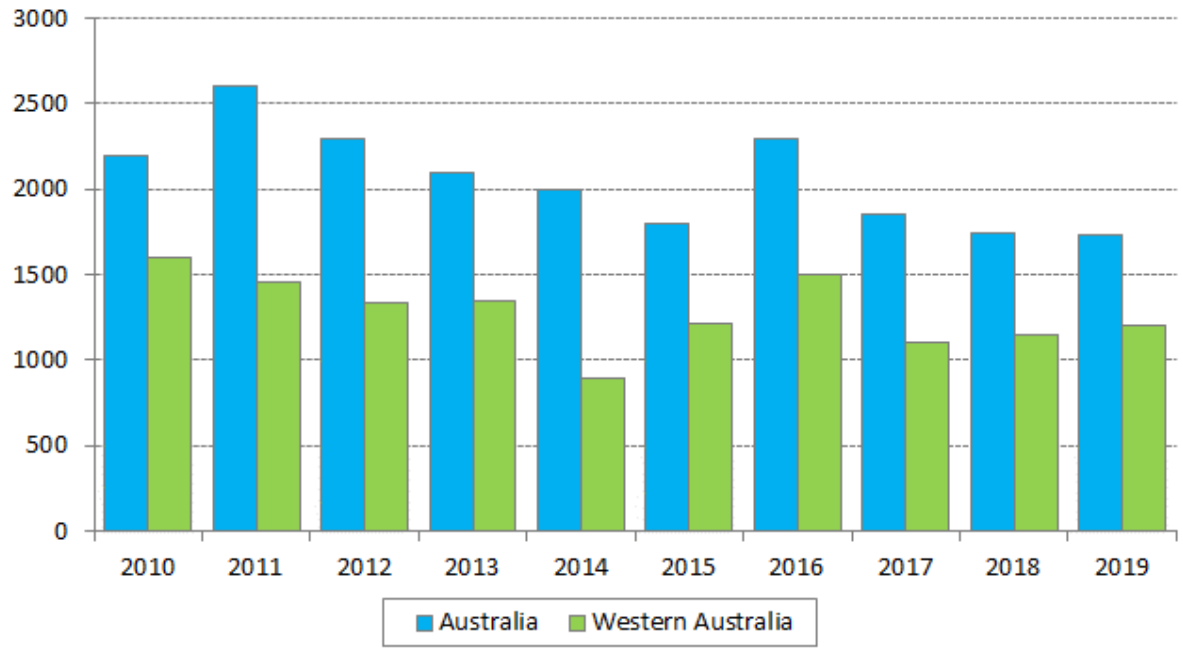
Figure 46: Western Australian cobalt production to 2030 by scenario (kt)



Source: DMIRS (WA), 2019, Major Commodities Resources Data and NIEIR.

12. Mineral sands

Figure 47: Mineral sands production – Australia and Western Australia (kt)



Source: DMIRS (WA), 2019, Major Commodities Resources Data and NIEIR estimates.

The mineral sands industry consists of the mining and processing of zircon and titanium dioxide products (ilmenite, rutile, and other upgraded titanium dioxide products). Iluka Resources[13] reported that world production of zircon in 2018 was around 1.2 million tonnes. World production of titanium dioxide in 2018 was some 2.5 million tonnes.

Australia has large reserves of mineral sands. In December 2018, Geoscience Australia[14] reported that Australia had 276.3 million tonnes of ilmenite, 35.4 million tonnes of rutile and 79.9 million tonnes of zircon. In 2018, Australia had 19 per cent of the world's ilmenite reserves, 50 per cent of world rutile reserves and 63 per cent of world zircon reserves. Australia's inferred resources of mineral sands could be much larger than this.

The majority of Australia's mineral sands resources are in Victoria, New South Wales along the Murray Basin, the Eucla Basin in South Australia and in the Perth and Canning Basin in Western Australia.

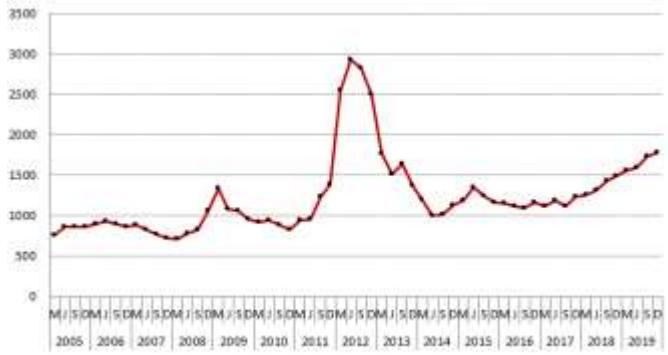
Zircon is an opaque, hard wearing mineral that is used by the ceramic tile industry. Zircon is also used by production processes in refractories and foundry casting (glass and steel production). Zircon chemicals are also used in catalytic fuel converters and air and water purification systems.

Titanium minerals are used in the production of paint, toothpaste and plastics. This is the largest single end-use of titanium feedstocks. Titanium metal is also used in aircraft construction, engines and medical equipment.

[13] Iluka, Mineral Sands Information, November, 2019.

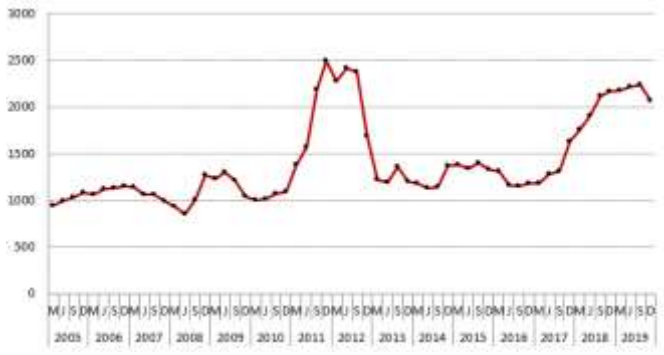
[14] Geoscience Australia, Australia's Identified Mineral Resources, 2019, p. 10.

Figure 48: Rutile nominal price (A$/t)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

Figure 49: Zircon nominal price (A$/t)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

The key drivers of mineral sands products are the construction industry and manufactured industrial and consumer goods. Titanium dioxide products are also linked to aeroplane and ship building, defence spending and electricity generation.

Australia has around 10 mineral sands mines operating in Western Australia, New South Wales and South Australia. Western Australia has 6 operating mine, including:

- the Yoongarillup and Keysbrook mines operated by Doral Mineral Sands;
- the Wonnerup and Cooljarloo mines operated by Tronox;
- the Cataby mine operated by Iluka Resources; and
- the Boonanarring mine operated by Image Resources.

Tronox operates two mineral sands mines in New South Wales, the Gingko and Snapper miens. Iluka also operates the Jacinth Ambrosia mine in South Australia as well as in Sierra Leone.

Exports of mineral sands minerals from Western Australia were valued at $1.2 billion in 2019. The major markets for these exports were China (47.3 per cent), the United States (6.5 per cent), the United Kingdom (6.3 per cent) and the Netherlands (6.0 per cent).

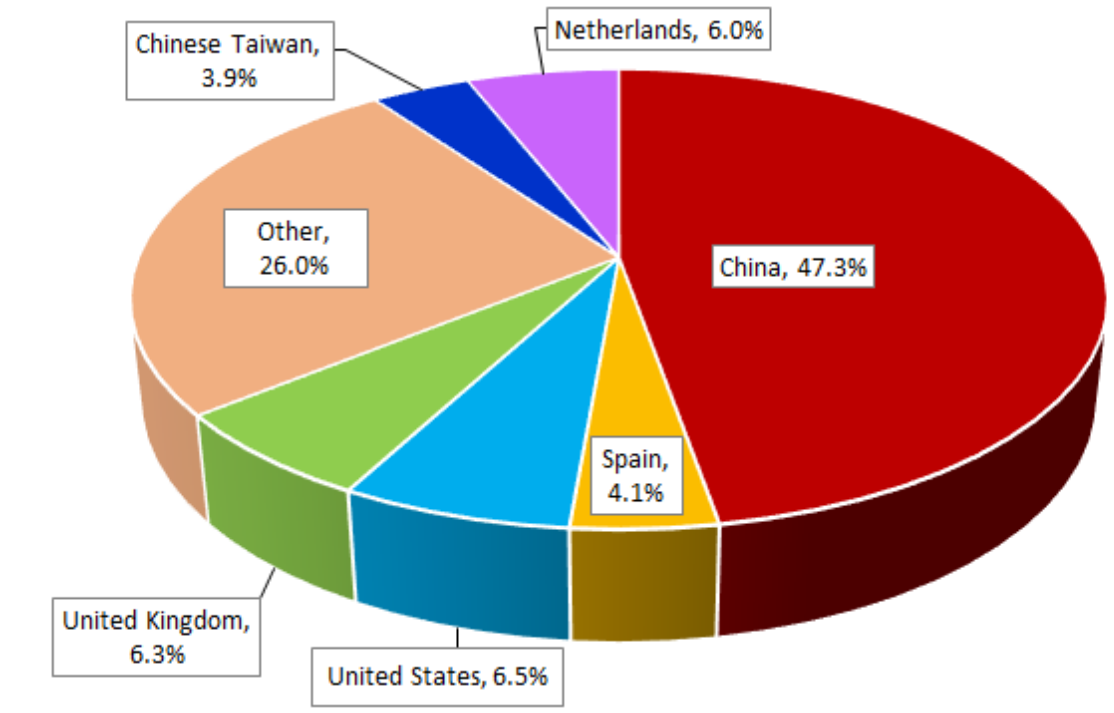
There are a number of well advanced proposals for new mineral sands mines in Western Australia, including:

- the Coburn mineral sands project, proposed by Strandline Resources Ltd which has significant reserves of zircon and titanium dioxide. The initial mine life of 22.5 years could be extended. A loan facility has been secured for $150 million;
- the Thunderbird mineral sands project by Sheffield Resources located in the Canning Basin. The company has already secured off-take agreements for zircon and ilmenite product. The mine could produce up to 114 kt of zircon and 439 kt of ilmenite per annum and is estimated to have a 42 year mine life; and
- the Cyclone zircon project proposed by Diatreme Resources located in Western Australia's Eucla Basin. The mine could produce up to 65 kt of zircon per year.

A much larger development has been proposed by Iluka Resources at Balranald in New South Wales. New production capacity has been estimated at 450 kt of ilmenite, 170 kt of zircon and 130 kt of rutile per annum. Three projects have been announced in Victoria at Donald, the Avonbank project and the Fingerboards project.

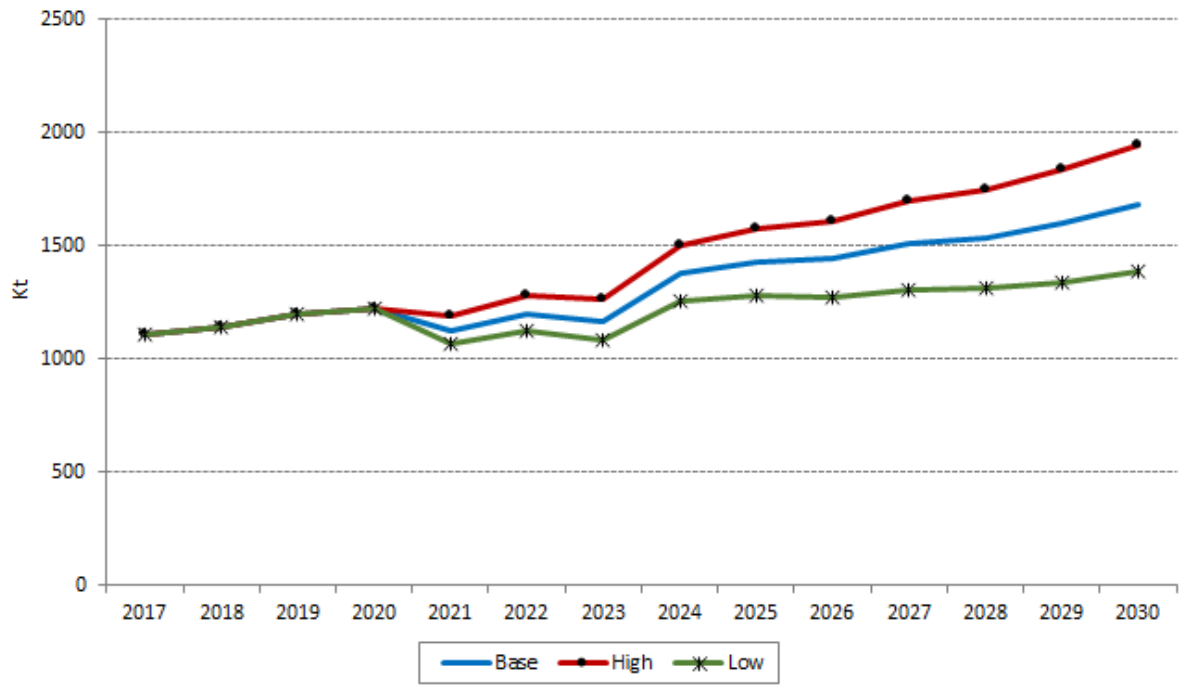
Figure 51 shows the forecasts for mineral sands production for Western Australia to 2030 by scenario.

Figure 50: Percentage share of Western Australian mineral sands exports, 2019 (%)



Source: DMIRS (WA), 2019, Major Commodities Resources Data.

Figure 51: Western Australian mineral sands production to 2030 by scenario (kt)



Source: DMIRS (WA), 2019, Major Commodities Resources Data and NIEIR.

13. Commodity production forecasts

Tables 4 to 6 summarise the production outlooks for the Base, High and Low scenarios, respectively, for Western Australia on a calendar year basis. The key drivers of the high and low growth scenarios for commodity production are different assumptions regarding world and Australian economic growth. This would also be reflected in different commodity price outlooks for the high and low growth scenarios. Australian production of mineral resources is primarily driven by the demands from overseas countries for these commodities, as well as commodity prices and movements in the exchange rate.

Table 4 Western Australian commodity production forecasts for the Base scenario

Calendar	Alumina (Mt)	Copper (kt)	Gold (t)	Iron ore (Mt)	Nickel (kt)	Zinc (kt)	Lithium (kt)	Lead (kt)	Cobalt (kt)	Mineral sands (kt)
2017	13.8	177.1	201.1	877.3	185.5	85.4	1706.6	7.9	5.0	1105.9
2018	13.5	183.6	213.5	899.1	160.0	90.8	1965.9	8.6	4.9	1142.9
2019	14.0	173.1	218.0	910.1	158.8	88.7	1616.8	7.2	5.7	1201.1
2020	14.2	177.8	243.7	963.2	179.1	99.5	1772.9	7.8	7.4	1226.2
2021	14.0	158.0	278.5	947.9	160.4	98.0	1907.2	7.8	7.0	1121.0
2022	14.1	168.2	281.9	911.2	147.3	102.6	1907.2	7.4	6.4	1194.6
2023	14.2	157.9	250.3	949.2	181.0	116.4	2325.6	7.4	7.5	1168.6
2024	14.2	196.2	224.6	1003.7	202.3	116.6	3211.1	7.5	9.4	1375.7
2025	14.5	203.8	221.4	1027.8	213.2	123.7	3303.6	7.9	9.7	1427.8
2026	14.5	202.6	233.6	1035.6	198.2	123.2	3702.1	8.3	10.2	1441.6
2027	14.5	207.3	229.8	1042.0	187.1	126.3	4299.1	8.4	10.0	1506.6
2028	14.5	208.8	224.9	1043.8	201.0	126.5	4615.1	8.5	11.0	1534.8
2029	14.5	219.3	224.1	1050.8	217.0	130.0	4907.4	8.5	11.7	1597.2
2030	14.5	231.4	223.6	1057.7	233.0	130.2	4961.0	8.6	12.9	1677.9

Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

Table 5 Western Australian commodity production forecasts for the High scenario

Calendar	Alumina (Mt)	Copper (kt)	Gold (t)	Iron ore (Mt)	Nickel (kt)	Zinc (kt)	Lithium (kt)	Lead (kt)	Cobalt (kt)	Mineral sands (kt)
2017	13.8	177.1	201.1	877.3	185.5	85.4	1706.6	7.9	5.0	1105.9
2018	13.5	183.6	213.5	899.1	160.0	90.8	1965.9	8.6	4.9	1142.9
2019	14.0	173.1	218.0	910.1	158.8	88.7	1616.8	7.2	5.7	1201.1
2020	14.2	177.8	243.7	963.2	179.1	99.5	1772.9	7.8	7.4	1226.2
2021	14.3	167.9	304.2	1055.4	170.0	103.6	2139.1	8.2	7.4	1190.0
2022	14.4	180.6	309.6	1020.6	157.7	109.3	2159.6	7.9	6.9	1281.0
2023	14.6	171.3	276.5	1069.6	195.5	125.1	2658.4	8.0	8.2	1265.7
2024	14.7	215.1	249.5	1137.8	220.6	126.3	3705.3	8.2	10.3	1504.9
2025	15.1	225.7	247.3	1172.0	234.7	135.1	3847.5	8.7	10.7	1577.2
2026	15.1	226.7	262.4	1187.8	220.2	135.6	4351.6	9.3	11.4	1608.0
2027	15.2	234.3	259.5	1202.2	209.7	140.1	5099.6	9.5	11.3	1696.7
2028	15.2	238.3	255.3	1211.2	227.3	141.5	5524.3	9.7	12.5	1745.1
2029	15.2	252.7	255.9	1226.5	247.6	146.5	5927.0	9.8	13.4	1833.2
2030	15.2	269.3	256.6	1241.6	268.3	147.9	6045.2	9.9	15.0	1943.9

Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

Table 6	Western Australian commodity production forecasts for the Low scenario									
Calendar	Alumina (Mt)	Copper (kt)	Gold (t)	Iron ore (Mt)	Nickel (kt)	Zinc (kt)	Lithium (kt)	Lead (kt)	Cobalt (kt)	Mineral sands (kt)
2017	13.8	177.1	201.1	877.3	185.5	85.4	1706.6	7.9	5.0	1105.9
2018	13.5	183.6	213.5	899.1	160.0	90.8	1965.9	8.6	4.9	1142.9
2019	14.0	173.1	218.0	910.1	158.8	88.7	1616.8	7.2	5.7	1201.1
2020	14.2	177.8	243.7	963.2	179.1	99.5	1772.9	7.8	7.4	1226.2
2021	13.7	151.0	268.8	915.0	154.8	94.0	1819.5	7.2	6.5	1068.9
2022	13.7	158.8	268.6	868.3	140.4	97.1	1792.0	6.7	5.9	1123.3
2023	13.8	147.2	235.4	892.8	170.2	108.8	2151.6	6.6	6.8	1080.8
2024	13.7	180.5	208.5	931.6	187.8	107.5	2924.1	6.6	8.3	1252.7
2025	13.9	185.0	202.8	941.3	195.3	112.5	2961.4	6.8	8.4	1279.8
2026	13.9	181.5	211.1	935.6	179.1	110.5	3265.2	7.1	8.7	1271.6
2027	13.7	183.3	204.8	928.6	166.8	111.7	3729.8	7.1	8.4	1306.9
2028	13.7	182.1	197.6	917.3	176.7	110.4	3937.5	7.0	9.1	1309.4
2029	13.7	188.6	194.2	910.5	188.0	111.8	4116.2	6.9	9.5	1339.5
2030	13.7	196.2	191.0	903.4	199.0	110.4	4089.7	6.8	10.3	1383.1

Sources: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, Resources and Energy Quarterly, June 2020 and NIEIR.

14. Commodity price forecasts

NIEIR conducted a survey of public world commodity price forecasts from major economic institutions. The survey presented in Table 7 was completed in August 2020, and was used to inform the commodity production outlook. The price forecasts are influenced by the timing, in terms of when they were prepared.

Table 8 also contains price forecasts for lithium carbonate out to 2022. These were prepared by NIEIR and the Office of the Chief Economist based on supply and demand characteristics of the forecast lithium market.

As indicated in Table 7, the short-term outlook for major commodities is mixed. Compared to 2020, gold, copper, nickel and zinc world prices are expected to rise. Iron ore prices are expected to ease over the next two years, while alumina prices are expected to remain relatively flat.

Table 7 Survey of world commodity price forecasts, August 2020

	Iron ore (US$ per tonne)			Gold (US$ per ounce)			Copper (US$ per tonne)		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2019	80	80	80	1392	1392	1392	6005	6005	6005
2020	79	86	92	1600	1647	1710	5200	5369	5555
2021	71	80	90	1550	1747	2100	5500	5989	6500
2022	65	70	75	1512	1760	2200	5649	6295	7000

	Nickel (US$ per tonne)			Zinc (US$ per tonne)			Alumina (US$ per tonne)		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2019	13904	13904	13904	2550	2550	2550	0	335	0
2020	11500	12104	12578	1900	1954	1994	0	272	0
2021	12000	13459	14278	2000	2089	2175	0	280	0
2022	12553	14025	15123	2050	2118	2250	0	289	0

Note: Forecast prices from 2020 to 2022.
Sources: Office of the Chief Economist (June 2020), The World Bank (April 2020), National Australia Bank (August 2020), Trading Economics (2020).

Table 8 World Lithium price forecast (US$ per tonne) – Lithium hydroxide LME

	2019	2020	2021	2022
Office of Chief Economist	11,640	7,327	7,676	8,135
NIEIR	11,640	7,327	7,480	7,725

Note: 2020 prices.
Source: Office of Chief Economist, June 2020.