Resources and Energy Quarterly

December 2018

WWW.INDUSTRY.GOV.AU/**REQ**

Australian Government
Department of Industry, Innovation and Science

Office of the Chief Economist

Resources and Energy Quarterly

December 2018

Further information

For more information on data or government initiatives please access the report from the Department's website at:
www.industry.gov.au/oce

Editor

David Thurtell

Chapter Authors

Resource and energy overview: David Thurtell

Macroeconomic outlook: Thuong Nguyen

Trade tensions box: Joseph Moloney, Nathan Lawrence and Thuong Nguyen

Steel and iron ore: Joseph Moloney

Metallurgical and thermal coal: Monica Philalay

Gas: Nikolai Drahos

Oil: Kate Martin

Gold: Thuong Nguyen

Aluminium, alumina and bauxite: Andrea Bath

Uranium, copper, nickel, lithium: Mark Gibbons

Zinc: Andrea Bath

Special topic *Resources and Energy Major Projects:* Joseph Moloney (lead)

Acknowledgements

The authors would like to acknowledge the contributions of:

Mark Cully, Melissa Bray, Jamie Todling, Ken Colbert, Kelly O'Brien and Monica Conaghan.

Cover image source: Shutterstock

ISSN 1839-5007

Vol. 8, no. 4

Contents

Foreword

Australia remains on track to set a new record in its resource and energy commodity exports in 2018–19. A decline in the Australian dollar has helped boost commodity export earnings up above $264 billion — meaning resource and energy commodities now represent more than half of Australia's total export value. This is an upward revision on our previous forecasts, reflecting strong growth in coal and LNG export earnings, as well as favourable movements in iron ore prices.

Behind the strong figures are a growing set of risks. The world is nine years into the post-GFC recovery, and the peak of the current industrial production cycle has clearly passed, with potential issues around debt and spending emerging in a number of countries. Commodity demand — driven by various government stimulus packages — helped Australia to withstand the global financial crisis, but governments now have less room to move on the fiscal and monetary front.

Trade tensions between the US and China are magnifying these economic risks, and are also having some immediate impacts on prices for a range of commodities. Prices for copper, nickel and aluminium — all commodities with strong links to the global economic cycle — have been hit particularly hard, as the US and China exchange tariff hikes and global supply chains are disrupted. Recent trade tensions are unlikely to have a significant impact on Australian commodities. Exports may be redirected, and prices may be volatile in coming months, but the fundamentals continue to support solid commodity demand around the world, especially for the high-grade commodities Australia offers.

There may even be a silver lining for Australian exporters: to fend off the economic impact of US tariffs, China has committed to a sizeable infrastructure program, and has introduced a substantial new set of stimulus measures, as well as new incentives for research and development in the private sector. These policies are likely to provide ongoing support for commodity demand.

There is a risk that this ramp-up of stimulus in China may reduce the country's capacity to further respond in the event of any substantial slowdown in global economic growth in the years to come. China may find itself in a similar position to the US and Europe, which have maintained sizeable fiscal deficits and low interest rates for many years. The key risk to the commodity outlook thus lies in the 'double whammy': the potential dual impact of growing trade tensions and a substantial slowdown in global economic activity.

Each December edition of the *Resources and Energy Quarterly* contains an analysis of Australia's resources investment pipeline. Over the past 15 years, hundreds of billions of dollars have been directed towards unlocking deposits and removing infrastructure bottlenecks. It is this investment which has allowed the resources sector to become the largest source of Australia's export earnings, as well as a substantial employer and driver of growth in Australia's regions. This edition shows that prospective resource investment is starting to recover again, following a sharp fall due to the completion of the giant LNG projects. Investment is being helped along by the relatively low Australian dollar and by new growth markets in renewable energy and electric vehicles.

Mark Cully

Chief Economist
Department of Industry, Innovation and Science

About this edition

The *Resources and Energy Quarterly* contains the Office of the Chief Economist's forecasts for the value, volume and price of Australia's major resources and energy commodity exports.

Each December edition of the *Resources and Energy Quarterly* features a 'short term' (two year) outlook for Australia's major resource and energy commodity exports and the Major Projects update. A 'medium term' (five year) outlook is published in the March quarter edition of the *Resources and Energy Quarterly*.

Underpinning the forecasts contained in the *Resources and Energy Quarterly* is the Office of the Chief Economist's outlook for global resource and energy commodity prices, demand and supply. The forecasts for Australia's resource and energy commodity exporters are reconciled with this global context.

The global environment in which Australia's producers compete can change rapidly. Each edition of the *Resources and Energy Quarterly* factors in these changes, and makes appropriate alterations to the forecasts, by estimating the impact on Australian producers and the value of their exports.

In this report, commodities are grouped into two broad categories, referred to as 'resources' and 'energy'. 'Energy' commodities comprise metallurgical and thermal coal, oil, gas and uranium. 'Resource' commodities in this report are all other mineral commodities.

Unless otherwise stated, all Australian and US dollar figures in this report are in nominal terms. Inflation and exchange rate assumptions are provided in the Macroeconomic Outlook chapter.

Data in this edition of the Resources and Energy Quarterly is current as of 11 December 2018.

Resources and Energy Quarterly publication schedule

Publication	Expected release date	Outlook period
March 2019	1 April 2019	Australian data: 2023–24 World data: 2024
June 2019	1 July 2019	Australian data: 2020–21 World data: 2021
September 2019	1 October 2019	Australian data: 2020–21 World data: 2021
December 2019	19 December 2019	Australian data: 2020–21 World data: 2021

Source: Department of Industry, Innovation and Science (2018)

Overview

Resources and Energy Quarterly December 2018

Resources and energy sector

18% of Australia's GDP growth in the September quarter of 2018

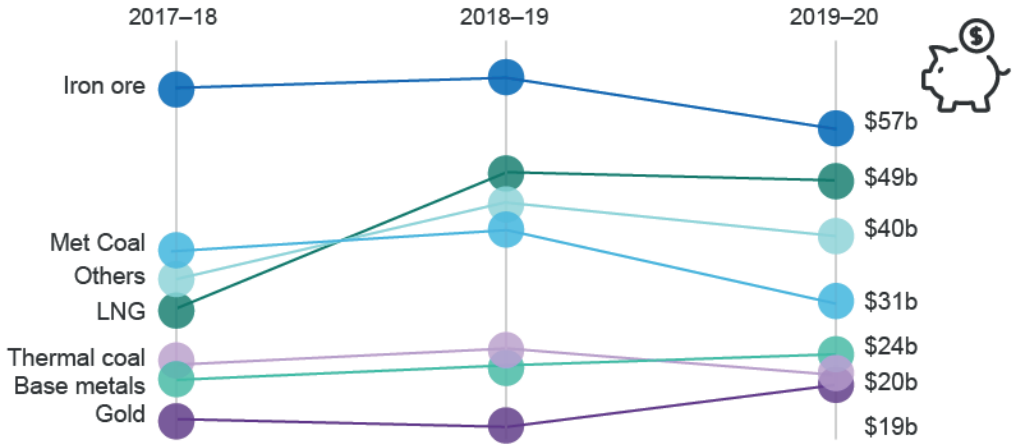
8.2% of GDP in 2017–18

55% Australia's goods and services exports in 2017–18

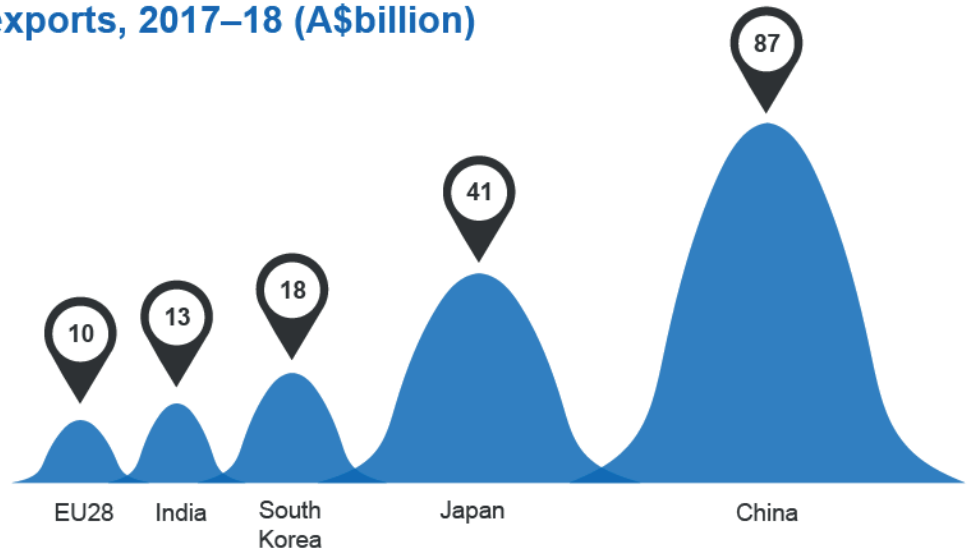
70% of Australia's exports of goods in 2017–18

242,600 people employed (as at August 2018)

Australia's resources and energy exports, A$billion



Major markets for Australia's resources and energy exports, 2017–18 (A$billion)



1.1 Summary

- Helped by a weaker Australian dollar in 2018–19, Australia's resource and energy exports are likely to hit a new record high of $264 billion, before falling back to $241 billion (still the second highest on record) in 2019–20.
- Australia's resources and energy export volumes are expected to show firm growth over the outlook period. The prices of Australia's major resource commodities have been high, but are expected to drift lower in 2019–20 because of moderating demand and rising supply.
- The world industrial production cycle appears to have peaked in 2018. The extent of the expected down cycle in resource commodities depends on whether China can maintain economic growth as the US-China trade dispute impacts.

1.2 Export values

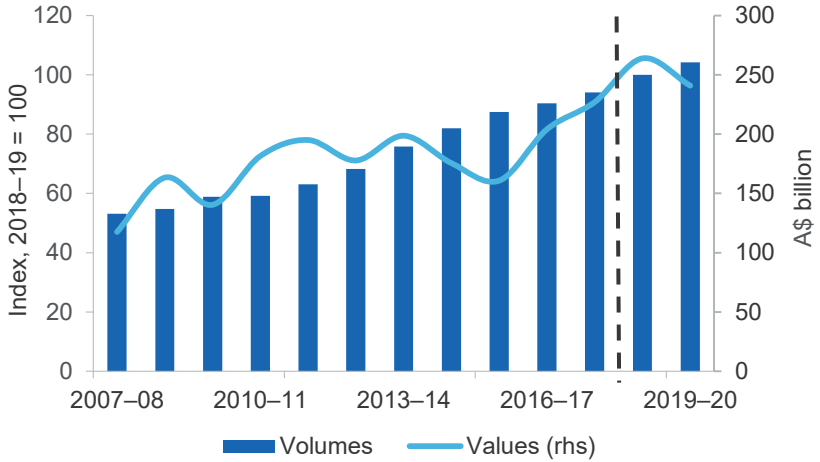
Australia's export values expected to be $264 billion in 2018–19

The Office of the Chief Economist's (OCE) Resources and Energy Export Values Index (preliminary estimate) rose by 29 per cent in the year to the December quarter 2018. This was due to a 23 per cent rise in prices and a 6.4 per cent rise in volumes. Figure 1.2 shows that in 2018–19, a forecast 10.4 per cent rise in prices will add to the impact of a 6.3 per cent rise in export volumes. The value of resource and energy exports is thus forecast to rise by 16.3 per cent to a record $264 billion. 2019–20 is forecast to see export values drop by 8.7 per cent to $241 billion, as a 12.5 per cent fall in prices more than offsets the impact of a 4.3 per cent rise in volumes.

The ongoing weakness in the AUD/USD is boosting commodity returns

In Australian dollar terms, the OCE's Resources and Energy Commodity Price Index grew by 7.1 per cent (preliminary estimate) in the December quarter to be 23.0 per cent higher than a year earlier. In US dollar terms, the index grew by 5.4 per cent in the quarter, to be 15.2 per cent higher than a year earlier. Figure 1.3 shows that prices for resource commodities rose by 6.8 per cent in the December quarter, while prices of energy commodities grew by 7.4 per cent in the quarter in Australian dollar terms.

Figure 1.1: Australia's resource and energy export values/volumes

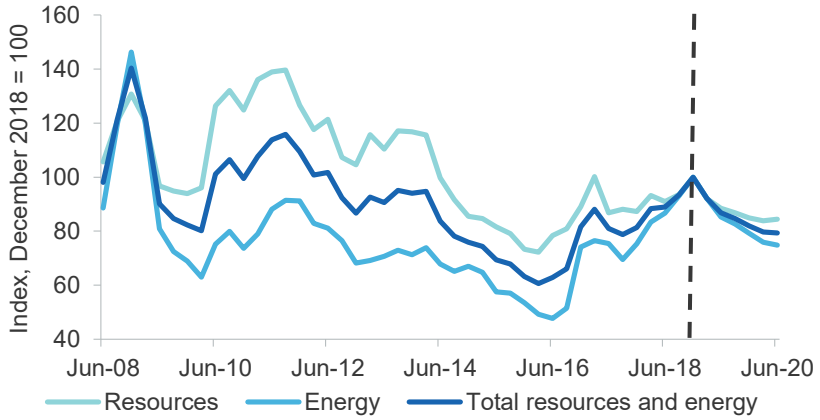


Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Figure 1.2: Annual growth in Australia's resources and energy export values, contributions from prices and volumes

Source: Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Figure 1.3: Resource and energy export prices, AUD terms



Notes: The export price index is based on Australian dollar export unit values (EUVs, export values divided by volumes); the export price index is a Fisher Price Index, which weights each commodity's EUV by its share of total export values.

Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

1.3 Macroeconomic and trade tension influences

There is evidence that the peak of the current global economic cycle has passed, raising doubts over the strength of demand for resource and energy commodities over the outlook period. Leading indicators of industrial activity continue to weaken, and monetary conditions in most economies are not as stimulatory as they were 3 months ago. US dollar strength is still drawing liquidity out of nations with fiscal/debt woes, and is also helping to hold down resource commodity prices, especially metals.

The US economy continues to growing strongly, but the impact of the 2018 tax cuts will gradually dissipate. Following the November 2018 mid-term elections, US fiscal policy is unlikely to prove as stimulatory in the forecast period as it has been in the past year. The Democratic Party — set to take control of the US House of Representatives in the first week of 2019 — is likely to favour higher infrastructure spending and the preservation of health care and welfare programs at the expense of further tax cuts and increased spending on both defence and a wall on the Mexico border. The Republican-controlled Senate is unlikely to back increased infrastructure spending if it requires tax hikes and/or increased debt issuance.

Chinese economic growth is unlikely to rise, as stimulatory policy merely tries to offset the impact of US trade measures. The rest of the world is growing at or above trend pace, and low inflation in all major economies except the US continues to provide scope for easy monetary conditions to continue.

Foreign trade measures have been a central focus of resource and energy commodity markets over the past quarter. While a new trade agreement between the US, Canada and Mexico has removed worries of a North American trade conflict, a new concern is whether US barriers on auto imports are raised, sparking retaliatory measures from the likes of the Eurozone and Japan. The US and China have not managed to resolve the disagreements on trade that have seen tit-for-tat tariff measures imposed over the past eight months. And the concern is that the US demands are so damaging to China's technological and industrial ambitions that it is unlikely the Chinese Government will accede to them fully. However, our analysis on the US-China trade tensions (see the next chapter) suggests that the impact on Australia to date is very limited. In fact, the fall in the AUD/USD over the past 10 months has more than offset the likely adverse impact of the US tariffs on imports from China.

Chinese steel production continues to grow strongly. This strength is likely the result of recent Chinese government efforts to ensure that growth does not slow too much as the US import tariffs start to impact on Chinese exports. These efforts include some relaxation of monetary policy and increased infrastructure spending. The winter production curbs that characterised last year in particular, may be relaxed modestly this winter. Such a relaxation would help maintain steel sector employment and ensure the supply of steel for infrastructure projects.

World equity markets have seen some sharp corrections over the past few months, suggesting concerns over the economic outlook. Chinese equities have continued to decline since our last report, and have now lost all of the gains of 2017. US equities have lost ground recently, after a strong start to

2018; rising US interest rates and concerns over US-China trade tensions have contributed to the falls. Strength in early 2018 came as many US companies used tax cuts and the profit repatriation holiday (granted to US companies with overseas operations) to buy back shares, announce higher dividends and reduce debt issuance. There has been concern that using their funds this way has come at the expense of investment in new production capacity — and hence economic growth continued low inflation.

1.4 Prices

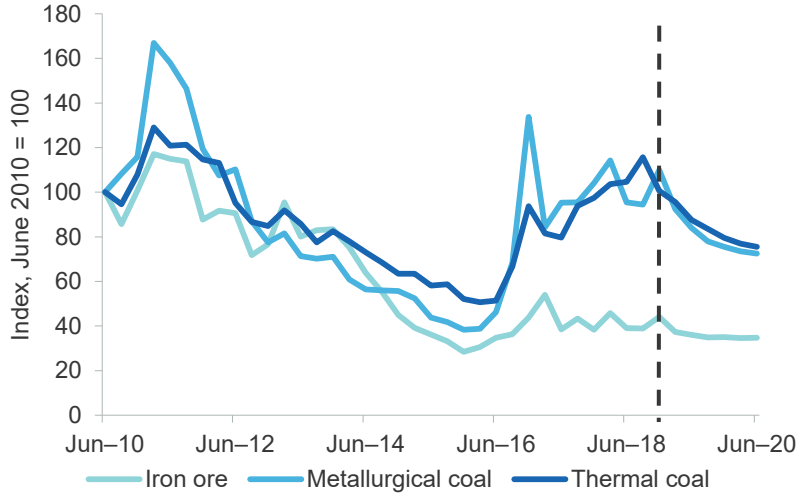
The iron ore price has been supported by the (unexpected) ongoing strength in China's steel market. Winter cutbacks were delayed, and the BHP train derailment in Western Australia briefly raised fears of shortages. The iron ore price is forecast to decline modestly over the next two years (Figure 1.4), as Chinese steel output eases and world supply grows.

Metallurgical coal spot prices rebounded back over the US$200 a tonne mark in the December quarter, as supply concerns hit the market. The price is likely to ease back over the forecast period. Low energy thermal coal prices have declined much more sharply than high energy thermal coal prices. Thermal coal prices are expected to ease through 2019 and 2020, as supply rebounds and demand moderates (Figure 1.4).

Oil prices declined sharply in the December quarter, which has flow-through implications for LNG revenues over the next few months. However, with oil prices expected to stabilise at about US$72 a barrel, Australia's growing oil, condensate and LNG volumes should result in petroleum and LNG revenues holding at relatively high levels.

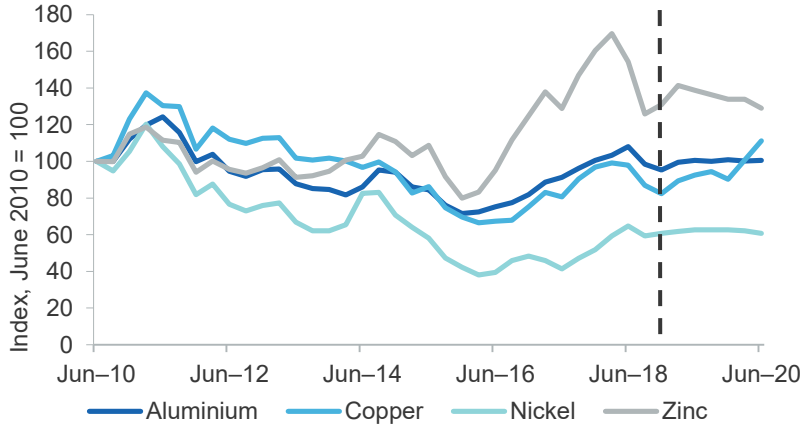
Gold has recovered some of its September quarter losses, despite a significant rise in real bond yields and a further gain in the US dollar against most currencies. A rebound is expected when the US dollar finishes its rise some time in 2019. Base metal prices declined in the December quarter (Figure 1.5) but most are expected to hold up or even rise (in the case of copper) from here.

Figure 1.4: Bulk commodity prices



Notes: Prices are in US dollars, and are the international benchmark prices
Source: Bloomberg (2018)

Figure 1.5: Base metal prices



Notes: Prices are in US dollars, and are the international benchmark prices
Source: Bloomberg (2018)

1.5 Export volumes

Export volumes to grow, driven by growing energy exports

The OCE's Resources and Energy Export Volumes Index (preliminary estimate) rose by 6.4 per cent year-on-year in the December quarter 2018, taking the index to a new record high. Resource commodity volumes rose by 0.4 percent, and energy commodity volumes rose by 12.2 per cent.

Surging LNG and crude oil exports drove annual growth in overall resources and energy export volumes in the December quarter. The deliberate derailment of a runaway iron ore train by BHP appears likely to have a minor impact on iron ore exports in 2018–19. Port maintenance and mine problems are likely to inhibit growth in metallurgical coal exports in 2018–19, but better supply to the seaborne market is likely in 2019–20.

1.6 Contribution to growth and investment

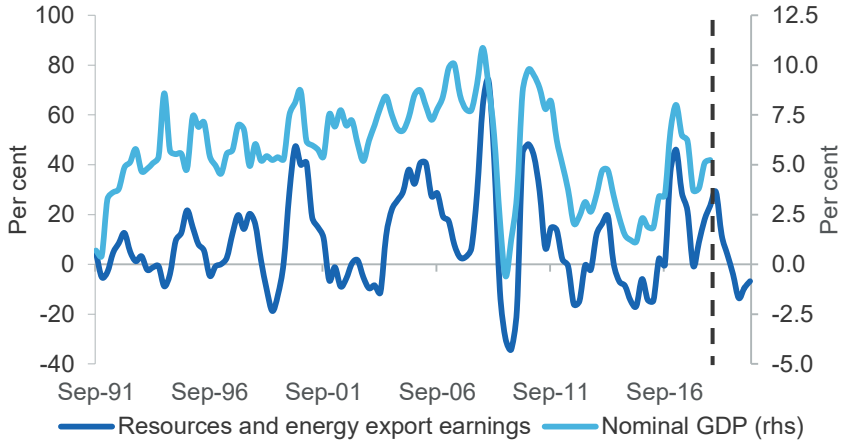
Mining industry continues to support overall economic growth

Australia's real Gross Domestic Product (GDP) grew by 0.3 per cent in the September quarter 2018. The mining industry directly accounted for 18 per cent of the growth in Australia's GDP in the September quarter. Since the global financial crisis, swings in resource and energy export earnings have correlated closely with swings in nominal GDP. Figure 1.6 suggests that with growth in resource and energy export values likely having peaked in late 2018, if the correlation persists, nominal GDP growth could soon weaken from recent rates.

Mining value-added edged back marginally in the September quarter, as a result of falls in the value-add of coal and iron ore. Partly offsetting this, oil and gas extraction grew strongly in value-added terms, with the sector now benefiting from the completion of several major infrastructure projects.

Oil and gas extraction and iron ore mining have been the largest contributors to mining industry value-added growth in the last few years, propelled by growing export volumes. In the coming few years, it is likely that slowing export growth and relatively low investment will see a smaller contribution to Australia's GDP growth from the oil and gas production sector.

Figure 1.6: Australia's nominal GDP vs resource and energy commodity export earnings, annual per cent change



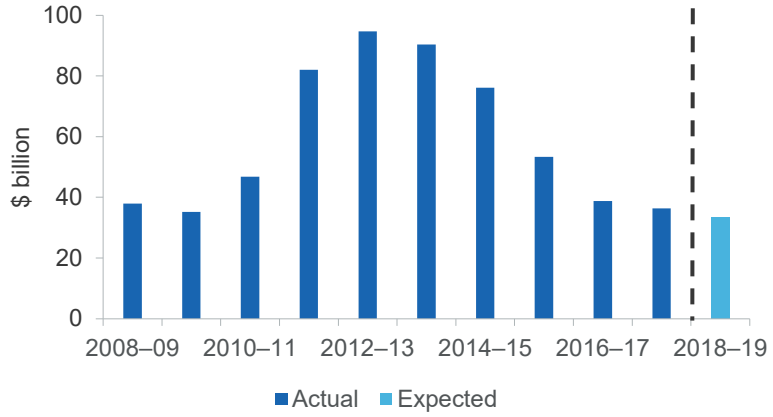
Source: Department of Industry, Innovation and Science (2018), ABS (2018)

Mining investment has fallen slightly further but could begin to rebound

Investment in Australia's mining industry stood at $36 billion in 2017–18 — a 6 per cent decline from 2016–17 (see Figure 1.7). Investment continued to edge down year-on-year in the September quarter. The major driver was the oil and gas sector, where investment has been falling steadily since 2013 (Figure 1.8). The fall in investment in oil and gas reflects the completion of large projects such as Wheatstone in Western Australia and Ichthys in the Northern Territory.

Falls in oil and gas investment were partially offset by a lift in investment in coal mining, metal ore mining and other mining. This lift in investment activity — just as the wind down in oil and gas investment is concluding — suggests that the bottom of the mining investment cycle is approaching. The feature chapter on Resources and Energy Major Projects in this edition of *Resources and Energy Quarterly* paints a similar picture of mining investment trends: while investment has fallen over the past few years, there is significant potential for a rebound in the value of committed projects from 2018 onwards.

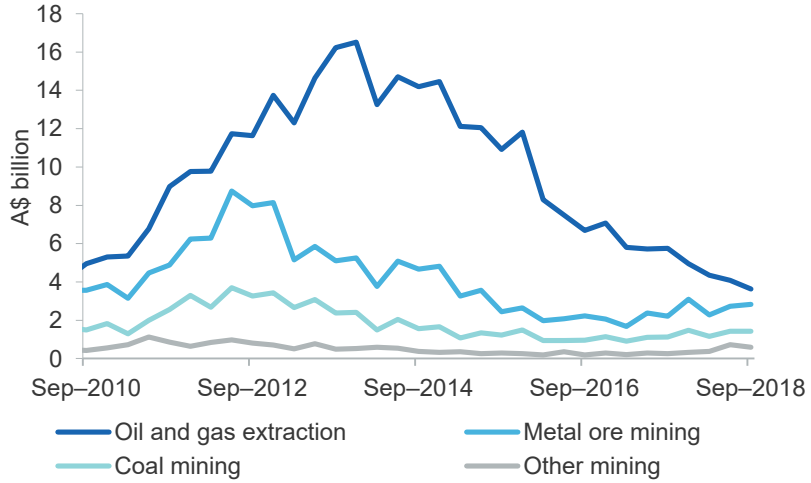
Figure 1.7: Mining industry capital expenditure, fiscal year



Notes: Chart data is in nominal terms

Source: ABS (2018) Private New Capital Expenditure and Expected Expenditure, 5625.0

Figure 1.8: Mining industry capital expenditure by commodity



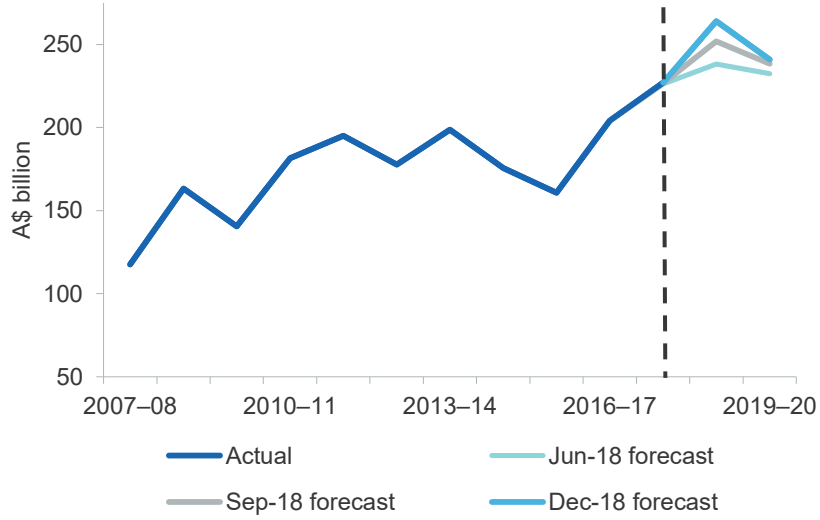
Notes: Other mining includes non-metallic mineral mining and quarrying and exploration and other mining support services; chart data is in nominal terms

Source: ABS (2018) Private New Capital Expenditure and Expected Expenditure, 5625.0

1.7 Revisions to the outlook

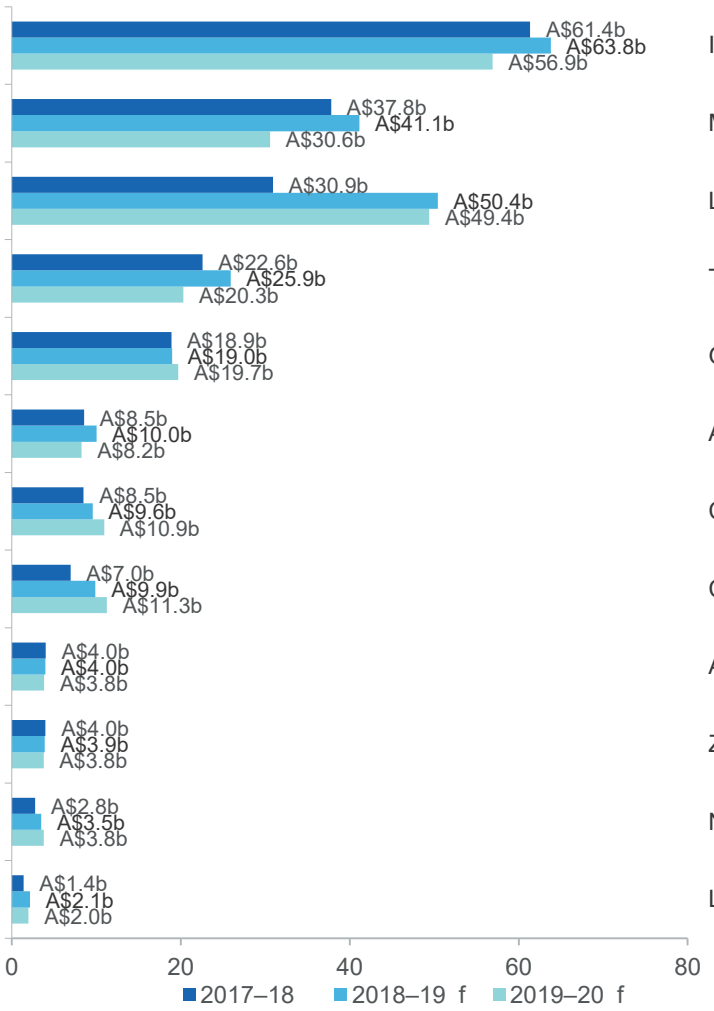
The outlook for Australia's resources and energy export earnings in 2018–19 has been revised up by around $12.1 billion from the September 2018 *Resources and Energy Quarterly*. The weaker AUD/USD factored into our forecasts is estimated to add $7.4 billion to export values, while higher-than-expected metallurgical coal and iron ore prices account for the rest of the forecast gain. The forecast for Australia's resources and energy export earnings in 2019–20 has been revised up by $2.6 billion, reflecting the weaker outlook for the AUD-USD exchange rate, particularly in the latter half of 2019.

Figure 1.9: Revisions to the outlook



Source: Department of Industry, Innovation and Science (2018)

Figure 1.10: Australia's major resource & energy commodity exports



CAGR per cent change from 2017–18

	2018–19[f]			2019–20[f]		
	volume	EUV	value	volume	EUV	value
Iron ore	→ 0	▲ 4	▲ 4	▲ 2	▼ –5	▼ –4
Metallurgical coal	▲ 4	▲ 5	▲ 9	▲ 3	▼ –13	▼ –10
LNG	▲ 21	▲ 34	▲ 63	▲ 13	▲ 12	▲ 26
Thermal coal	▲ 3	▲ 12	▲ 15	▲ 2	▼ –7	▼ –5
Gold	▼ –1	▲ 1	→ 0	▲ 2	▲ 1	▲ 2
Alumina	▼ –2	▲ 20	▲ 17	▼ –1	▼ –1	▼ –2
Copper	▲ 10	▲ 3	▲ 13	▲ 7	▲ 6	▲ 14
Crude oil	▲ 17	▲ 22	▲ 42	▲ 19	▲ 7	▲ 27
Aluminium	▼ –4	▲ 3	▼ –1	▼ –2	▼ –1	▼ –2
Zinc	▲ 25	▼ –21	▼ –2	▲ 16	▼ –16	▼ –3
Nickel	▲ 11	▲ 12	▲ 25	▲ 11	▲ 5	▲ 17
Lead	▲ 44	▲ 6	▲ 52	▲ 24	▼ –5	▲ 19

Notes: Nominal terms; per cent change is compound annual growth (CAGR) from 2017–18 to the specified year; f forecast.

Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Table 1.1: Outlook for Australia's resources and energy exports

						Annual percentage change		
	Unit	2016–17	2017–18	2018–19[f]	2019–20[f]	2017–18	2018–19[f]	2019–20[f]
Resources and energy	A$m	204,130	227,130	264,001	240,956	11.3	16.3	–8.7
– real[b]	A$m	212,854	232,318	264,001	235,250	9.1	13.6	–10.9
Energy	A$m	85,328	101,957	132,399	117,037	19.5	29.9	–11.6
– real[b]	A$m	88,974	104,302	132,399	114,265	17.2	26.9	–13.7
Resources	A$m	118,802	125,138	131,603	123,919	5.3	5.2	–5.8
– real[b]	A$m	123,879	128,016	131,603	120,985	3.3	2.8	–8.1

Notes: **b** In 2018–19 Australian dollars. **f** forecast.
Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Table 1.2: Australia's resource and energy exports, selected commodities

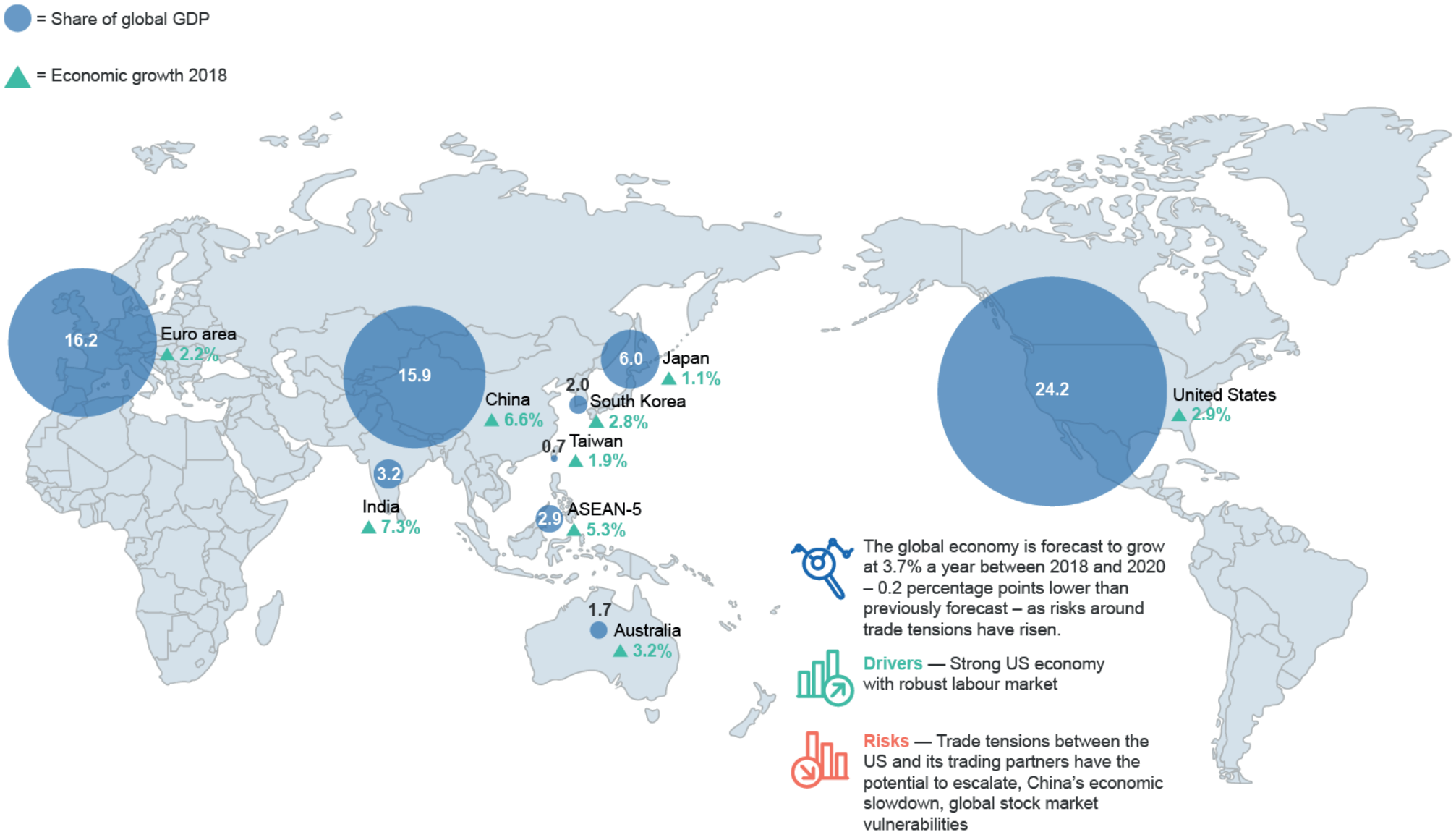
	Prices				Export volumes				Export values A$b		
	Unit	2017–18	2018–19[f]	2019–20[f]	Unit	2017–18	2018–19[f]	2019–20[f]	2017–18	2018–19[f]	2019–20[f]
Iron ore	US$/t	61	57	51	Mt	849	852	879	61	64	57
Metallurgical coal	US$/t	205	191	150	Mt	179	187	190	38	41	31
LNG	A$/GJ	9.5	13	12	Mt	62	75	78	31	50	49
Thermal coal	US$/t	99	99	78	Mt	203	208	209	23	26	20
Gold	US$/oz	1,297	1,246	1,291	t	348	345	359	19	19	20
Alumina	US$/t	418	440	358	kt	17,746	17,400	17,511	8.5	10	8.2
Copper	US$/t	6,746	6,166	6,959	Kt	894	979	1,030	8.5	10	11
Crude oil[a]	US$/bbl	64	74	72	Kb/d	226	264	319	7.0	9.9	11
Aluminium	US$/t	2,133	2,057	2,099	Kt	1,431	1,372	1,383	4.0	4.0	3.8
Zinc	US$/t	3,183	2,745	2,700	Kt	1,164	1,456	1,565	4.0	3.9	3.8
Nickel	US$/t	12,466	13,667	13,875	Kt	196	218	240	2.8	3.5	3.8
Lithium	US$/t	795	837	780	Kt	1124	1347	1529	0.9	1.1	1.2
Uranium	US$/lb	21	27	28	t	8,118	6,743	7,240	0.6	0.7	0.7

Notes: **a** Export data covers both crude oil and condensate. **f** forecast. Price information: Iron ore fob (free-on-board) at 62 per cent iron content estimated netback from Western Australia to Qingdao China; Metallurgical coal premium hard coking coal fob East Coast Australia; Thermal coal fob Newcastle 6000 kc (calorific content); LNG fob Australia's export unit values; Gold LBMA PM; Alumina fob Australia; Copper LME cash; Crude oil Brent; Aluminum LME cash; Zinc LME cash; Nickel LME cash; Lithium spodumene ore;

Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; LME; London Bullion Market Association; The Ux Consulting Company; US Department of Energy; Metal Bulletin; Japan Ministry of Economy, Trade and Industry; Department of Industry, Innovation and Science (2018)

Macroeconomic Outlook

Resources and Energy Quarterly December 2018



2.1 Summary

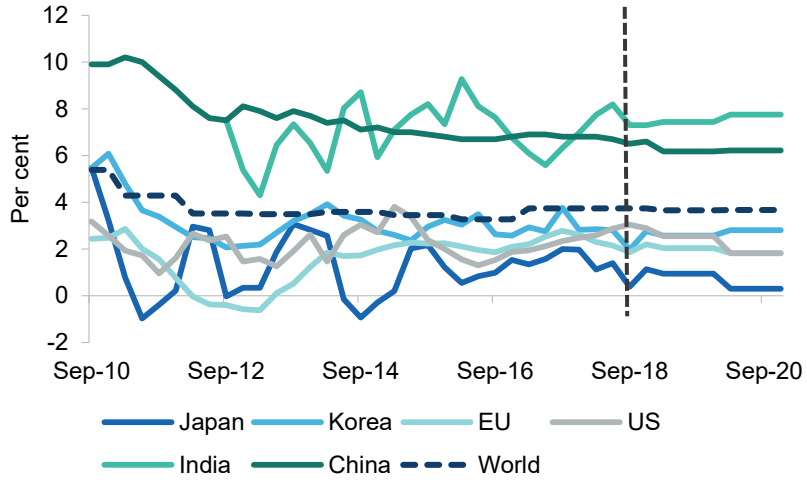
- The global economy is forecast to grow at 3.7 per cent a year between 2018 and 2020 — 0.2 percentage points lower than previously forecast. This primarily reflects the impact of tit-for-tat US-China adverse trade measures: slower foreign trade and investment.
- The US economy continues to grow strongly, but is expected to slow once the impact of the tax cuts wash through and recent interest rate hikes start to exert a larger effect. In China, domestic economic growth is decelerating. Eurozone economies recorded their weakest growth in four years in the September quarter.
- The outcome of the US mid-term elections in November 2018 has raised the prospects of legislative gridlock. Trade tensions between the US and its trading partners have the potential to escalate, and volatility in global stock markets is expected to continue through 2019. Geopolitical tensions in the Middle East may rise, following the recent reimposition of US sanctions on Iran.

2.2 Global economy

The September quarter 2018 saw the global economy expand at a slower pace than in the June quarter, with growth falling in both advanced and emerging economies (Figure 2.1). Growth in world manufacturing activity has started to ease off. The global manufacturing Purchasing Managers Index (PMI) was at 52.0 in November 2018, down from a cyclical high of 54.5 in December 2017. China, the US, Japan and the EU all have manufacturing PMIs above the 50 level (which indicates expansion), but downward movements are evident, which could have implications for global commodity demand (Figure 2.2).

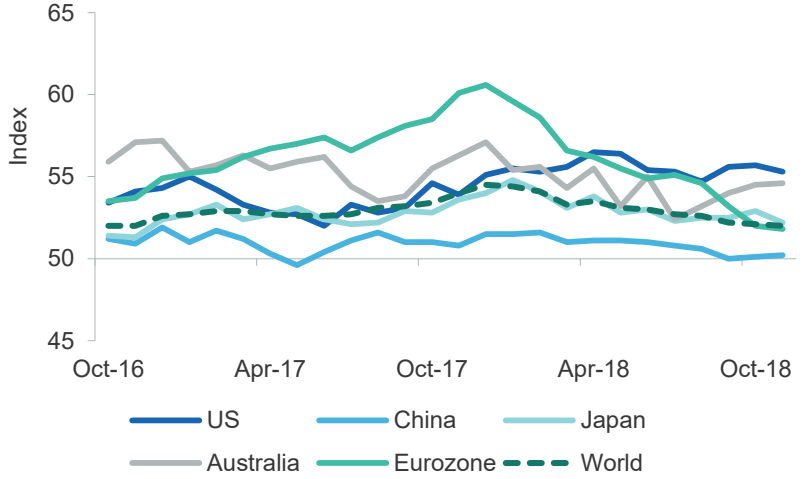
In October 2018, the International Monetary Fund (IMF) cut its global economic forecasts for the first time in two years, citing escalating trade tensions and stresses in emerging markets. Global economic growth is expected to fall below the July 2018 economic outlook, reaching 3.7 per cent annually in 2018, 2019 and 2020.

Figure 2.1: Global and major economies real GDP, YoY growth



Source: International Monetary Fund (2018)

Figure 2.2: Manufacturing Purchasing Managers Index (PMI)



Source: Markit (2018)

Other emerging economies — Indonesia, Brazil, Argentina, Mexico, Turkey, Iran and South Africa — are expected to suffer from rising US interest rates and capital outflows, with the growth forecast for developing economies cut by 0.2 of a percentage point in 2018 and 0.4 of a percentage point in 2019.

Steep falls in global stock markets since October 2018 have raised fears that escalating trade tensions could trigger a global stock market crash reminiscent of 2008, when US equity markets plunged by 25 per cent over a couple of days. Such a shock would be felt in markets around the world. Global share markets have already lost around US$7 trillion in value terms since October 2018. The benchmark US Standard and Poor 500 Index has dropped by 7.5 per cent, in line with the fall over the same period in the Chinese stock market. Despite these falls, the current value (US$72 trillion) of world equity markets is still three times higher than it was in the wake of the 2008 global financial crisis, when it fell to US$26 trillion.

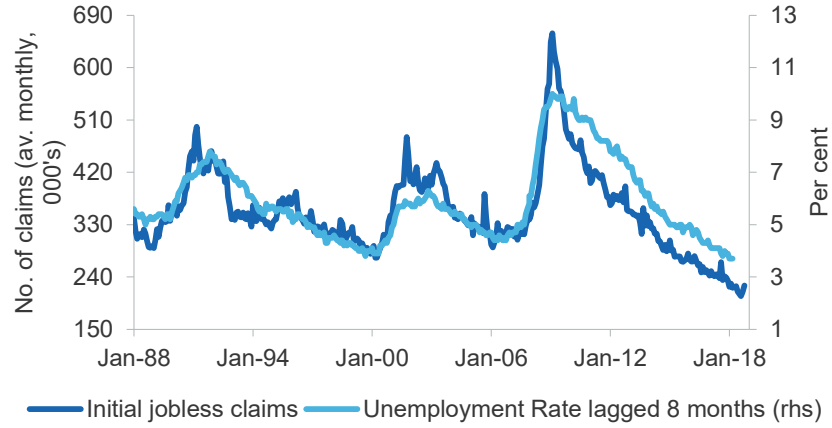
2.3 United States

US economic growth slowed to 3.0 per cent year-on-year in the September quarter. While still robust, US growth has been partly constrained by China's retaliatory tariffs on US exports, which have seen exports of soybeans, petroleum and non-automotive capital goods falling significantly. Imports of consumer goods and motor vehicles continue to rise, as businesses seek to build stockpiles before US import duties come into effect.

Despite slower economic growth, the US economy remains fundamentally solid. The US manufacturing activity in November continued to expand, with the US Institute for Supply Management (ISM) Manufacturing Index increasing to 59.3 in November 2018, from 57.7 in October. Consumer spending remained strong, and the unemployment rate at a near 50 year low of 3.7 per cent in November 2018 (Figure 2.3).

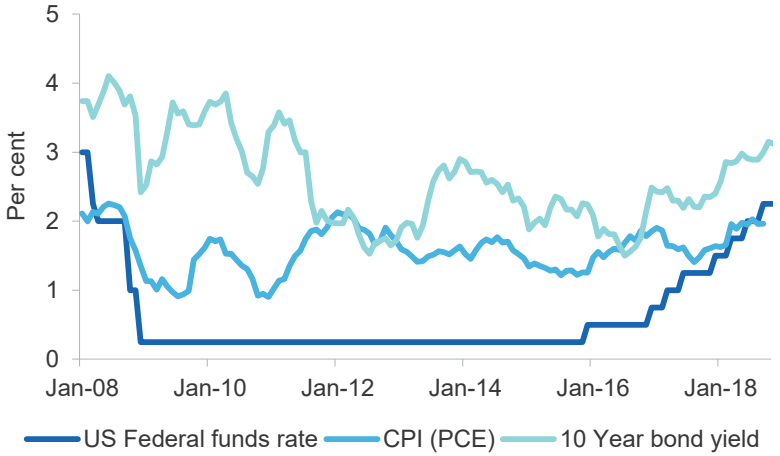
However, the US economy is likely to face several pressures in the short term. The results of the November mid-term elections have dampened

Figure 2.3: US unemployment rate and Initial jobless claims



Source: US Department of Labour (2018); Bureau of Labour Statistics (2018)

Figure 2.4: US Federal funds rate, CPI and 10-Year bond yield



Source: US Federal Reserve (2018) Federal Funds Rate; US Bureau of Labour Statistics (2018) US Personal Consumption Expenditure (PCE) Core Price Index

prospects for further stimulatory tax cuts over the next two years. Tariffs imposed on a wide range of imports from China (totalling US$517 billion) are expected to push inflation and interest rates higher, dampening consumer and business confidence. Median weekly wages rose by 1.1 per cent in the September quarter 2018 compared to the June quarter 2018, suggesting that the labour market is tightening. Higher interest rates are pressuring the US housing markets, which contracted at their steepest pace in more than a year in the September quarter.

The US Federal Reserve is expected to reassess its timetable of interest rate rises for 2019, leaving the Federal fund rates unchanged at 2.25 per cent in November. At the time of writing, a rate hike is still expected following the next meeting on 18 December 2018 (Figure 2.4).

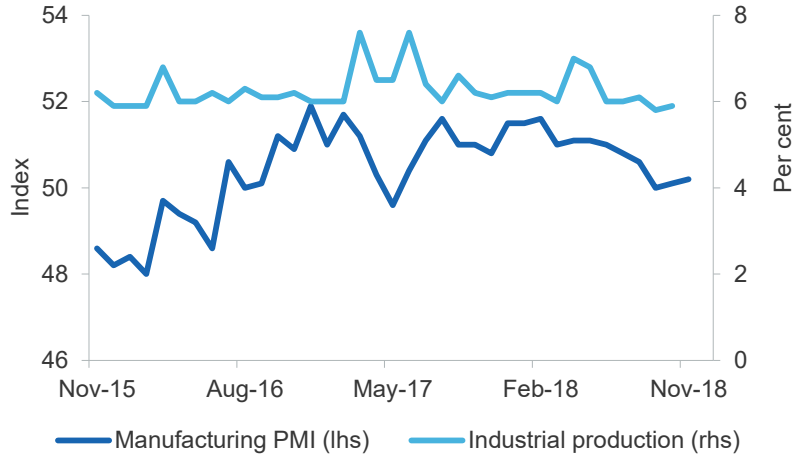
2.4 China

The Chinese economy grew by 6.5 per cent year-on-year in the September quarter 2018. This is the lowest growth rate since the aftermath of the global financial crisis (GFC), and reflects escalating trade tensions with the US and increased borrowings by local governments.

China's industrial production increased at a slower pace in October 2018 (5.9 per cent year-on-year), down from a 6.8 per cent rise in August 2018. This was the second lowest growth since February 2016, and mainly reflects a slowdown in manufacturing output. The manufacturing Manufacturers Purchasing Managers' Indices (PMIs) were at or close to neutral territory (indicating no growth in activity or contraction on a monthly basis) in November. China's official PMI fell to 50 in November from 50.2 in October. The Markit manufacturing PMI in November rose to 50.2, up slightly from the 16-month low of 50.1 in October 2018 (Figure 2.5).

On 31 October 2018, the Chinese Renminbi traded at 6.9737 per US dollar — the lowest level against the US dollar in more than a decade. The currency dropped nearly 9 per cent against the US dollar in 2018, and may drop further should trade tensions continue to heat up (Figure 2.6).

Figure 2.5: China's industrial production and Manufacturing PMI



Source: Markit (2018); Netherland CPB (2018)

Figure 2.6: The US dollar/Chinese Renminbi

Source: Thomson Reuters (2018)

Exports are still strong, but will face greater pressure as higher US tariffs come into effect. China's property sector is not expected to provide as much support for commodity demand as it has in the recent past. China's economic growth is forecast to slow to 6.2 per cent in 2020, as a result of lower internal demand and tightening financial regulations.

The Chinese Government has introduced a number of targeted measures aiming at offsetting the impact of the US trade measures on the economy. These measures include:

- Increased spending on urban infrastructure has risen, with recent projects including a 78.7 billion Yuan urban rail project for Changchun, a 95 billion Yuan subway network project for Suzhou, and transport projects for Guangdong worth 1.36 trillion Yuan.
- Increased export tax rebates, effective October 2018, will apply to 397 products, including steel, chemicals, lithium batteries, light-emitting diodes, multi-component semiconductors, machinery products, and books and newspapers.
- Import tariff cuts on consumer goods from July 2018 — these will reduce the price of nearly 1,500 consumer products, ranging from cosmetics, washing machines, refrigerators to other home appliances. The average tariff rate was cut significantly — from 15.7 per cent to 6.9 per cent. Tariff cuts have also been made on industrial goods.
- Personal tax-free thresholds were raised, effective October 2018, from 3,500 Yuan to 5,000 Yuan per month.
- New personal tax deductions — effective from January 2019 — allow homeowners and tenants to get tax free allowance for their mortgage and rental payments, and parents to claim tax deduction against their children's education expenses.

Some immediate impact is evident in construction, with the construction activity index in the services PMI lifting by 5.4 points year-on-year in October 2018, to 63.9. The measures are likely to have a rising impact over time.

2.5 Other economies

Japan

Japan's economic growth contracted by 0.6 per cent on quarter in the September quarter 2018 — the steepest contraction since the June quarter 2014 — as a result of several natural disasters. Private consumption, which accounts for 60 per cent of GDP, dropped by 0.2 per cent, following a 0.7 per cent increase in the June quarter. Trade tensions between the US and its trading partners impacted Japan's exports, which declined by 1.8 per cent in the September quarter.

Japan's economic growth is forecast to slow to 0.3 per cent in 2020, as a rising consumption tax, ageing and shrinking of the working population, and trade tensions, which all impact on consumption. A rise in Japan's consumption tax rates (by 2 percentage points, to 10 per cent, from 1 October 2019) is intended to fund growing pension expenses and support fiscal consolidation. However, it may also reduce consumption in 2020. Japan's fiscal and monetary policies are already stimulatory, and there is limited room to respond to external shocks including trade tensions with the US.

Europe

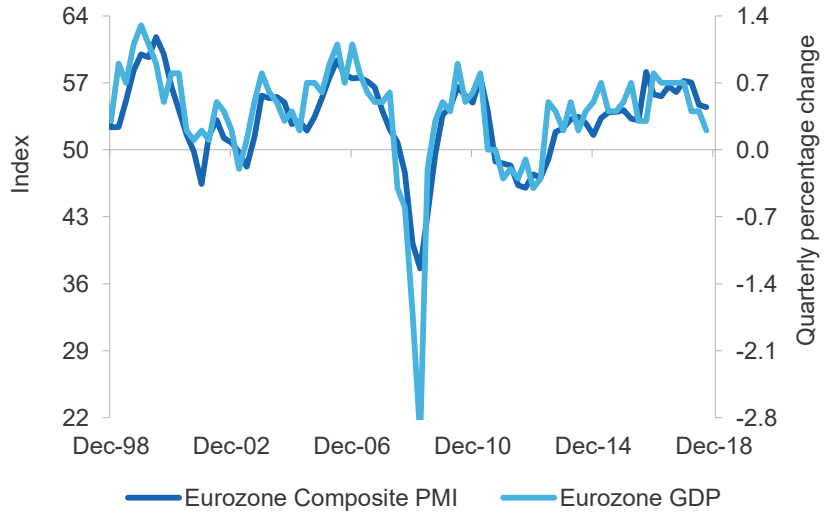
The Eurozone economy grew by 1.9 per cent year-on-year in the September quarter — the weakest growth in four years — as Italy's economy stalled. The Eurozone's manufacturing PMI fell to a 27-month low of 51.8 in November 2018, amid worries about the trade tensions and rising prices (Figure 2.7).

The Eurozone's inflation rate is expected to pick up, supported by a tightening labour market. Eurozone unemployment remained at a post global financial crisis low of 8.1 per cent in October 2018. This is 4 percentage points down from a high of 12.1 per cent in 2013, but there is a significant divergence across the Eurozone. Germany's unemployment rate fell to a thirty-year low of 3.3 per cent in October 2018, but unemployment rates in Spain (14.9 per cent) and Italy (10.6 per cent) remain stubbornly high.

Eurozone economic growth is expected to slow further in the next few years. Italy's debt and deficit problems and Brexit pose risks to growth. A potential threat is US protectionist measures against Europe's automotive vehicles and automotive parts sectors. The International Monetary Fund has revised the Eurozone economy forecast down by 0.4 percentage points for 2018 and 0.1 percentage points for 2019.

The European Central Bank (ECB) has committed to end its stimulatory US$2.6 trillion asset purchase scheme by the end of 2018, despite the weaker economic growth outlook. The Eurozone's interest rates are also likely to rise in the second-half of 2019, as wage rises push up inflation.

Figure 2.7: Eurozone Composite PMI and Real GDP



Source: Bloomberg (2018); International Monetary Fund (2018)

South Korea

South Korea's economic growth slowed to 2.0 per cent year-on-year in the September quarter 2018. This was the weakest growth in nine years, and reflects a sharp 7.8 per cent fall in construction in the September quarter. Slower growth was also recorded in private consumption (which expanded by 2.6 per cent in the quarter) and government expenditure (which grew by 4.7 per cent).

South Korea's economic growth is forecast to slow to 2.8 per cent in 2018 from 3.1 per cent in 2017, and to 2.6 per cent in 2019, as trade tensions between the US and its trading partners have spillover effects on South Korean exports of intermediate goods. The South Korean government announced an expansionary 2019 budget in late August 2018. South Korea's industrial production rebounded in October 2018, up 10.7 per cent year-on-year. However, South Korean companies are expected to adopt a cautious approach amid the uncertain global trade environment.

India

India's real GDP growth rate rose to 8.2 per cent year-on-year in the June quarter, as the post goods and services tax (GST) recovery gathers pace. The growth was supported by strong urban and rural demand, and improved industrial activity.

India's economy remains one of the fastest growing economies in the world. The GST — introduced from 1 July 2017 — has provided the government with additional revenue to spend on social and infrastructure projects, and low wages are improving India's competitiveness. The Indian government is also undertaking projects to increase the quality of India's ports, including the development of a transhipment hub. Real GDP is forecast to grow by 7.3 per cent in 2018, rising to 7.7 per cent in 2020.

Rising oil prices and global trade tensions represent the primary risks to the Indian economy, which otherwise continues to perform solidly.

Table 2.1: Key world macroeconomic assumptions

Per cent	2017	2018[a]	2019[a]	2020[a]
Economic growth[b]				
Advanced economies	2.4	2.4	2.1	1.7
Australia	2.3	3.2	2.8	2.7
Eurozone	2.7	2.2	2.0	1.8
France	2.3	1.6	1.6	1.6
Germany	2.5	1.9	1.9	1.6
Japan	1.7	1.1	0.9	0.3
New Zealand	3.0	3.1	3.0	3.1
South Korea	3.1	2.8	2.6	2.8
United Kingdom	1.7	1.4	1.5	1.5
United States	2.3	2.9	2.5	1.8
Emerging economies	4.7	4.7	4.7	4.9
ASEAN-5[d]	5.3	5.3	5.2	5.2
China[e]	6.9	6.6	6.2	6.2
Chinese Taipei	2.8	2.7	2.4	2.3
Emerging Asia	6.5	6.5	6.3	6.4
India	6.7	7.3	7.4	7.7
Latin America	1.3	1.2	2.2	2.7
Middle East	2.2	2.0	2.6	2.9
World[c]	3.7	3.7	3.7	3.7

Notes: a Assumption; b Year-on-year change; c Weighted using purchasing power parity (PPP) valuation of country gross domestic product by IMF; d Indonesia, Malaysia, the Philippines, Thailand and Vietnam; e Excludes Hong Kong

Source: IMF (2018) World Economic Outlook; Department of Industry, Innovation and Science

Table 2.2: Exchange rate and inflation assumptions

	2017	2018	2019	2020
AUD/USD exchange rate	0.77	0.75	0.74	0.77
Inflation rate				
United States	97.6	100.0	102.2	103.4
	2016–17	**2017–18**	**2018–19**	**2019–20**
Australia	95.9	97.8	100.0	102.4

Notes: The inflation rate for Australia is used to covert Australian export values to real 2018–19 dollars.
The inflation rate for the United States is used to convert commodity prices denominated in USD to real 2018 dollars.

Source: Department of Industry, Innovation and Science (2018); Bloomberg (2018) Survey of economic forecasters

Box 2.1: Trade Tensions

Over the course of 2018, the US administration implemented several restrictive trade policies which vary between trade partners and mostly involve the use of tariffs or quotas on imports. Some trading partners of the US responded by imposing tariffs on imported goods from the US.

China is Australia's largest export destination for iron ore, bauxite, copper ores and concentrates, and the second largest destination for metallurgical coal. The imposition of US trade tariffs on global imports of steel and aluminium (for which Australia has negotiated an exemption), as well as tariffs on Chinese imported goods — many of which contain high amounts of steel, copper and aluminium — has the potential to reduce China's demand for steel making imports, namely iron ore and metallurgical coal, as well as imported copper (refined, ores and concentrates) and aluminium (and inputs alumina and bauxite).

However, because China's domestic consumption is large compared to their exports to the US of products containing these commodities (Table 2.3) — and not every product subject to the US tariffs contains steel, copper or aluminium — the OCE expects the direct impact on Australia's export earnings from the US-China tariffs will be negative but small.

Table 2.3: China's use of major commodities, 2017

	Steel	Copper	Aluminium
Net production and imports (million tonnes)	788	17	34
China's domestic consumption	86%	63%	72%
China's export to the world	14%	37%	28%
- China's export to USA	1%	6%	5%

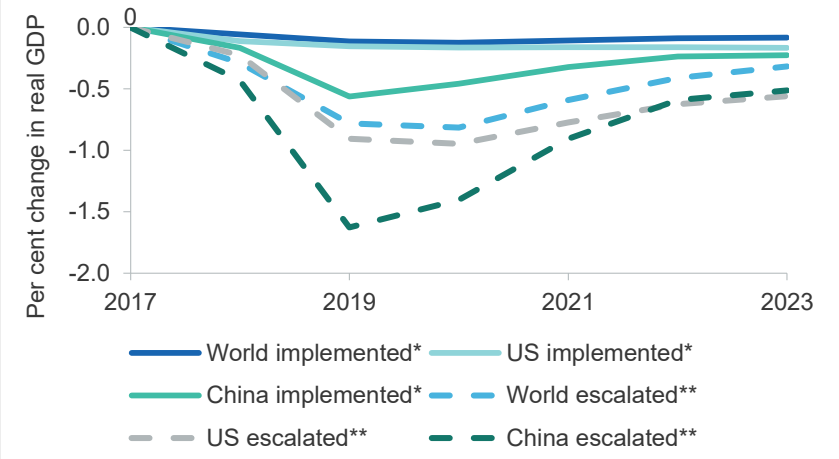
Notes: Domestic production calculated by subtracting world exports from net production and imports for each commodity.

Source: Department of Industry, Innovation and Science (2018); International Trade Centre (2018)

Importantly, the indirect impact of trade tensions — which could negatively impact on the pace and direction of global economic growth (especially in China and the US) — may weigh on commodity prices and therefore have a much larger impact on Australia's export earnings.

In the October 2018 World Economic Outlook, the International Monetary Fund revised down GDP forecasts for a number of countries, attributed to rising trade tensions. For 2019, world GDP growth has been revised down by 0.2 per cent to 3.7 per cent, US down by 0.2 per cent to 2.5 per cent, and China down by 0.2 per cent to 6.2 per cent. Figure 2.8 shows the estimated change in the level of real GDP, which is negative for the next five years. Peak impact comes in 2020, with world GDP, US and China 0.8, 0.9 and 1.4 percentage points lower, respectively, than they otherwise would have been.

Figure 2.8: Change in real GDP: Trade tensions scenario

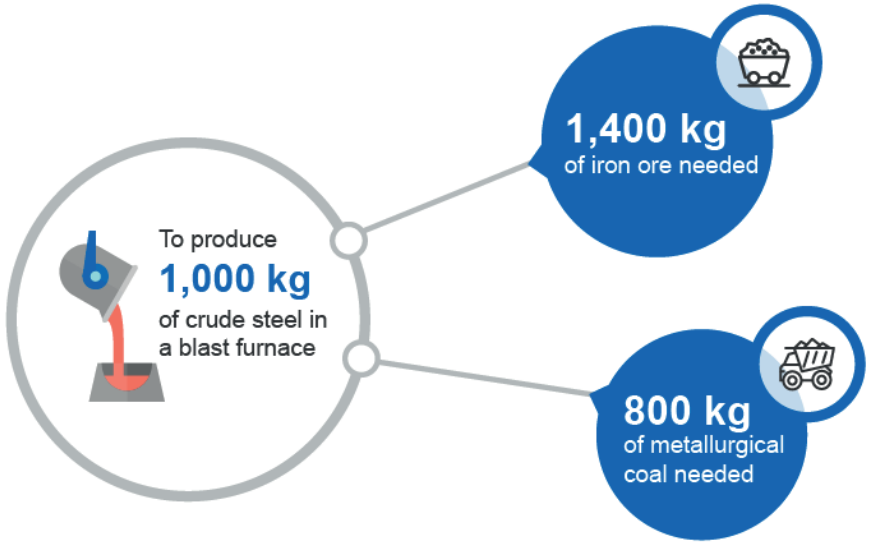


Note: * Implemented measures include $50 billion of tariffs on steel, aluminium, solar panels and washing machines, $50 billion and $200 billion of tariffs that have already been imposed on Chinese imports. ** Escalated measures include $267 billion of tariffs that is likely to impose on Chinese imports should the trade tensions escalate.

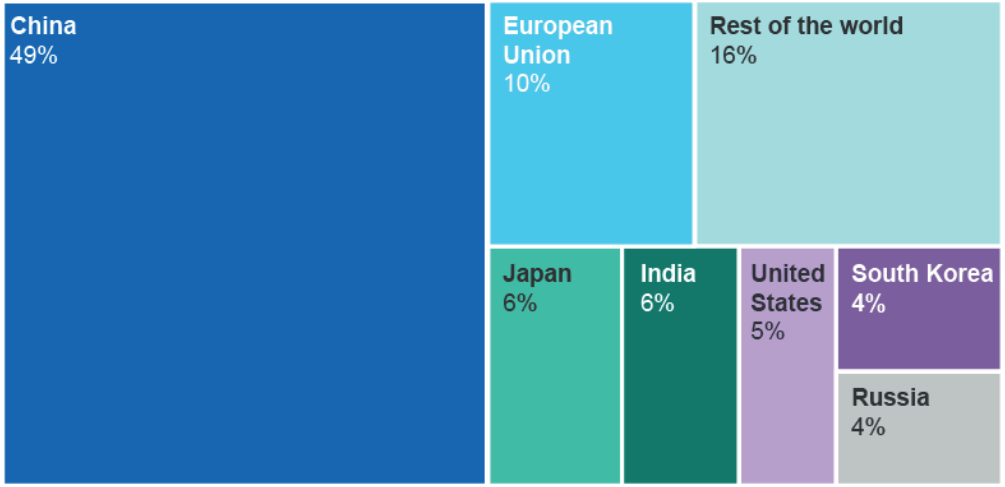
Source: International Monetary Fund (2018)

Steel

Resources and Energy Quarterly December 2018

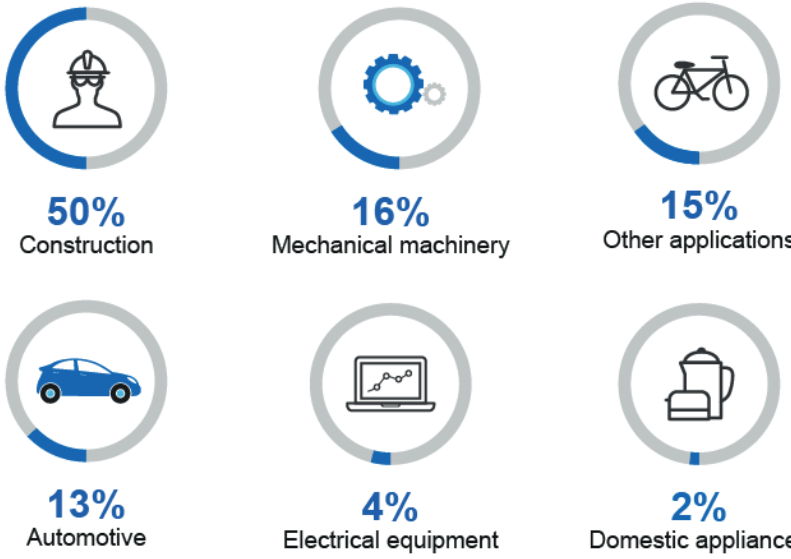


Major steel producers, 2017



Steel consumption per capita (kilograms per person), 2017

Steel use by sector



3.1 Summary

- World steel production is forecast to rise from 1.7 billion tonnes in 2017 to 1.8 billion tonnes in 2020, as broad growth across most major producers keeps pace with consumption.
- Compared to the strong year-on-year growth of 4.9 per cent in 2018, world consumption is forecast to grow at a slower pace over the next two years, due to softening global economic growth.
- Growing consumption will be led by several emerging markets, while consumption in China — the world's largest consumer — is forecast to be steady in 2019 and taper in 2020.
- The threat of escalating protectionist trade policies is expected to have a smaller than previously expected, but still negative, impact on downstream demand for products containing steel.

3.2 World production and consumption

World steel production increased strongly in the ten months to October 2018 compared to last year, driven by high steel prices and margins, robust production in China — the world's largest steel maker — and a rise in the capacity utilisation of steel mills in major producing nations.

World steel production and consumption set to rise

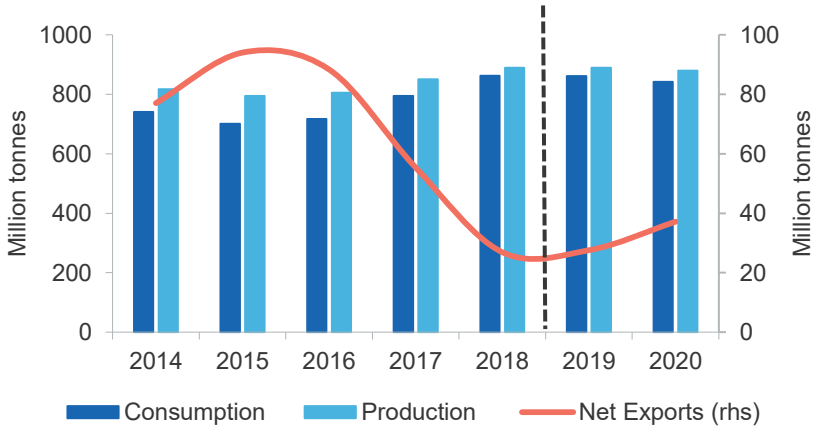
World steel production is forecast to increase by 1.8 per cent annually from 1,689 million tonnes in 2017 to 1,780 million tonnes in 2020. Higher production will be led by growth in India and other emerging markets (Figure 3.2), while production in China — which represents half of world production — is expected to be steady in 2019 and taper in 2020, driven by an expected slow-down in economic growth, offsetting higher infrastructure investment.

World steel consumption is forecast to increase at an annual average of 1.4 per cent from 1,707 million tonnes in 2017 to 1,779 million tonnes in 2020. Higher consumption will be led by growth in India and other emerging markets (excluding China). Demand elsewhere is forecast to be steady, with some tapering in demand from China, the US and European Union, driven by slowing economic growth over 2019 and 2020.

Slowing growth in China impacting on steel production

Chinese steel production is forecast to be steady in 2019 (Figure 3.1). Winter pollution restrictions are expected to reduce steel production in the first quarter of 2019, however steel makers are expected to resume near full capacity over the rest of 2019. Many Chinese steel mills have implemented strategies to mitigate the impact of winter pollution controls and larger, more efficient producers are expected to endure more lenient capacity constraints. Ongoing environmental controls and high steel margins are expected to incentivise the use of scrap material by Chinese steel mills over the outlook period, weighing on the demand for iron ore.

Figure 3.1: China's steel consumption, production and exports



Notes: Net exports is the sum of total steel production minus consumption

Source: World Steel Association (2018); Department of Industry, Innovation and Science (2018)

China's steel production is expected to decline in 2020, driven by slowing economic growth. A government-driven boost in infrastructure spending over 2018 and 2019 is expected to taper in 2020. Supply-side reforms over the past several years — aimed at reducing some loss-making production capacity — are expected to reach a conclusion by 2020. However, ongoing environmental pressure may induce some relocation of steel production across China, creating some uncertainty regarding the net effects on future capacity.

Chinese steel consumption is forecast to be steady in 2019, after three years of substantial growth, driven by strong demand from construction and infrastructure investment. Chinese steel consumption is forecast to moderate to 842 million tonnes in 2020. Cooling economic growth is expected to taper industrial production and urban residential construction from its current rapid pace over the outlook period, weighing on steel consumption. However greater government spending on infrastructure, particularly domestic railways, is expected to partially offset the impact of a slowing economy.

China's net exports of steel are forecast to decline from 55 million tonnes in 2017 to 31 million tonnes in 2020, driven by slowing global economic growth. China's exports are expected to be increasingly directed towards emerging markets in South East Asia, and further supported by the development of One Belt One Road infrastructure projects.

Steady growth elsewhere alongside strong growth in India

Steel production in the EU — the world's second largest producer and consumer — is forecast to increase by 1.3 per cent annually, from 168 million tonnes in 2017 to 175 million tonnes in 2020, in line with the pace of growth in consumption.

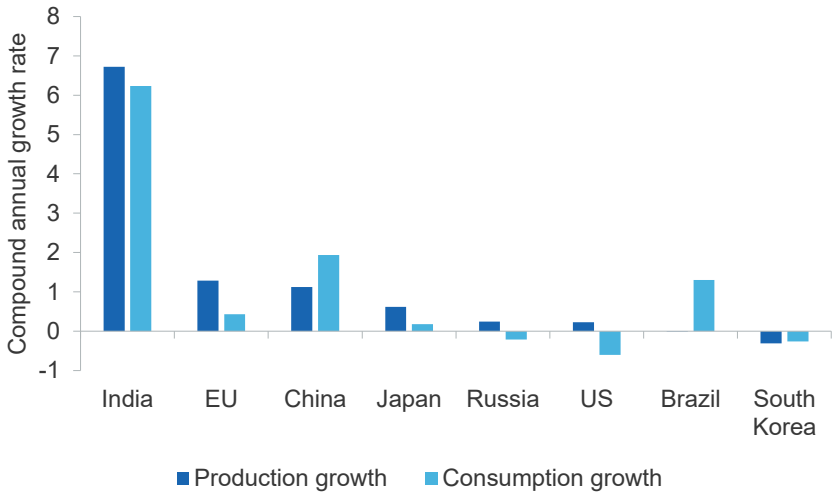
Japan's steel production is forecast to be steady in the short-term, as higher exports offset slow consumption growth. Domestic consumption benefited from 2020 Olympics-related projects, however an increase in consumption tax (from 8 to 10%) from 1 October 2019 is expected to lower consumption, construction and investment. Japan's net exports are forecast to rise over the outlook period, but slowing global growth remains a key risk to the downside as does the threat of US tariffs on vehicles.

Emerging markets (excluding China) are forecast to increase steel production by 2.5 per cent each year, from 328 million tonnes in 2017 to 345 million tonnes in 2020. Higher production will be driven by the ongoing expansion of India's steel-making capacity. India's steel production is forecast to grow by 6.7 per cent annually to reach 123 million tonnes in 2020 (representing 7.0 per cent of world production).

Consumption in emerging markets (excluding China) is forecast to increase by 2.4 per cent each year, from 253 million tonnes in 2017 to 271 million tonnes in 2020. Higher consumption will be driven by rising consumption in India and other parts of Asia. India's steel consumption is forecast to grow strongly over the outlook period, driven by rapid urban population growth, substantial government investment in infrastructure, housing and urban development, and its growing manufacturing sector.

Steel production in the US grew by 4.8 per cent year-on-year in 2018 to an estimated 86 million tonnes, supported by trade tariffs on imported steel products. However, with the onset of slowing residential construction, steel consumption and production are forecast to decline in 2019 and 2020. US tariffs are expected to have a small negative impact on steel consumption over the outlook, but are unlikely to be a key driver of total world consumption, which depends mostly on economic growth.

Figure 3.2: Production and consumption growth from 2017 to 2020



Notes: Calculated as compound annual growth rate from 2017 to 2020
Source: Department of Industry, Innovation and Science (2018)

Table 3.1: World steel consumption and production

	Million tonnes				Annual percentage change		
Crude steel consumption	**2017[s]**	**2018[s]**	**2019[f]**	**2020[f]**	**2018[s]**	**2019[f]**	**2020[f]**
World steel consumption	1,707	1,791	1,794	1,779	4.9	0.2	–0.9
China	795	862	862	842	8.5	–0.1	–2.3
European Union 28	172	175	174	174	1.7	–0.2	–0.2
United States	109	109	108	107	0.2	–1.0	–1.0
India	96	103	109	116	6.7	6.0	6.0
Japan	75	75	75	75	0.2	0.2	0.2
South Korea	59	59	59	59	–0.1	–0.3	–0.4
Russia	43	42	42	42	–0.9	0.3	0.0
Brazil	22	23	23	23	0.7	1.7	1.5
Crude steel production	**2017**	**2018[s]**	**2019[f]**	**2020[f]**	**2018[s]**	**2019[f]**	**2020[f]**
World steel production	1,689	1,785	1,791	1,780	5.7	0.3	–0.6
China	850	889	889	879	4.6	0.0	–1.2
European Union 28	168	171	174	175	1.3	1.6	0.9
Japan	105	105	106	107	0.2	0.8	0.9
India	101	106	115	123	4.8	8.5	6.9
United States	82	86	84	82	4.8	–2.0	–2.0
Russia	71	72	72	72	1.2	–0.5	0.0
South Korea	71	72	71	70	1.7	–2.2	–0.4
Brazil	34	35	34	34	1.3	–2.1	0.8

Notes: **s** estimate **f** forecast.

Source: World Steel Association (2018); Department of Industry, Innovation and Science (2018)

Iron Ore

Resources and Energy Quarterly December 2018

1st

Australia is the largest exporter of iron ore in the world

849 million tonnes exported in 2017-18

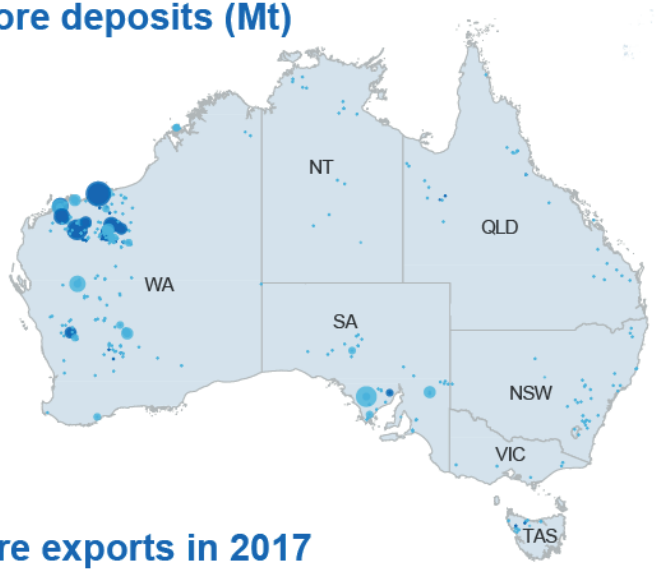
That's enough to build **10,050** Sydney Harbour bridges

$61 billion exported in 2017–18

29% largest iron ore reserves in the world

Major Australian iron ore deposits (Mt)

- <229
- 230–813
- 814–1,777
- 1,778–3,042
- 3,043–5,446
- >5,447
- Deposit
- Operating mine



Global share of iron ore exports in 2017

52%	24%	4%	3%	2%	15%
Australia	Brazil	South Africa	Canada	Ukraine	Rest of the world

Australia's iron ore key export destinations, 2017–18

83%	8%	6%	2%	1%
China	Japan	South Korea	Taiwan	Rest of the world

Global share of iron ore imports in 2017

69%	9%	8%	5%	16%
China	European Union	Japan	South Korea	Rest of the world

4.1 Summary

- The free on board (FOB) Australia iron ore price is forecast to decline to US$51 a tonne in 2020, driven by slowing global economic growth and a well-supplied seaborne market.
- Australia's iron ore export volumes are forecast to increase from 849 million tonnes in 2017–18 to 879 million tonnes in 2019–20, driven by a ramp up in production from Australia's largest producers.
- The value of Australia's iron ore exports is forecast to decline from $61 billion in 2017–18 to $57 billion in 2019–20, with the impact of lower prices more than offsetting growth in export volumes.
- The impact of US-China trade tensions is expected to have a relatively minor, but negative impact on Australia's export earnings.

4.2 Prices

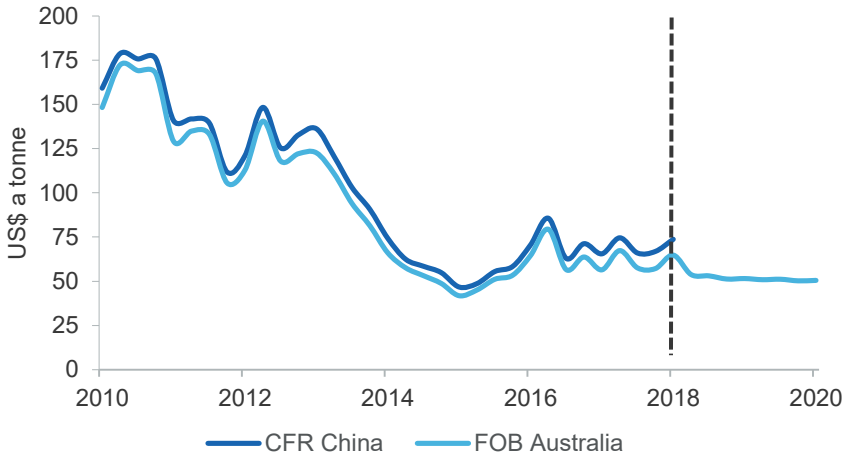
Iron ore prices lift in the last quarter of 2018

The FOB Australia iron ore price (62% Fe) — the price at which most Australian iron ore is sold — rallied by 15 per cent year-on-year in the December quarter to average US$65 a tonne. The price — which has been sluggish over 2018 compared to rising steel and high grade iron ore prices — increased, due to delays in implementing China's winter production cuts. The price was also supported by falling steel margins, which reduced the incentive to use high grade ores in steel production.

Iron ore prices forecast to decline

The iron ore price is forecast to gradually decline, to average US$53 a tonne (FOB Australia) in 2019 and US$51 a tonne in 2020, as a result of declining demand, a well-supplied seaborne market and the growing supply of Chinese scrap (Figure 4.1). Chinese steel makers are expected to use a higher proportion of scrap material over the outlook period, thereby reducing their demand for iron ore. Higher scrap use will be driven by an increase in electric arc furnace steelmaking and greater use of scrap material in basic oxygen furnace steelmaking, as producers pursue greater productivity and lower emissions.

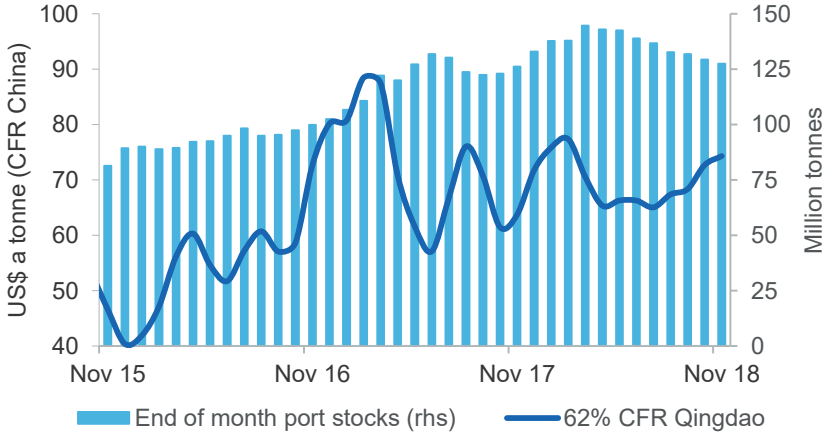
Figure 4.1: Iron ore price, FOB Australia and CFR China, quarterly



Notes: The OCE forecasts the FOB (free on board) Australia iron ore price for 62% Fe, not the benchmark CFR (cost and freight) North China iron ore price.

Source: Bloomberg (2018) Metal Bulletin; Department of Industry, Innovation and Science (2018)

Figure 4.2: End of month Chinese port stocks and monthly price



Source: Bloomberg (2018) Steelhome, Metal Bulletin; Department of Industry, Innovation and Science (2018)

The supply of high grade ores (65% Fe) and pellets from Brazil is expected to increase, as Vale's S11D project continues to ramp up, and their Sao Luis pellet plant — which restarted last quarter —raises pellet production to 55 million tonnes. The demand for, and supply of, high iron content alternatives is expected to weigh on prices for lower grade iron ores over the outlook period.

Steel prices are expected to decline over the outlook period and subsequently reduce profit margins for steel producers. Grade differentials widened to historic levels throughout 2018 as Chinese steel makers' used high grade ores to maximise production and comply with more stringent environmental policies. However, lower margins are expected to diminish the price difference between premium and lower grade iron ores over the outlook period. Port stocks of iron ore are expected to remain near historic highs reached in the March quarter 2018 (Figure 4.2), driven by rising seaborne supply and larger share of scrap usage in steel production.

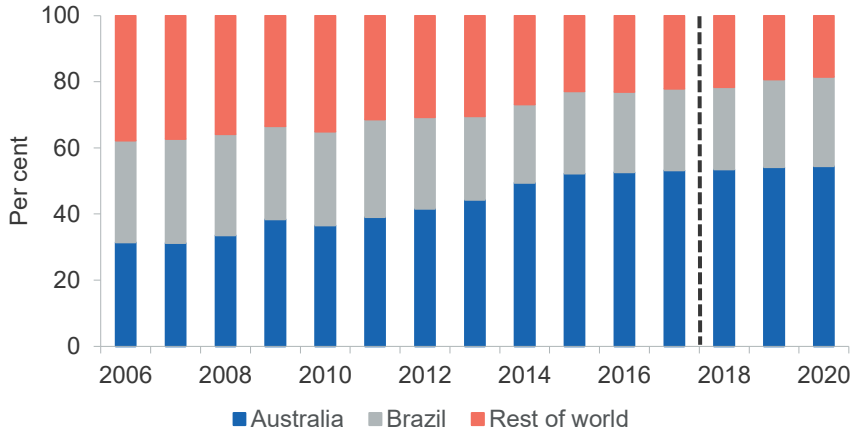
4.3 World trade

World exports are forecast to rise by 1.8 per cent annually to 1,638 million tonnes in 2020, as new mines and expansions ramp up in Australia and Brazil. Emerging markets (excluding China) are expected to increasingly drive import demand for iron ore, while demand from China — the world's largest importer — may have peaked in 2017 (Table 4.1). Australia and Brazil are expected to share a higher proportion of world iron ore exports over the outlook period (Figure 4.3).

China's iron ore imports projected to gradually decline

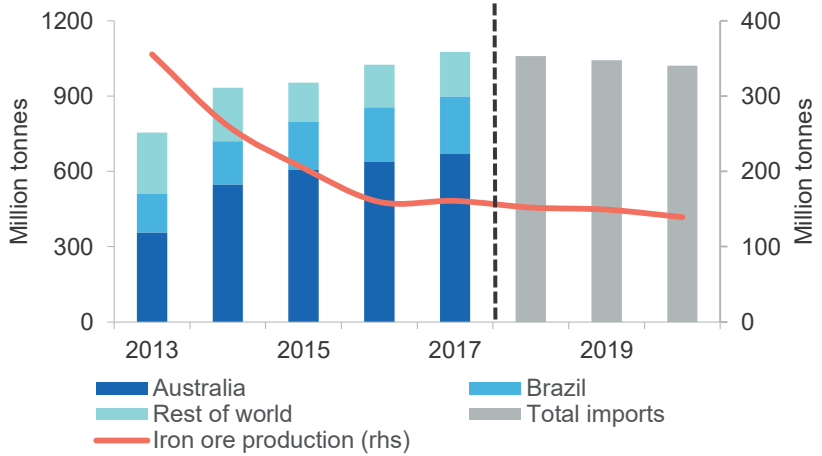
China's iron ore imports declined by 0.5 per cent year-on-year in the ten months to October, despite strong growth in steel production. Weaker-than-expected import demand was driven by a rundown in inventories, as well as increased use of scrap, pellets and high grade iron ores — which displaced lower grade iron ore in steel making. The decline in imports is expected to continue, with China's iron ore imports forecast to fall from 1,075 million tonnes in 2017 to 1,059 million tonnes in 2020 (Figure 4.4).

Figure 4.3: Share of world iron ore exports



Source: Bloomberg (2018); Department of Industry, Innovation and Science (2018)

Figure 4.4: China's iron ore imports and production



Notes: China's iron ore production is quality adjusted

Source: Bloomberg (2018) Antaike Information Development; Bloomberg (2018) China Customs General administration; Department of Industry, Innovation and Science (2018)

World export volumes forecast to rise, primarily from Brazil

The seaborne iron ore market is forecast to increase from 1,554 million tonnes in 2017 to 1,638 million tonnes in 2020, driven by rising production in Australia and Brazil — the world's largest iron ore producers.

Exports from Brazil are forecast to grow by 4.4 per cent annually over the outlook period, to 437 million tonnes in 2020. The rise in Brazilian output comes as Vale's S11D project at the Carajás complex ramps up production. Anglo American's Minas-Rio expansion is also expected to reach full capacity of 26.5 million tonnes by 2020.

4.4 Australia

Export volumes set to rise

Australian export volumes are expected to increase by 0.4 per cent to 852 million tonnes in 2018–19, and by a further 3.2 per cent to 879 million tonnes in 2019–20. The gains will be driven by Australia's largest producers, as they continue to ramp up towards record production levels. Higher volumes are expected to be achieved through productivity improvements and replacement mines at Rio Tinto's and BHP's operations, including the ramp up at Rio Tinto's Silvergrass operations in the Pilbara.

Two train derailments during the December quarter are only expected to have a minimal impact on export volumes. BHP's train derailment in November is expected to temporarily reduce production by 2–3 million tonnes for the December quarter, but not cause further interruptions in 2019. A second train operated by Mineral Resources derailed in November, but involved an empty train returning from port to their Koolyanobbing mine and is not expected to result in a loss of production. Mineral Resources also announced the first train load of iron ore from their recently acquired Koolyanobbing operation, as they ramp up to a targeted capacity of over 6 million tonnes annually.

In December, Fortescue Metal Group is expected to commence production of their West Pilbara Fines (WPF) blend, graded at 60.1% Fe (iron ore content). Fortescue's Eliwana mine and rail project in the Pilbara region of Western Australia is expected to support the annual production of 40 million tonnes of the WPF blend from late 2020 onwards.

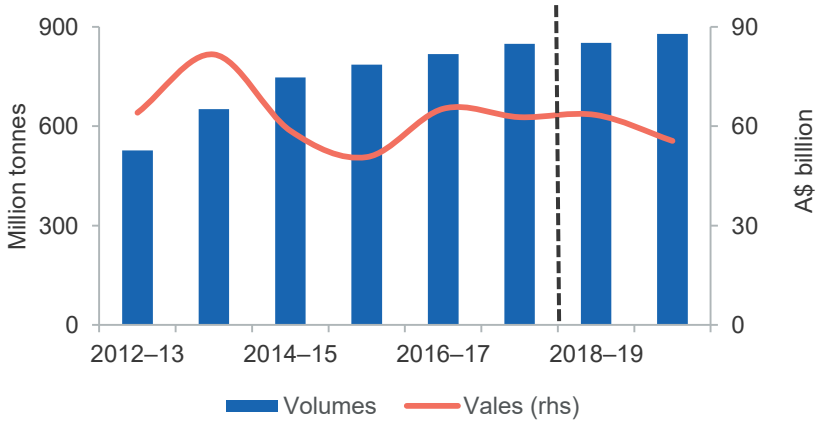
Exploration expenditure increased 3.8 per cent year-on-year to 87 million in the September quarter, the second highest amount in four years.

Australia's iron ore export earnings to be weighed down by lower prices

Lower prices forecast over the outlook period are expected to more than offset the impact of higher volumes, leading to a fall in export earnings from $61 billion in 2017–18 to $57 billion in 2019–20. The implementation of US tariffs on China is expected to have a small but negative impact on Australia's export earnings for iron ore (see the trade box).

Export earnings have been revised up by $3.0 billion in 2018–19 since the September *Resources and Energy Quarterly*. The upwards revision reflects a weaker outlook for the Australian dollar, as well as the recent rally in iron ore prices over the December quarter. The price forecast for 2018–19 has been revised higher from US$54.5 a tonne in September to US$57.2 a tonne. The outlook for export earnings is broadly unchanged in 2019–20, as is the price outlook which is forecast to average US$51 a tonne in 2020.

Figure 4.5: Australia's iron ore export volumes and values



Source: ABS (2018) International Trade, Australia, 5454.0; Department of Industry, Innovation and Science (2018)

Table 4.1: World trade in iron ore

	Million tonnes				Annual percentage change		
	2017	2018[f]	2019[f]	2020[f]	2018[f]	2019[f]	2020[f]
Total world trade	1,554	1,590	1,636	1,638	2.3	2.9	0.2
Iron ore imports							
China	1,075	1,064	1,062	1,059	–1.1	–0.2	–0.2
European Union 28	144	155	158	159	7.5	1.7	0.6
Japan	127	129	130	132	2.2	0.8	0.9
South Korea	72	77	75	75	6.6	–2.2	–0.4
India	5	5	12	19	1.6	146	51
Iron ore exports							
Australia	827	840	879	882	1.6	4.6	0.3
Brazil	384	398	430	437	3.7	8.2	1.5
Ukraine	33	35	30	29	7.1	–16	–1.0
India	29	11	10	8	–62	–10	–20

Notes: **s** Estimat**e; f** Forecast.

Source: World Steel Association (2018); International Trade Centre (2018); Department of Industry, Innovation and Science (2018)

Table 4.2: Iron ore outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018[f]**	**2019[f]**	**2020[f]**	**2018[f]**	**2019[f]**	**2020[f]**
Prices[bc]								
– nominal	US$/t	64.0	61.7	52.6	50.7	–3.6	–15	–3.7
– real[d]	US$/t	65.6	61.7	51.5	49.0	–6.0	–16	–4.8
Australia	**Unit**	**2016–17**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**
Production								
– Steel[hs]	Mt	5.35	5.71	6.05	6.06	6.8	6.0	0.1
– Iron ore	Mt	873	898	903	928	2.8	0.5	2.9
Exports								
Steel	Mt	1.00	1.15	0.95	0.97	15	–17	2.4
– nominal value	A$m	875	925	777	737	5.8	–16	–5.1
– real value[hi]	A$m	912	947	777	719	3.8	–18	–7.4
Iron ore	Mt	818	849	852	879	3.8	0.4	3.2
– nominal value	A$m	62,617	61,331	63,670	56,915	–2.1	3.8	–11
– real value[i]	A$m	65,293	62,742	63,670	55,567	–3.9	1.5	–13

Notes: **b** fob Australian basis; **c** Spot price, 62 per cent iron content basis; **d** In 2018 US dollars; **f** Forecast; **h** Crude steel equivalent; Crude steel is defined as the first solid state of production after melting. In ABS Australian Harmonized Export Commodity Classification, crude steel equivalent includes most items from 7206 to 7307, excluding ferrous waste and scrap and ferroalloys; **i** In 2018–19 Australian dollars; **s** Estimate.

Source: ABS (2018) International Trade in Goods and Services, Australia, 5368.0; Bloomberg (2018) Metal Bulletin; World Steel Association (2018); AME Group (2018); Company Reports; Department of Industry, Innovation and Science (2018)

Metallurgical Coal

Resources and Energy Quarterly December 2018

Australia is the **largest exporter** of metallurgical coal

1st

Every tonne of steel produced needs about **800kg** of metallurgical coal.

Metallurgical coal is a non-substitutable raw material in the production of steel from iron ore.

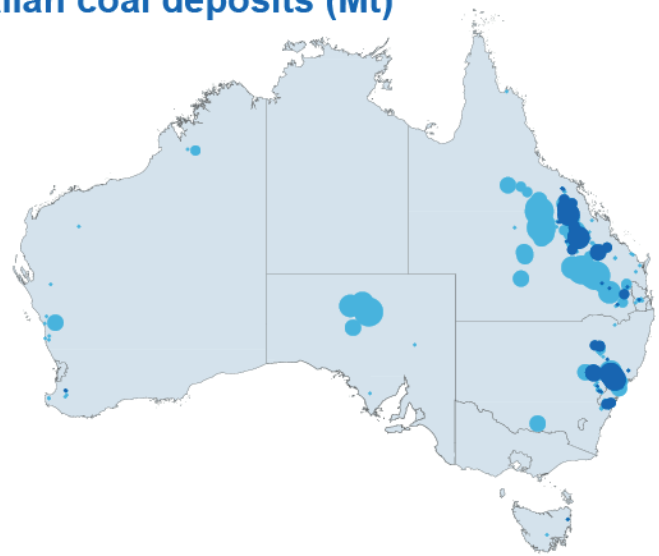
Australia accounted for around **17%** of world production in 2017

It takes more than **200 tonnes** of metallurgical coal to make every wind turbine

179 million tonnes exported in 2017–18 valued at **$38 billion**

Major Australian coal deposits (Mt)

- <500
- 500-1,000
- 1,001-2,000
- 2,001-4,000
- >4,000
- Deposit
- Operating mine



Australia's metallurgical coal export earnings by destination, 2017–18

25% India

22% China

19% Japan

10% South Korea

5% Taiwan

19% Rest of the world

Global share of metallurgical coal exports in 2017

54% Australia

15% USA

9% Canada

8% Mongolia

7% Russia

7% Rest of the world

Global share of metallurgical coal imports in 2017

24% China

16% India

16% Japan

15% EU

12% South Korea

17% Rest of the world

5.1 Summary

- Supply disruptions pushed the premium hard coking coal (HCC) spot price to well over US$220 a tonne during the December quarter.
- Supply growth and softening demand are expected to reduce the premium HCC spot price from an estimated average of US$207 a tonne in 2018, to US$145 a tonne by 2020.
- Australia's export volumes are forecast to grow from 179 million tonnes in 2017–18 to 190 million tonnes in 2019–20. This reflects an expected recovery from supply disruptions and modest production growth.
- Australia's metallurgical coal export earnings are forecast to increase from $38 billion in 2017–18 to a new record of $41 billion in 2018–19, before declining to $31 billion in 2019–20. The impact of growing export volumes is forecast to be more than offset by lower prices.

5.2 Prices

Tight supply has driven the metallurgical coal price higher

The premium HCC spot price (FOB Australia) averaged an estimated US$220 a tonne in the December quarter of 2018, 15 per cent higher than the previous quarter, and 5.7 per cent higher year-on-year. The premium HCC spot price reached well over US$220 a tonne in November and December, reaching an 8-month high. There were disruptions to supply from exporting producers in Australia and the United States and domestic producers in China. Strong demand from India and China also contributed to a tightening market.

The HCC spot price is forecast to remain relatively well supported in the near-term, due to ongoing constrained supply and strong demand, before declining to US$165 a tonne in 2019 and US$145 a tonne in 2020. The HCC price is expected to be driven down by both supply growth and an expected softening of import demand from China, as steel production weakens and domestic production recovers.

Nevertheless, with strong demand growth expected from India, metallurgical coal prices are forecast to remain relatively well supported over the next two years, relative to the lows of 2015–16 (Figure 5.1).

Figure 5.1: Australian premium HCC spot price, quarterly

Source: IHS (2018); Department of Industry, Innovation and Science (2018)

5.3 World trade

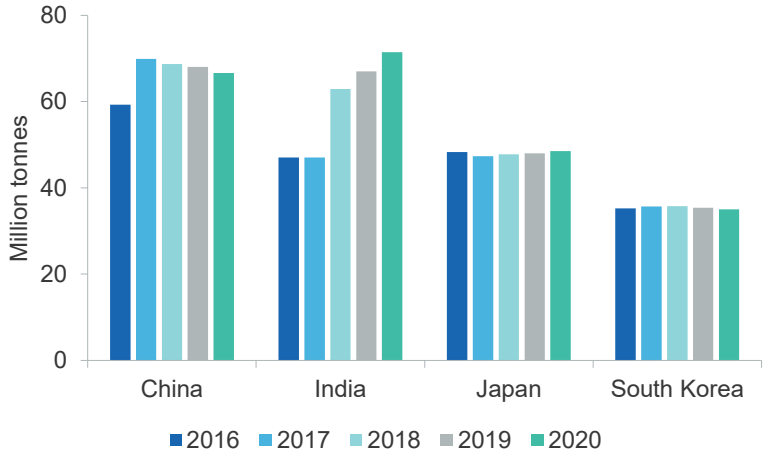
World trade in metallurgical coal grew by an estimated 4.4 per cent to 324 million tonnes in 2018, driven by strong industrial production growth, and consequently, strong growth in steel output around the world.

However, with an expected slowdown in global economic growth, and particularly in China, growth in world metallurgical coal trade is forecast to slow to 3.1 per cent in 2019 and 1.8 per cent in 2020, to reach 340 million tonnes in 2020.

World imports

India is forecast to be the key source of import demand growth, driven by the ongoing expansion of its domestic steel sector, while China's import demand is expected to decline (Figure 5.2). India is forecast to overtake China as the world's largest importer of metallurgical coal by 2020. Metallurgical coal demand from both Japan and South Korea is forecast to remain largely subdued over the outlook period.

Figure 5.2: Asian metallurgical coal imports



Notes: 2018 and onwards are forecasts.

Source: IHS (2018); Department of Industry, Innovation and Science (2018)

China's metallurgical coal imports forecast to drift lower

Metallurgical coal imports from China increased by 21 per cent year-on-year in the four months to October. Steel production grew by 6.6 per cent year-on-year over the same period, driven by high margins and strong demand. At the start of the quarter, imports were also supported by domestic supply tightness, with safety and environmental inspections disrupting output at the two largest metallurgical coal producing provinces, Shandong and Shanxi.

With steel margins falling, winter production cuts and import restrictions, China's metallurgical coal imports are expected to slow over the last two months of 2018. However, the possibility of more lenient winter cuts and further stimulatory measures — to offset the impact of the trade tariffs imposed by the US — may provide more support for metallurgical coal imports than anticipated.

Over the next two years, China's metallurgical coal imports are forecast to decline modestly. The decline will be primarily driven by a forecast moderation in steel production as economic growth slows. The growing use of electric arc furnaces and scrap steel in steel production is also expected to weigh on demand for metallurgical coal. The rate of growth in Chinese domestic metallurgical coal production will remain the key uncertainty over the outlook period. Domestic production accounts for around 90 per cent of total demand, with small changes to domestic production potentially having substantial impacts on import demand.

India expected to become largest metallurgical coal importer by 2020

India's metallurgical coal imports have surged in 2018, driven by the ongoing expansion of the domestic steel sector. Steel production grew by 5.5 per cent in the year to October, and metallurgical coal imports grew to 45 million tonnes in the year to September, an increase of 19 per cent year-on-year.

India is forecast to overtake China as the world's largest importer of metallurgical coal in 2020, with India's imports forecast to grow steadily over the next two years, to reach 71 million tonnes in 2020. India has limited domestic reserves of metallurgical coal, and will need to increase imports to support the rapid growth of its domestic steel industry.

Subdued import demand from Japan and South Korea

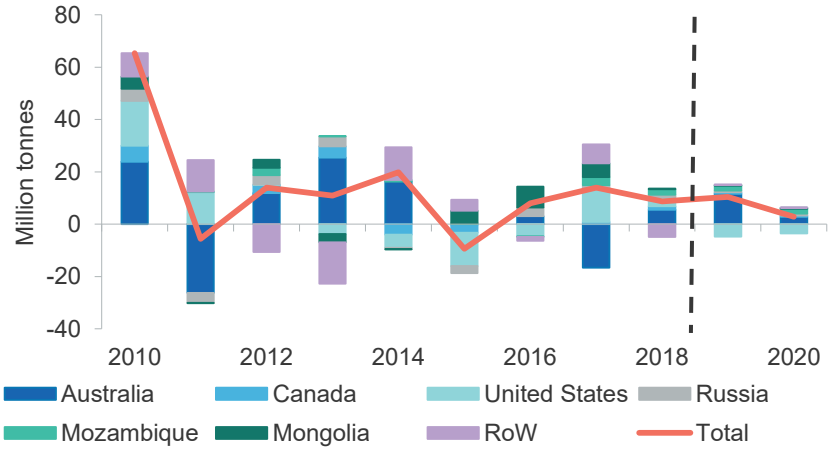
While the traditional importers in the Asian market — China, Japan and South Korea — will continue to dominate the seaborne market, import growth from these countries is forecast to remain largely subdued. Japan's imports of metallurgical coal are forecast to grow modestly over the outlook period, supported by demand for steel for use in the domestic construction sector. Metallurgical coal imports from South Korea are forecast to remain largely flat, due to weak domestic demand from its major steel-using sectors.

In contrast, metallurgical coal imports from emerging markets are forecast to grow considerably, although from a low base. Many countries are building up their steel capacity to meet demand from the construction sector, driven by large infrastructure projects. In particular, Vietnam, Indonesia and Malaysia have substantial additions to blast-furnace steel capacity, which will support the demand for metallurgical coal.

World exports

Strong prices in 2018 have encouraged increased output, the restart of idled operations, and decisions to proceed with the development of new mines. Much of the growth in new output will occur in 2019, as supply constraints in major exporting countries ease (Figure 5.3). Australia will comfortably remain the largest exporter of metallurgical coal, accounting for a forecast 57 per cent of the seaborne market in 2020. However, this represents a decline from Australia's share in the pre-Cyclone Debbie period (60 per cent in 2016), with Canada, Russia and Mozambique all forecast to increase their exports.

Figure 5.3: Annual change in world metallurgical coal exports



Source: IEA (2018); Department of Industry, Innovation and Science (2018)

Exports from the United States forecast to decline

There has been robust growth in metallurgical coal exports from the United States throughout 2018, increasing by 14 per cent to 42 million tonnes in the year to September. Notably, exports to India and Japan have both reached seven-year highs. Export volumes were impacted in September by Hurricane Florence, but have since recovered.

As a swing supplier of coal, the United States is expected to reduce its metallurgical coal exports modestly over the outlook period as prices ease, though exports should remain strong relative to levels in the 2014–2017 period.

Exports forecast to grow from Russia, Canada and Mozambique

Exports of metallurgical coal from other producing nationals are forecast to grow, driven by stronger demand from the Asian market, where traditional importers are seeking to diversify their sources of supply.

In Canada, several operations are ramping up capacity, supporting a forecast 2.4 million tonne increase in exports between 2017 and 2020. Exports are also expected to grow from Russia, as expansions and new additions to capacity increase exports by 2.1 million tonnes to 25 million tonnes from 2017 to 2020. Beyond the outlook period, east Russia has substantial metallurgical coal reserves in the Yakutia region, which, if developed, could further boost Russia's exports and market share.

Mozambique was once flagged to be the next major exporter of metallurgical coal. However, the two major exporting mines, Vale's Moatize and Jinda Steel's Songa mines, have faced a range of challenges, including infrastructure constraints, quality issues and local opposition. Nevertheless, exports from Mozambique are expected to grow as these operations ramp up, reaching 13 million tonnes in 2020, up from 7 million tonnes in 2017.

Mongolia's exports constrained by transportation bottlenecks

Mongolia's exports of metallurgical coal to China have continued to be constrained, due to transportation bottlenecks. Substantial investment into road and rail infrastructure will be required for any significant recovery in export growth. Beyond the outlook period, a plan for a new 247 kilometre rail link from the Tavan Tolgoi mine to the Chinese border has the potential to provide support for an additional 20 million tonnes of Mongolian coal by the mid-2020s. In the meantime however, coal exports from Mongolia are forecast to remain subdued at around 26 million tonnes.

5.4 Australia

Metallurgical coal export earnings forecast to reach a record $41 billion

Australia's metallurgical coal export earnings totaled $9.8 billion in the September quarter of 2018, an increase of 12 per cent year-on-year. Export volumes decreased by 7.4 per cent over the same period. Australian exports have continued to be constrained by a number of port, rail and other issues. There has also been an increase in the amount of semi-soft metallurgical coal being sold in to thermal coal markets; volumes of semi-soft and pulverised coal injection (PCI) coal exports declined by 13 per cent in the September quarter, with some of these volumes likely counted as thermal coal exports. The narrowing gap between the prices for thermal coal and semi-soft metallurgical coal has made it more economical to sell semi-soft metallurgical coal as thermal coal, without incurring the additional washing costs for metallurgical coal.

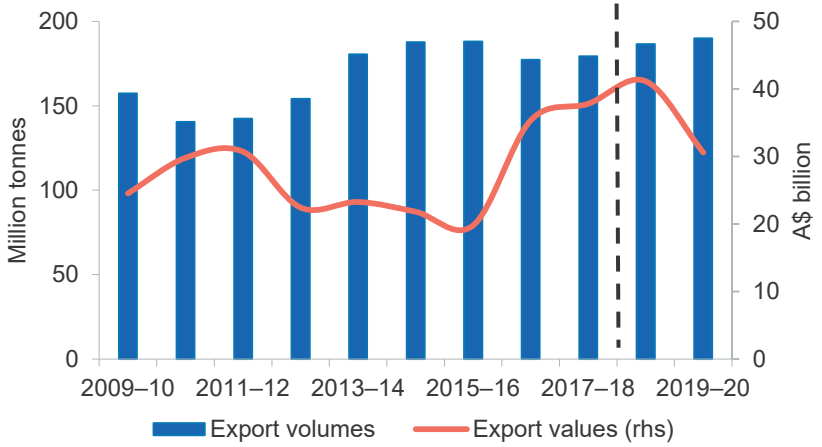
Australia's metallurgical coal export earnings are forecast to increase from a record $38 billion in 2017–18 to a new record of $41 billion in 2018–19, driven by strong prices in the second half of 2018 (Figure 5.4). Export earnings are then forecast to decline to $31 billion in 2019–20.

Modest growth in production and export volumes is expected to only partially offset the impact of forecast weaker prices (Figure 5.5). Export volumes are forecast to increase to 187 million tonnes in 2018–19, and to 190 million tonnes in 2019–20. The expected ramp up of new and restarted mines in Queensland (including Isaac Plains East, Cook, Baralaba) softens the impact of a fire at North Goonyella, which will remove around 2 million tonnes to at least late 2019.

Revisions to the outlook

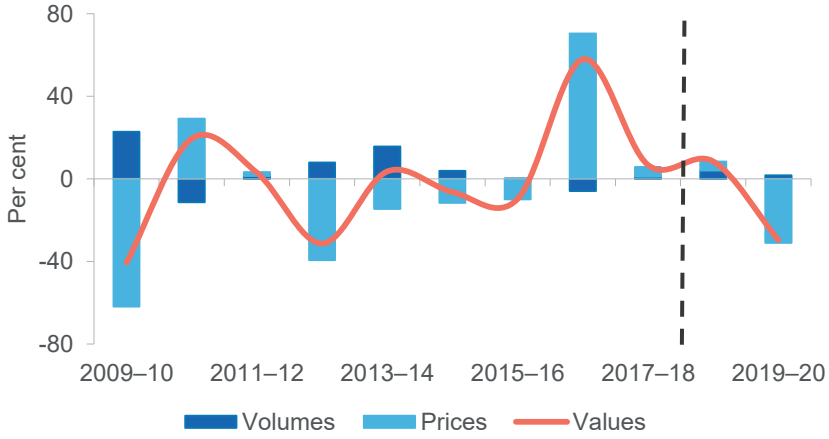
Australia's metallurgical coal export earnings for 2018–19 have been revised up by $5.7 billion from the September *Resources and Energy Quarterly*, reflecting a weaker outlook for the Australian dollar and stronger than expected prices in 2018. Export earnings in 2019–20 have been revised down by $1.0 billion, due to a downwards revision to export volumes.

Figure 5.4: Australia's metallurgical coal exports



Source: ABS (2018) International Trade, Australia 5454.0; Department of Industry, Innovation and Science (2018)

Figure 5.5: Annual growth in Australia's metallurgical coal exports values, and contributions from export volumes and prices



Notes: Price changes are based on export unit values.

Source: ABS (2018) International Trade, Australia 5454.0; Department of Industry, Innovation and Science (2018)

Table 5.1: World trade in metallurgical coal

	Unit	2017	2018[s]	2019[f]	2020[f]	Annual percentage change 2018[e]	2019[f]	2020[f]
World trade	Mt	311	324	334	340	4.4	3.1	1.8
Metallurgical coal imports								
China	Mt	70	69	68	67	–1.7	–1.0	–2.0
Japan	Mt	47	48	48	49	1.0	0.4	1.1
India	Mt	47	63	67	71	33.8	6.5	6.7
European Union 28	Mt	44	47	48	49	4.9	2.4	1.9
South Korea	Mt	36	36	35	35	0.2	–1.0	–1.0
Metallurgical coal exports								
Australia	Mt	173	178	190	193	3.2	6.6	1.5
United States	Mt	50	54	49	45	6.9	–8.8	–7.2
Canada	Mt	29	30	31	31	4.8	1.7	1.6
Russia	Mt	23	24	24	25	3.7	2.8	2.7
Mozambique	Mt	7	9	11	13	31.0	19.8	17.4

Notes: s Estimate **f** Forecast.

Source: IHS (2018); Department of Industry, Innovation and Science (2018)

Table 5.2: Metallurgical coal outlook

World	Unit	2017	2018[s]	2019[f]	2020[f]	Annual percentage change 2018[s]	2019[f]	2020[f]
Contract prices[e]								
– nominal	US$/t	210	208	171	145	–0.9	–18.0	–15.0
– real[d]	US$/t	215	208	167	140	–3.2	–19.8	–15.9
Spot prices[g]								
– nominal	US$/t	190	207	165	145	9.3	–20.3	–12.4
– real[d]	US$/t	194	207	161	140	6.7	–22.1	–13.4
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Production[s]	Mt	187	185	194	196	–1.4	5.0	1.3
Export volume	Mt	177	179	187	190	1.2	4.1	1.7
– nominal value	A$m	35,335	37,793	41,126	30,579	7.0	8.8	–25.6
– real value[i]	A$m	36,845	38,662	41,126	29,855	4.9	6.4	–27.4

Notes: **d** In 2018 US dollars. **e** Contract price assessment for high-quality hard coking coal. **i** In 2018–19 Australian dollars. **f** Forecast. **g** Hard coking coal fob Australia east coast ports. **s** Estimate.
Source: ABS (2018) International Trade in Goods and Services, Australia, 5368.0; Department of Industry, Innovation and Science (2018); IHS (2018)

Thermal Coal

Resources and Energy Quarterly December 2018

1st

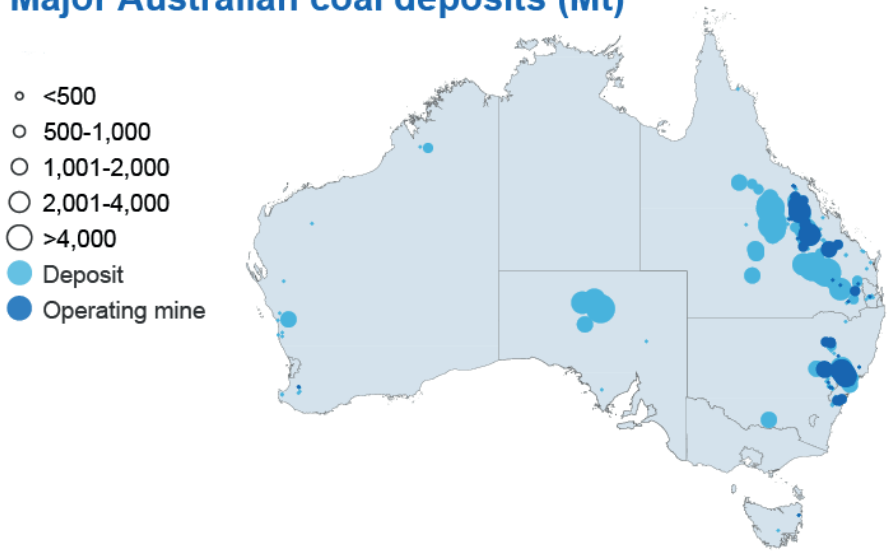
Australia is the **second largest** thermal coal exporter in the world.

203 million tonnes exported in 2017–18, valued at **$22.6 billion**

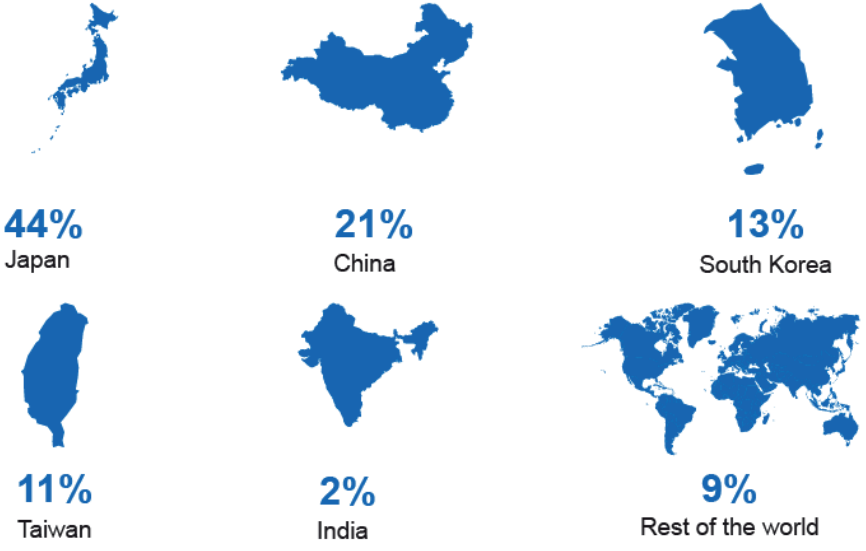
Around **80%** of Australia's thermal coal is exported

1 tonne of coal powers the average Australian household for approximately **4 months.**

Major Australian coal deposits (Mt)



Australia's thermal coal export earnings by destination, 2017–18



44% Japan

21% China

13% South Korea

11% Taiwan

2% India

9% Rest of the world

Global share of thermal coal exports in 2017

37% Indonesia

20% Australia

14% Russia

8% Columbia

7% South Africa

2% USA

11% Rest of the world

Global share of thermal coal imports in 2017

19% China

18% European Union

14% India

13% Japan

10% South Korea

6% Taiwan

20% Rest of the world

6.1 Summary

- The Newcastle benchmark spot price is forecast to decline from an estimated average of US$105 a tonne in 2018 to US$74 a tonne in 2020, primarily driven by declining import demand from China.
- Australia's export volumes are forecast to grow from 203 million tonnes in 2017–18 to 209 million tonnes in 2019–20, reflecting productivity improvements and modest production growth from new capacity.
- Australia's thermal coal export earnings are forecast to reach a new record of $26 billion in 2018–19, up from a record $23 billion in 2017–18, driven by strong prices. Export earnings are then forecast to decline to $20 billion in 2019–20, as the impact of lower prices more than offsets rising export volumes.

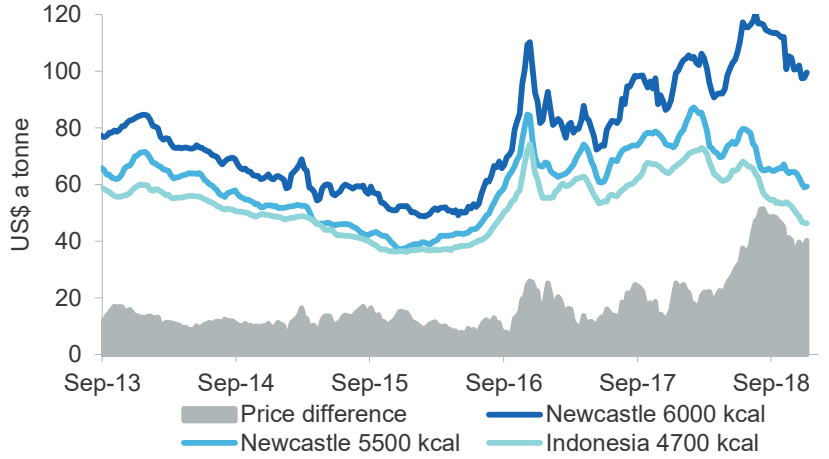
6.2 Prices

Prices have declined on weak import demand from China

The Newcastle benchmark spot price (6000 kcal/kg net as received) averaged an estimated US$100 a tonne in the December quarter of 2018, a 13 per cent decline from the previous quarter, but 6.9 per cent higher year-on-year (Figure 6.1). Prices steadily declined to below US$100 a tonne in November, almost a 6-month low, primarily as a result of falling import demand from China, due to stronger domestic production and softening power demand in the period between summer and winter. Chinese imports are expected to fall sharply in November and December on the back of tightened restrictions on coal imports, with reports that these may be extended through to the Chinese New Year period for some power utilities.

The gap in prices for high and low quality coals narrowed in the December quarter, as the Newcastle benchmark price fell more sharply than the prices for lower quality coals. Nevertheless, the price difference remains at high levels compared to the last five years. The gap has been driven by growing demand for higher quality coal due to air quality concerns, particularly in east Asia, and lower supply of higher quality coal.

Figure 6.1: Thermal coal spot prices, weekly



Notes: Price difference refers to the gap between Newcastle 6000kcal and 5500kcal
Source: IHS (2018)

Thermal coal prices are forecast to drift lower due to softer demand

The Newcastle benchmark spot price is forecast to decline over the next two years, from an estimated average of US$105 a tonne in 2018 to US$86 a tonne in 2019 and US$74 a tonne in 2020. The Japanese Fiscal Year (JFY, April to March) contract price is forecast to settle at US$89 a tonne in 2019–20 and US$77 a tonne in 2020–21.

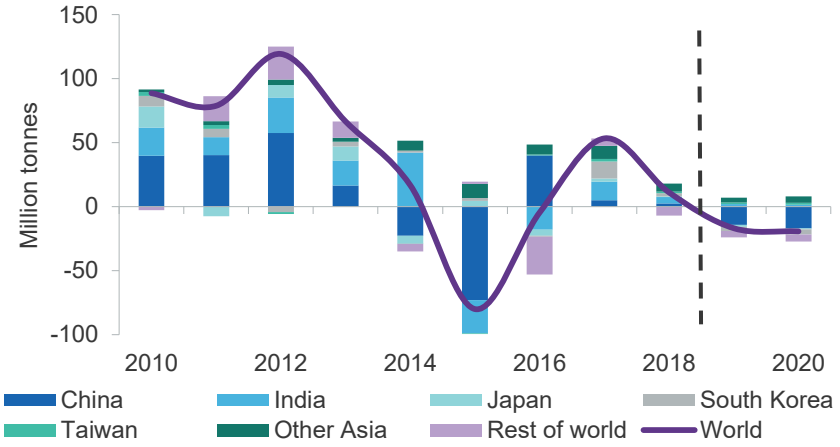
The forecast decline in prices is driven primarily by an expected slowdown in import demand from China over the next two years. Ongoing policy changes to reduce emissions and dependency on coal in other major economies are also expected to weigh on demand and thus prices.

Nevertheless, a lack of substantial investment in new thermal coal capacity is expected to put a floor under prices, which are forecast to remain well above the lows of 2015 and 2016. Despite the recent strength in prices, a range of factors have contributed to a slowdown in investment in Australia and the rest of the world, including difficulties attracting finance and uncertainty regarding future policy developments around the world.

6.3 World trade

World trade in thermal coal is estimated to have grown by 1.0 per cent to 1.1 billion tonnes in 2018 but it is expected to decline by 1.5 per cent to 1.08 billion tonnes in 2019, and by 1.8 per cent to 1.06 billion tonnes in 2020. Underpinning the decline in world trade is a decline in thermal coal imports from China and advanced economies, which is offsetting growth from emerging economies in Asia (Figure 6.2).

Figure 6.2: Annual change in world thermal coal imports



Source: IEA (2018); Department of Industry, Innovation and Science (2018)

World imports

Import restrictions to drive down China's thermal coal imports

China's imports of thermal coal slowed substantially in September and October. Imports have been weighed down by import restrictions, an ongoing depreciation of the yuan and a rebound in domestic production. At the time of writing, trade data was not available for the last two months of the year. However, a sharp decline in thermal coal imports is expected, with import controls tightened from mid-November to the end of 2018, and possibly through to Chinese New Year, as the government attempts to cap imports to alleviate pressures in an oversupplied domestic market.

China's coal imports will continue to be driven by government policy

With supply side reforms in China's coal sector largely concluded, and new additions to capacity on the horizon, domestic supply is expected to increase over the next two years, resulting in reduced import demand. Ongoing coal to gas switching is also expected to contribute to declining thermal coal imports over the forecast period.

Industrial policies, safety and environmental policies, and controls on imports, are all expected to affect the pace at which new domestic supply comes online and the trajectory of China's thermal coal import demand over the next two years. Government policy thus remains the largest uncertainty over the outlook period.

Import demand from Japan and South Korea to marginally decline

Japan's imports of thermal coal in 2018 have been broadly steady year-on-year, but are forecast to decline marginally over the outlook period, driven primarily by softer demand due to nuclear restarts. At the time of writing, nine of Japan's fleet of 42 nuclear reactors had gained approval to restart. Eight of these reactors were in operation, with the remaining one offline for regular maintenance. Eighteen reactors currently have applications for restart. Japan's Institute of Energy Economics expects two reactors to restart by 2020, with an additional three restarts also possible by 2020. However, ongoing legal disputes and public opposition could lead to delays.

South Korea's thermal coal imports have also been broadly steady year-on-year. While Australia and Indonesia remained its largest suppliers, South Korea has continued to diversify its sources of thermal coal. In the four months to October 2018, imports from Australia and Indonesia declined by 4.7 and 13 per cent year-on-year, respectively, while imports from Canada, Colombia and Russia increased by 61, 58 and 17 per cent, respectively, although from a lower base.

South Korea's thermal coal exports are forecast to decline marginally over the outlook period, as a result of ongoing government efforts to reduce the country's reliance on coal. After a one-month trial of a cap on the sulphur

content of coal burned in October, the government will impose the cap again in March to May 2019, a month less than originally expected. As the cap applies to coal burned, not imports, higher sulphur coal can be blended with lower sulphur products. Australian coal is not expected to be substantially affected, with power generators reported to be forgoing South African and Indonesian coal rather than Australian coal.

India's domestic production struggles to keep pace with demand growth

India's thermal coal imports have increased in 2018, driven by strong demand. India's domestic coal production has not kept pace with rising demand from the power and industrial sectors. The government has directed Coal India, the state-owned coal producer, to divert supply to power plants in the lead up to winter, leaving industrial users to source coal from seaborne markets. While India's domestic thermal coal production grew by a solid 9.7 per cent year-on-year in the year to October to 551 million tonnes, efforts to ramp up domestic production to meet demand have been constrained by domestic infrastructure bottlenecks. Despite government plans for self-sufficiency, India's thermal coal imports are forecast to grow modestly over the outlook period, as growth in demand continues to outweigh growth in domestic supply.

World exports

Indonesia's thermal coal exports forecast to decrease from current levels

Indonesia's thermal coal exports reached 316 million tonnes in the year to September, an increase of 11 per cent year-on-year. Despite weather-related supply disruptions, the Indonesian government has taken advantage of strong seaborne demand to boost exports, revising the 2018 production target from 485 million tonnes to 507 million tonnes in August. The additional production is intended to increase exports.

The government has historically prioritised securing low-cost coal for the domestic power sector, with price caps and tonnages reserved for domestic markets. However, coal is one of the country's largest exports, making it a potentially important means to reduce the country's trade deficit. Indonesia's thermal coal exports are nonetheless forecast to decrease over the next two years, as meeting domestic demand gradually takes precedence again.

South Africa's coal exports to remain subdued

South Africa's thermal coal exports have remained subdued throughout 2018, totaling 65 million tonnes in the year to September, down 3.9 per cent. South Africa's thermal coal exports are forecast to remain largely flat over the outlook period, weighed down by minimal investment in new mines. Eskom, the national electricity utility, has faced increasingly severe shortages of coal, which could result in the adoption of long-term contracts and more thermal coal being diverted to the domestic market.

Russia's thermal coal exports forecast to grow

Russia's largest dedicated coal port, Vostochny, exported 20 million tonnes of coal to the seaborne market in the year to October. This is 6.0 per cent higher than the same period last year, and reflects strong Asian demand. Russia's thermal coal exports are forecast to continue to grow over the outlook period, driven by growing sales to the Asian market, a weak Ruble, and upgrades to its rail and port infrastructure.

Thermal coal exports from swing producer United States forecast to fall

Thermal coal exports from the US have surged in 2018, with exports over the year to September growing by 44 per cent, predominantly to Asian markets. Thermal coal exports from the US are forecast to fall from 2018 levels over the outlook period, but remain strong relative to 2014 to 2017 levels. The US is a swing producer of coal, and exports are expected to decline in line with prices.

6.4 Australia

Thermal coal exports earnings forecast to reach a record $26 billion

Australia's thermal coal export earnings totaled $7.2 billion in the September quarter of 2018, increasing by 34 per cent year-on-year. The strong growth in export earnings was driven by high prices and growth in export volumes, which increased by 4.1 per cent year-on-year to reach a record 55 million tonnes.

In 2018–19, Australia's thermal coal export earnings are forecast to grow from $23 billion in 2017–18 to a new record of $26 billion, before declining to $20 billion in 2019–20 (Figure 6.3). Export earnings in 2018–19 are expected to be supported by a weaker Australian dollar, and the high contract price of US$110 a tonne settled for both the Japanese Fiscal Year (April 2018 to March 2019), and October 2018 to September 2019 periods, which serve as a benchmark for the rest of the industry. Roughly a third to a half of Australian thermal coal is sold under term contracts, although volumes under long-term contracts are on the decline. Japanese utilities have sought to diversify sources of supply and trade on the spot market, driven by government efforts to increase competition in its power sector.

Beyond 2018–19, modest growth in production and export volumes is expected to be outweighed by the impact of weaker prices (Figure 6.4). Export volumes are forecast to increase from 203 million tonnes in 2017–18 to 208 million tonnes in 2018–19 and to 209 million tonnes in 2019–20. Export growth is expected to be supported by productivity improvements, expansions, and the ramp up of production at new mines, including Mount Pleasant and Orion Downs. In late November 2018, Adani announced that funding for its scaled-back Carmichael project had been finalised. Production is expected to begin to ramp up in late 2020, beyond the outlook period, and eventually reach 10–15 million tonnes annually.

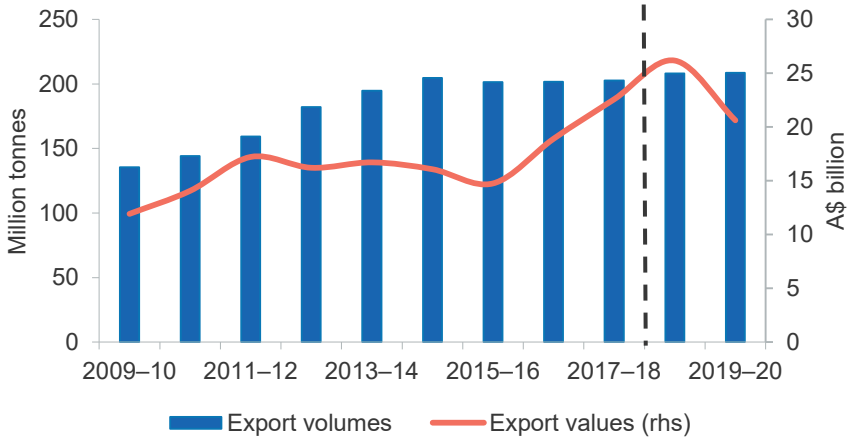
Revisions to the outlook

Australia's thermal coal export earnings have been revised up by $3.2 billion in 2018–19, and by $0.8 billion in 2019–20 from the September *Resources and Energy Quarterly*, reflecting a weaker outlook for the Australian dollar, and modest upwards revisions to prices and volumes.

Modest recovery in Australia's coal exploration expenditure

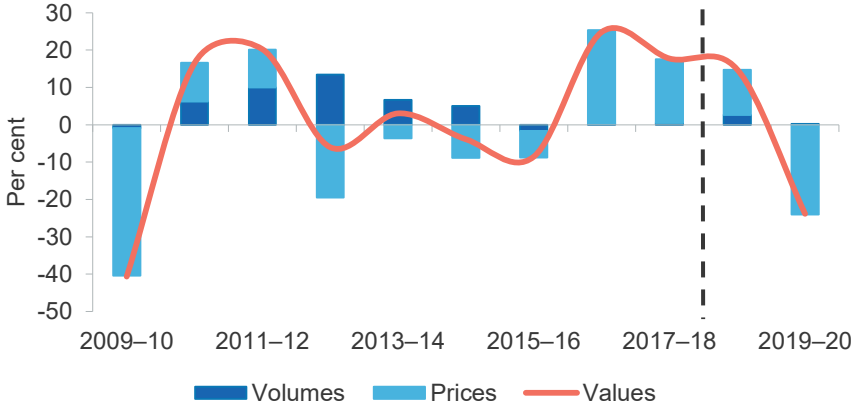
In the September quarter of 2018, Australia's coal exploration expenditure totaled $43.6 million, remaining steady from the June quarter of 2018, and increasing by 24 per cent year-on-year. The recent recovery in coal exploration expenditure reflects firmer prospects for the sector, on the back of the recent improvement in market conditions.

Figure 6.3: Australia's thermal coal exports



Source: ABS (2018) International Trade, Australia 5454.0; Department of Industry, Innovation and Science (2018)

Figure 6.4: Annual growth in Australia's thermal coal exports values, and contributions from export volumes and prices



Notes: Price changes are based on export unit values.
Source: ABS (2018) International Trade, Australia 5454.0; Department of Industry, Innovation and Science (2018)

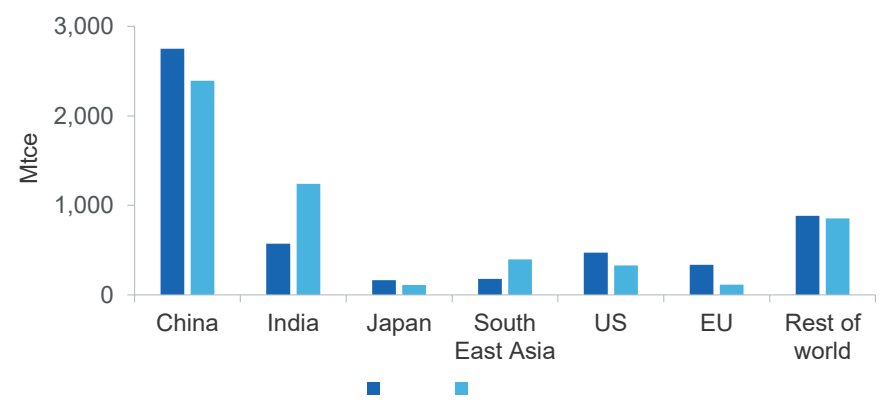
Box 6.1: Coal in the IEA's 2018 World Energy Outlook

The 2018 World Energy Outlook (WEO) in the central New Policies Scenario revises world coal demand down by 3 per cent from the 2017 WEO to 5,441 million tonnes of coal equivalent (Mtce) in 2040. The downward revision reflects increased competition from alternative fuels, which are benefiting from growing government policy support. In the New Policy Scenario, coal demand increases only marginally — by 1.6 per cent — between 2017 and 2040, while coal's share of global primary energy demand declines from 27 per cent to 22 per cent.

There are stark regional variations in the outlook for coal in the NPS

While advanced economies are projected to reduce coal use to reduce emissions, developing economies are projected to increase their coal use, capitalising on its relatively low cost. India and South East Asia are expected to be the key drivers of growth in coal use, with demand in those regions projected to more than double between 2017 and 2040 (Figure 6.5). The New Policy Scenario has China's coal demand declining by 13 per cent over the same period, driven by air quality concerns and efforts to diversify the energy mix. Among the coal exporting countries, only Australia is projected to substantially ramp up coal production, supported by a locational advantage to growing Asian markets and a high quality resource base.

Figure 6.6: Coal demand by country and region in the New Policy Scenario



Source: International Energy Agency (2018) World Energy Outlook 2018, OECD/IEA, Paris

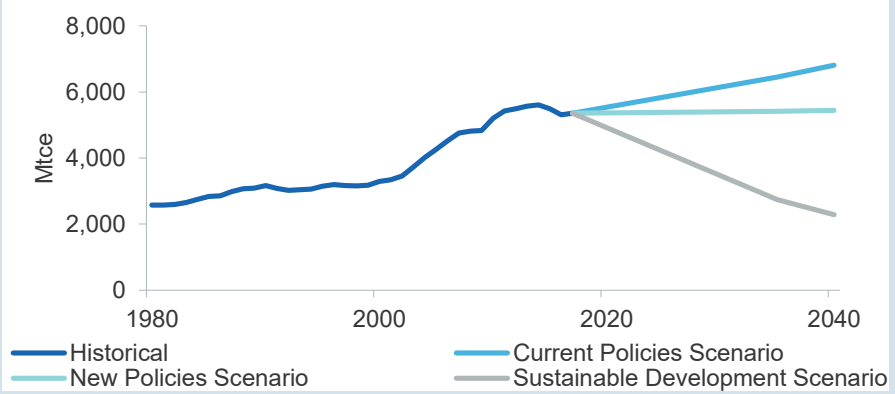
The prospects for coal depend on the evolution of technology and policies

The trajectory of global coal demand looks very different in the Current Policies and Sustainable Development Scenarios (Figure 6.6). While the WEO does not provide a breakdown of the outlook for metallurgical and thermal coal, the scenarios highlights that the prospects for coal, and particularly thermal coal, for which there are more substitutes, are highly dependent on the evolution of technology and policies.

In the Current Policies Scenario, coal demand increases by 27 per cent between 2017 and 2040. In the Sustainable Development Scenario, coal demand will need to decrease by 57 per cent, reducing coal's share in primary energy demand to 12 per cent by 2040.

Technology plays a critical role in the outlook for coal. Potential game-changers include an increase in the operational flexibility of coal-fired power to complement the variable nature of wind and solar, and the development of commercially viable carbon capture, utilisation and storage.

Figure 6.6: Global coal demand by scenario



Notes: The Current Policies Scenario considers the impact of policies and measures that are firmly enshrined in legislation as of mid-2018. The New Policies Scenario incorporates current policies and also the likely effects of announced policies, including official targets. The Sustainable Development Scenario entails a pathway consistent with the goals of universal access to modern energy by 2030; emissions reduction in line with the Paris Agreement; and improving air quality.

Source: International Energy Agency (2018) World Energy Outlook 2018, OECD/IEA, Paris

Table 6.1: World trade in thermal coal

	Unit	2017	2018[s]	2019[f]	2020[f]	Annual percentage change 2018[f]	2019[f]	2020[f]
World trade	Mt	1,088	1,099	1,082	1,063	1.0	–1.5	–1.8
Thermal coal imports								
Asia	Mt	800	819	808	795	2.4	–1.3	–1.6
China	Mt	201	204	189	172	1.2	–7.0	–9.0
India	Mt	161	166	168	170	3.1	1.2	1.0
Japan	Mt	140	141	139	139	0.5	–1.0	–0.5
South Korea	Mt	113	115	112	108	2.2	–3.0	–3.5
Thermal coal exports								
Indonesia	Mt	389	410	402	398	5.4	–2.0	–1.0
Australia	Mt	200	204	207	215	2.0	1.2	3.7
Russia	Mt	158	162	166	170	2.5	2.5	2.5
Colombia	Mt	83	84	85	85	0.8	0.9	1.0
South Africa	Mt	70	69	68	68	–1.0	–1.0	–1.0
United States	Mt	38	52	45	42	38.0	–13.0	–7.9

Notes: **s** Estimate; **f** forecast.

Source: IHS (2018); Department of Industry, Innovation and Science (2018)

Table 6.2: Thermal coal outlook

World	Unit	2017	2018[s]	2019[f]	2020[f]	Annual percentage change 2018[s]	2019[f]	2020[f]
Contract prices[b]								
– nominal	US$/t	84	110	89	77	31.0	–19.4	–13.5
– real[c]	US$/t	86	110	87	73	27.8	–21.3	–15.4
Spot prices[d]								
– nominal	US$/t	88	105	86	74	20.5	–18.5	–13.5
– real[e]	US$/t	90	105	84	72	17.6	–20.3	–14.5
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Production	Mt	262	262	271	272	–0.1	3.2	0.5
Export volume	Mt	202	203	208	209	0.5	2.7	0.3
– nominal value	A$m	18,902	22,584	25,898	20,297	19.5	14.7	–21.6
– real value[h]	A$m	19,709	23,103	25,898	19,816	17.2	12.1	–23.5

Notes: **b** Japanese Fiscal Year (JFY), starting April 1, fob Australia basis. Australia–Japan average contract price assessment for steaming coal with a calorific value of 6700 kcal/kg gross air dried; **c** In current JFY US dollars; **d** fob Newcastle 6000Kcal net as received; **e** In 2018 US dollars; **s** Estimate; **f** Forecast; **h** In 2018–19 Australian dollars.

Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; IHS (2018); NSW Coal Services (2018); Queensland Department of Natural Resources and Mines (2018); Company Reports; Department of Industry, Innovation and Science (2018)

Gas

Resources and Energy Quarterly December 2018

LNG is natural gas cooled to **–162°C**

Australia exported **62** million tonnes of LNG in 2017–18

18% rise from 2016–17 export volumes

2nd largest LNG exporter in the world

Combined nameplate capacity of Australia's 10 LNG projects is **88 million tonnes per annum**

Most Australian LNG is sold on oil-linked contracts

Australia's LNG export earnings by destination, 2017–18

47%	31%	12%	4%	3%	3%
Japan	China	South Korea	Singapore	India	Rest of the world

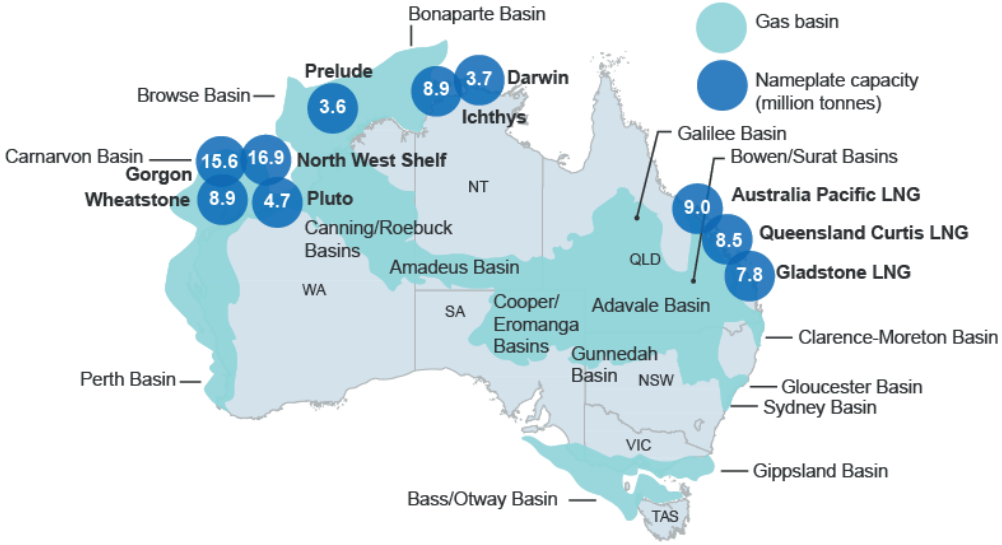
Share of world LNG exports in 2017

26%	18%	9%	7%	6%	34%
Qatar	Australia	Malaysia	Nigeria	United States	Rest of the world

Share of world LNG imports in 2017

29%	13%	12%	6%	5%	35%
Japan	China	South Korea	India	Taiwan	Rest of the world

Australia's LNG projects and gas basins



7.1 Summary

- The value of Australia's LNG exports is forecast to increase from $31 billion in 2017–18 to $50 billion in 2018–19, driven by higher export volumes and higher prices, and remain near this level in 2019–20.
- Australia's LNG exports are forecast to increase from 62 million tonnes in 2017–18 to 78 million tonnes in 2019–20, driven by the ramp up of the final two LNG projects in Australia's recent wave of LNG investment.
- LNG contract prices — at which most Australian LNG is sold — are forecast to rise in 2018–19 before easing slightly in 2019–20.
- LNG spot prices are expected to decline, as additions to global supply capacity outstrip growth in LNG demand and as oil prices ease.

7.2 Prices

LNG contract prices in Asia are forecast to moderate

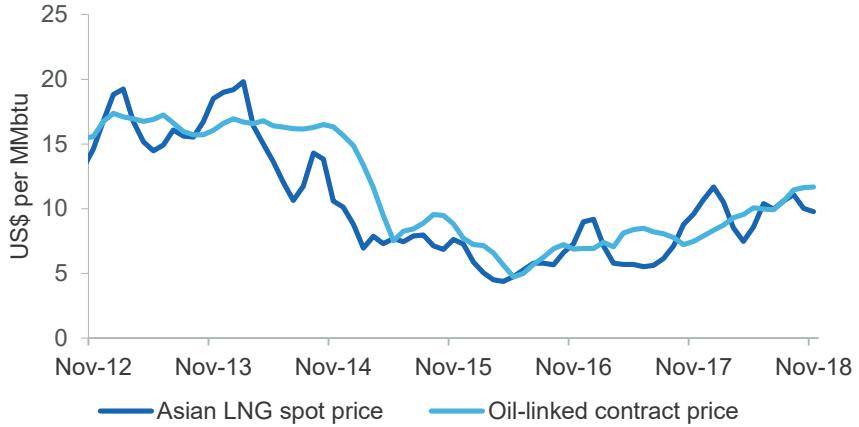
Most LNG in Asia is sold on long-term contracts, sometimes in excess of 20 years, where the price of LNG is linked to the price of oil. Oil-linked contract prices have been rising steadily since early 2016 (Figure 7.1) when oil prices reached a low of around US$30 a barrel.

Tracking oil prices, LNG contract prices in Asia are forecast to decline modestly from current highs, but remain well above levels seen over the past few years. The Japan Customs-cleared Crude (JCC) oil price, to which LNG contract prices in Asia are often linked, is forecast to average US$72 a barrel in 2020, down slightly on current levels of US$76 a barrel, but up from an average of US$54 a barrel in 2017.

LNG spot prices are also expected to decline

LNG spot prices in Asia have also been on the rise since early 2016, spiking during the previous two northern hemisphere winters and remaining elevated over the remainder of 2018 (Figure 7.1). Rising oil prices have likely contributed to higher LNG spot prices. Buyers have some flexibility in the volumes of LNG they purchase on long-term oil-linked contracts, and higher oil prices increase the relative attractiveness of spot cargoes, pushing up spot prices.

Figure 7.1: LNG spot and oil-linked contract prices in Asia, DES



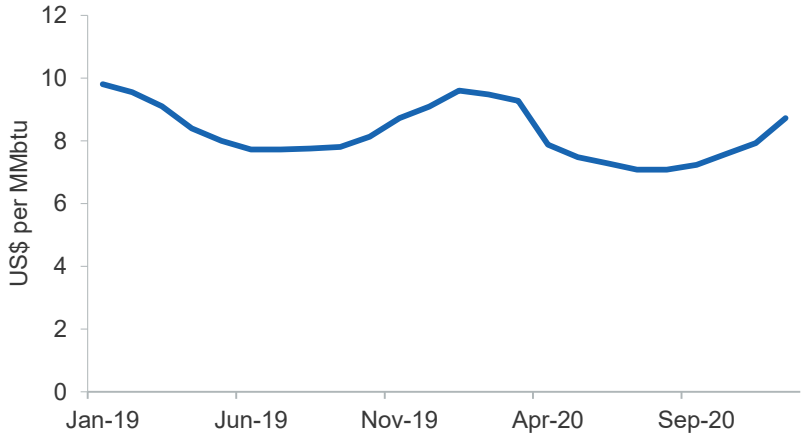
Notes: DES (Delivered Ex Ship) prices include shipping and insurance. The Argus North East Asian spot price is shown. The indicative LNG contract price in US$ per MMbtu is given as 14 per cent of the JCC oil price in US$ per barrel plus the cost of shipping.

Source: Argus (2018); Bloomberg (2018)

LNG spot prices in Asia are expected to decline in 2019 and 2020, as additions to global supply capacity outstrip growth in LNG demand, and as oil prices ease. The Asian LNG futures curve suggests a modest tapering in LNG spot prices over 2019 and 2020 (Figure 7.2). The futures curve also suggests that seasonality in LNG spot prices will continue. In Asia, gas storage — which moderates the impact of seasonal demand spikes on prices — is limited.

The Asian LNG futures curve points to relatively stable LNG spot prices over this northern hemisphere winter. The 2017–18 winter price spike was due to a rapid increase in Chinese LNG imports, driven by surging gas demand and an unexpected shortfall in China's pipeline gas imports from Central Asia. China has subsequently put in place measures to meet winter gas demand, such as boosting gas storage, and may not experience the same shortfall in pipeline gas imports from Central Asia this year. A more mild winter than last is also anticipated in North East Asia, which should help to ease demand pressures.

Figure 7.2: Asian LNG futures price, monthly, DES



Notes: The New York Mercantile Exchange Platts Japan/Korea Marker futures curve.
Source: Bloomberg (2018)

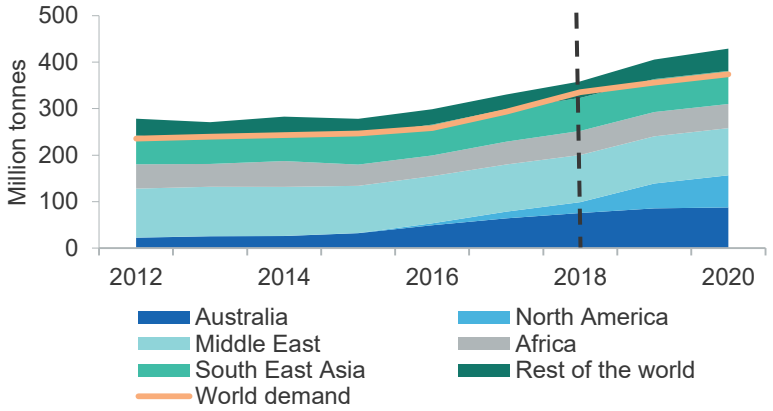
7.3 World trade

After a period of relatively low growth between 2011 and 2015, world LNG trade has expanded rapidly in the past few years. Strong growth is expected to continue: imports are projected to rise from 290 million tonnes in 2017 to around 367 million tonnes in 2020. Europe and emerging Asia — led by China — are expected to drive demand growth.

Nevertheless, the expansion in global LNG supply capacity is expected to outpace growth in LNG demand over the next few years (Figure 7.3). From early next decade, the LNG market is expected to begin rebalancing, as demand growth absorbs the available capacity.

LNG markets have been expected to enter a period of overcapacity for some time, but stronger than expected demand growth coupled with delays in project completions have delayed its arrival and reduced its anticipated severity (see Box 7.1 in the September 2018 *Resources and Energy Quarterly*).

Figure 7.3: Global supply capacity by country and world LNG demand



Notes: Nameplate capacity (the maximum annual production capacity of an LNG plant).
Source: Department of Industry, Innovation and Science (2018); Nexant (2018)

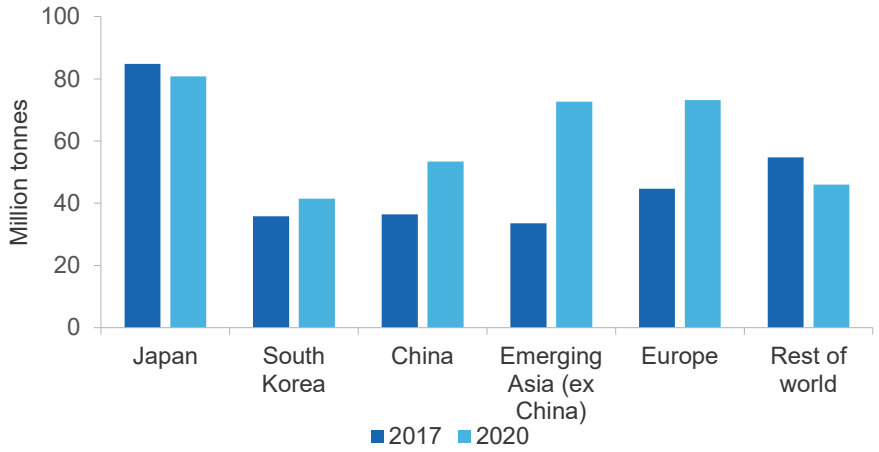
7.4 World imports

Nuclear restarts to reduce Japan's LNG imports

Japan sources almost all its gas using LNG imports, and has been the world's leading buyer of LNG since the 1970s. Japan's LNG imports are projected to fall from 85 million tonnes in 2017 to 81 million tonnes in 2020 (Figure 7.4), with the restart of several nuclear reactors over the past year reducing gas demand, and further restarts possible. Japan's LNG imports declined by 0.6 per cent in the first nine months of 2018, compared with the same period last year.

At the time of writing, nine of Japan's fleet of 42 nuclear reactors had gained approval to restart. Eight of these reactors were in operation, with Takahama No. 3 offline for regular maintenance. Japan's Institute of Energy Economics expects two more reactors to restart by March 2020, but there could be as many as five. Eighteen reactors have applications for restart with the Nuclear Regulation Authority — the administrative body charged with ensuring the safety of nuclear plants. However, nuclear energy in Japan continues to face public opposition and legal challenges. There remain significant risks of delays and slippages in nuclear restarts.

Figure 7.4: LNG import forecasts



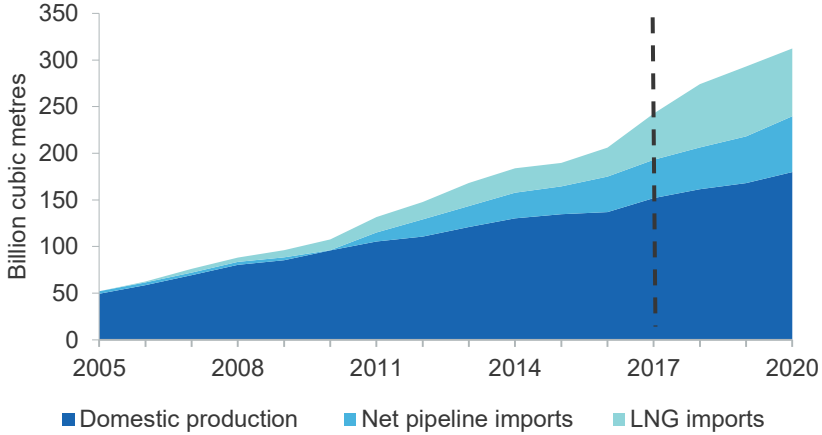
Source: Department of Industry, Innovation and Science (2018); Nexant (2018)

China to be the largest contributor to growth in LNG demand

China edged past South Korea to become the second largest LNG buyer in the world in 2017, with its imports reaching over 36 million tonnes (50 billion cubic metres). Gas consumption rose strongly, with China putting in place policies to address air pollution by encouraging gas use in place of coal. Strong growth continued into 2018, with LNG imports up 46 per cent year-on-year in the first nine months of 2018 at 37 million tonnes.

The Chinese government is aiming to raise the share of gas in the energy mix from 7 percent in 2017 to a target range of 8.3–10 per cent in 2020. LNG is likely to play a major role in servicing rising Chinese gas demand. By 2020, China's LNG imports are forecast to reach 53 million tonnes (73 billion cubic metres). Where in the Government's 2020 target range China's gas consumption reaches could have a major impact on LNG markets. China's target of lifting the share of gas in the energy mix implies gas consumption of 305–365 billion cubic metres. This difference of fifty billion cubic metres of gas is equivalent to around 37 million tonnes of LNG — as much LNG as China imported during 2017.

Figure 7.5: China's gas consumption by source



Source: Bloomberg (2018)

Other factors affecting China's LNG demand over the outlook period will be the extent of competition from domestic gas production and pipeline gas imports. China is expected to begin importing Russian gas via the Power of Siberia pipeline from late 2019. Imports are expected to be about 5 billion cubic metres in the first year of operation, reaching 38 billion cubic metres in the sixth year. China is reportedly targeting natural gas production of 200 billion cubic metres in 2020, up from around 150 billion cubic metres in 2017. But China faces challenges in lifting domestic output and is expected to fall short of this target: it has difficult geology and gas resources are located in densely populated or heavily cultivated areas.

Modest growth projected for South Korea's imports

South Korea was the world's third largest LNG buyer last year, and its imports were up 22 per cent year-on-year in the first nine months of 2018. South Korea's imports are forecast to increase from just under 36 million tonnes in 2017 to 41 million tonnes in 2020. South Korea's long-term plan is to increase the share of gas in the energy mix from 15 per cent in 2016 to around 19 per cent by 2030. From 1 April 2019, South Korea will lower taxes on LNG imports and again raise taxes on thermal coal imports.

Other emerging Asian economies and Europe to also drive demand

Other economies in emerging Asia are expected to make a large contribution to growth in global LNG imports during the outlook period, including India, Pakistan, Bangladesh, Indonesia, Thailand and Singapore. In India, LNG imports are forecast to increase from 18 million tonnes in 2017 to 33 million tonnes in 2020, with India's domestic gas production not expected to keep pace with growing demand. There are several LNG import terminals under construction on India's east coast and the Government is aiming to lift gas' share of the energy mix to 15 per cent by 2030 from 5 per cent at present.

Europe is another major driver of increasing LNG demand, despite relatively flat growth in gas consumption. LNG imports are being driven by long-term declines in indigenous gas production, particularly in the United Kingdom and the Netherlands. However, LNG imports will also need to compete with pipeline gas supply from Russia. A key uncertainty is the fate of the controversial Nord Stream II gas pipeline. The pipeline, which connects Russian gas fields to the EU pipeline network at Germany's Baltic coast, is scheduled to be completed in 2019 but is opposed by the United States and has divided political opinion in Europe.

7.5 World exports

A major expansion of world LNG supply capacity is underway

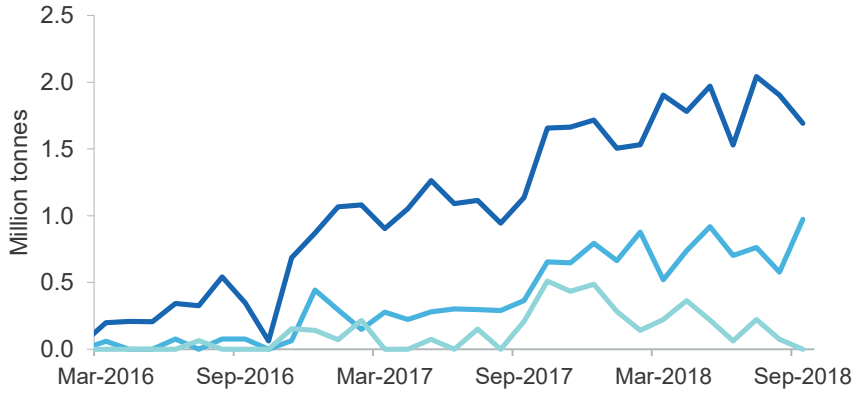
The next few years are expected to see a major expansion in global LNG supply capacity, driven primarily by the US, though some ramp-up is also expected in Australia and Russia.

Around two-thirds of the increase in supply capacity between 2018 and 2020 will come from the United States. The nameplate capacity of US LNG projects is on track to triple to around 70 million tonnes, with all six plants expected to be operational by the end of 2019. This expansion in LNG infrastructure is expected to make the US the third largest LNG exporter in the world, behind Australia (where nameplate capacity will soon reach 88 million tonnes) and Qatar (where nameplate capacity is expected to remain at 77 million tonnes for the next few years).

LNG trade has recently been caught up in trade tensions between China and the US. On 24 September, China imposed a 10 per cent tariff on imports of LNG from the US as part of its response to tariffs on US$200 billion of imports of Chinese goods announced by the US Administration. In the 12 months to September 2018, the US exported 3 million tonnes of LNG to China (Figure 8.6) — equivalent to 6 per cent of China's LNG imports, and around 14 per cent of US LNG exports.

Data is not yet available for the period following the implementation of the tariffs, but early signs are that they have encouraged a reorganisation of trade flows, with China looking to bring in more LNG from other sources, and US LNG exports being directed to other markets. Cheniere Energy, the largest LNG exporter in the United States, has reportedly swapped cargoes that were to be sold to PetroChina with non-US origin volumes.

Figure 7.6: US LNG exports, monthly

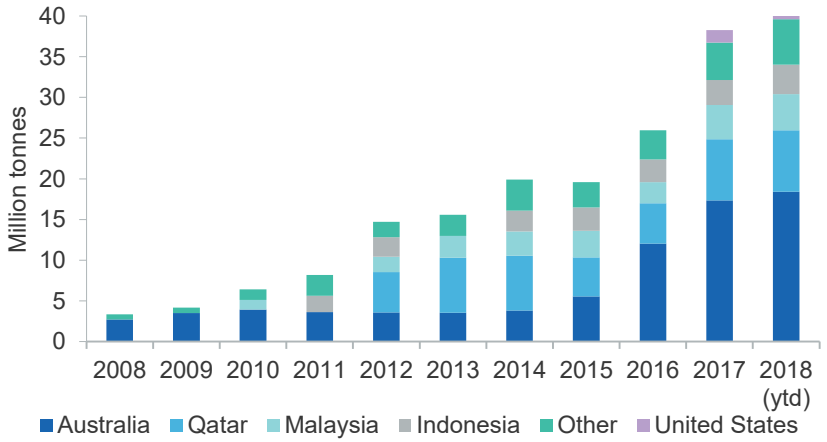


Source: EIA (2018)

The way in which trade flows reorganise will become clearer as data is made available for LNG trade over the northern hemisphere winter. US LNG exports to China (and Asia more broadly) were likely low in the September quarter due to seasonal rather than just geopolitical factors (Figure 7.6). However, over the northern hemisphere winter, US LNG exports to China would normally be expected to increase and act as a flexible source of supply to meet peak demand.

A longer-term risk is that escalating trade tensions discourage or delay final investment decisions (FIDs) for a second wave of US LNG projects. A long-term supply deal between US exporter Cheniere Energy and China National Petroleum (for 1.2 million tonnes of LNG per year) supported an FID in May 2018 for a third 4.5 million tonne train at Cheniere's Corpus Christi LNG project.

Figure 7.7: China's LNG imports



Notes: Data for 2018 is for January to October 2018.
Source: Bloomberg (2018)

Russia's LNG exports are expected to increase over the next few years, as the country's second LNG project, Yamal LNG, ramps up production. The commencement of operations at the third 5.5 million tonne train at Yamal will bring the nameplate capacity of Russian LNG facilities to 27 million tonnes. As average temperatures increase in the Arctic, the northern sea route appears to be emerging as a transport corridor between Russia and Asia. The Yamal project shipped a cargo of LNG to China via the northern sea route in November — reportedly the first ever shipment at this time of year, when the winter conditions normally inhibit transit. New capacity additions are also expected in Australia (discussed below).

Qatar's LNG exports are projected to remain largely unchanged

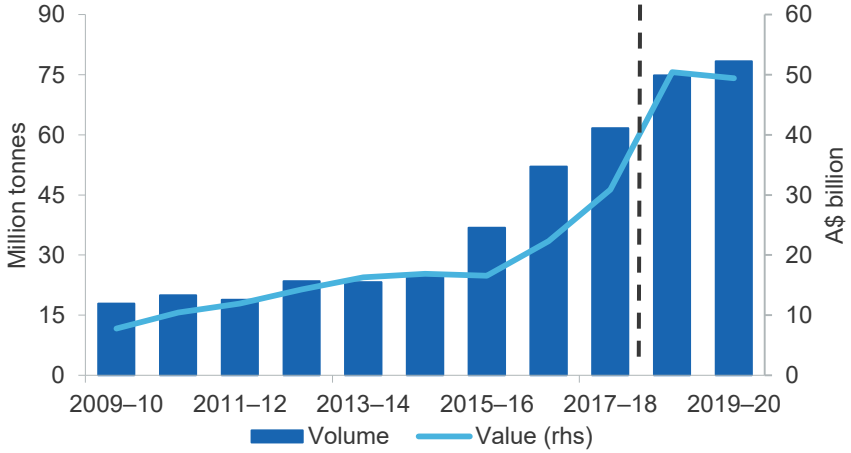
Qatar exported 75 million tonnes of LNG in 2017, making it the world's largest exporter of the liquefied fuel. Since 2011, Qatar's exports have ranged from 72–77 million tonnes a year, and they are expected to remain in this range over the outlook period. Qatar's plans to increase LNG production capacity by 43 per cent to 110 million tonnes is not expected to flow through to increases in its exports until 2024.

7.6 Australia

Higher prices and export volumes to boost LNG export earnings

Australia's LNG export earnings are forecast to increase from $31 billion in 2017–18 to $50 billion in 2018–19, and then remain near this level in 2019–20. The lagged effect of the recent spike in oil prices is expected to flow through to higher prices for Australian LNG in 2018–19, before prices ease in 2019–20. Increasing export volumes are expected to drive Australia's LNG export earnings higher over the next two years. Australia's LNG exports are forecast to reach 78 million tonnes in 2019–20, up from 62 million tonnes in 2017–18 (Figure 7.8).

Figure 7.8: Australia's LNG export earnings and volumes

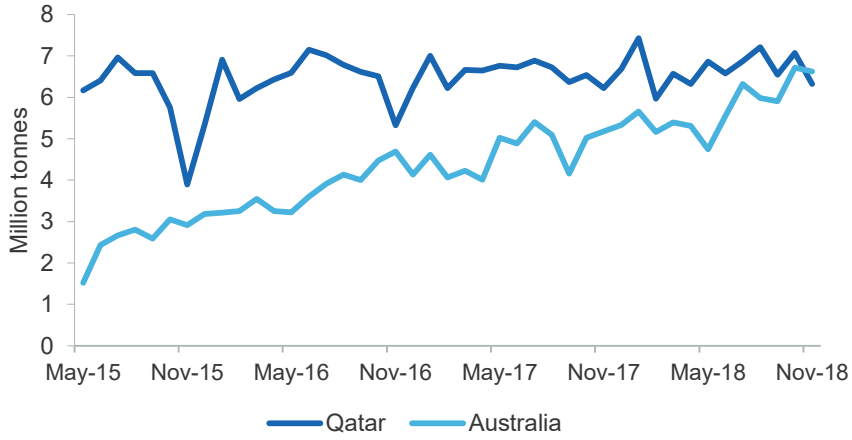


Source: ABS (2018); Department of Industry, Innovation and Science (2018)

Higher export volumes will be driven by the Wheatstone, Ichthys and Prelude LNG projects. Production at Wheastone will be substantially higher in 2018–19 than in 2017–18, with the project having ramped up to near full capacity last quarter. Ichthys shipped its first LNG cargo in October, and train 2 is expected online in 2019. Shell has indicated that the Prelude project will begin LNG production before the end of 2018, although this had not occurred at the time of writing.

On current projections, Australia will edge past Qatar as the world's largest LNG exporter (on an annual basis) in 2019 when exports reach 77 million tonnes, and extend its lead slightly further in 2020. Monthly shipping data suggests that Australia exported slightly more LNG than Qatar for the first time in November this year (Figure 7.9). However, given the narrow difference between the projected exports of the two nations, Australia overtaking Qatar is not a certainty.

Figure 7.9: Qatar and Australia's monthly LNG exports



Source: Bloomberg (2018)

Australia is only expected to be the largest LNG exporter in world for a few years. By the mid-2020s, Australia seems likely to be overtaken by both Qatar, which has plans to lift export capacity to 110 million tonnes, and the United States, where low-cost shale gas production could underpin the development of new LNG export projects.

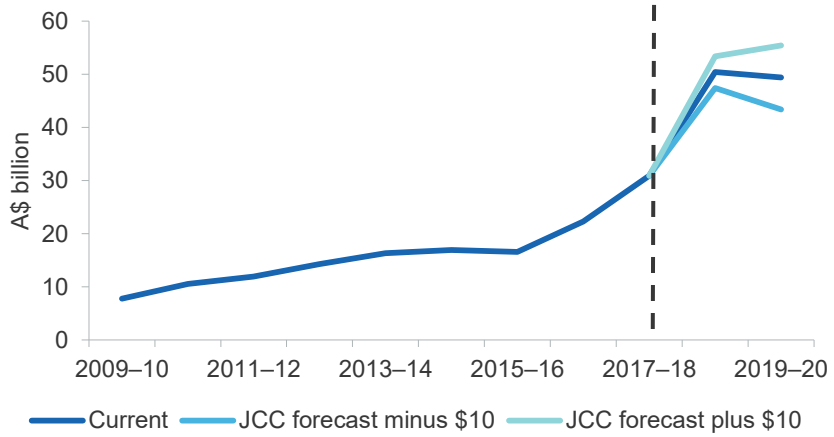
LNG export earnings have been revised up

Forecast LNG export earnings have been revised up by $2.0 billion in 2018–19 and $1.6 billion in 2019–20 since the September *Resources and Energy Quarterly*. The upwards revision reflects a weaker outlook for the Australian dollar and minor changes to production forecasts for a number of LNG projects.

Oil prices remain a key sensitivity

Oil prices have been volatile over the past few months, climbing over US$80 a barrel before falling to under US$60 a barrel. Future oil prices are a key sensitivity for LNG export earnings (Figure 7.10). The JCC is expected to be in the low US$70 a barrel range over the outlook period. If the JCC oil price forecast was reduced by US$10 a barrel, projected LNG export earnings would be $3 billion lower in 2018–19 at $47 billion and $6 billion lower at $43 billion in 2019–20.

Figure 7.10: LNG export earnings and the oil price sensitivity



Notes: JCC stands for Japan Customs-cleared Crude.

Source: Nexant (2018); Department of Industry, Innovation and Science (2018)

Box 7.1: The long-term outlook for natural gas

Natural gas is the fastest growing fossil fuel in all three of the International Energy Agency's (IEA) scenarios for the future of world energy. Under all three scenarios, gas comes to account for a greater share of the energy mix than coal. In the Sustainable Development Scenario — where energy demand is constrained and coal and oil consumption falls — gas consumption grows modestly, and gas becomes the dominant fuel in the global energy mix.

Under all three scenarios, gas demand is driven by emerging Asia. In the Sustainable Development Scenario — which sees the target of the Paris Agreement achieved — gas consumption in the Asia-Pacific is largely the same as in the New Policies Scenario (Figure 7.11). This suggests gas could act as a transition fuel in the Asia-Pacific, substituting for coal in power generation and making headway in other sectors. However, gas demand falls in other regions in the Sustainable Development Scenario, such as North America and Europe.

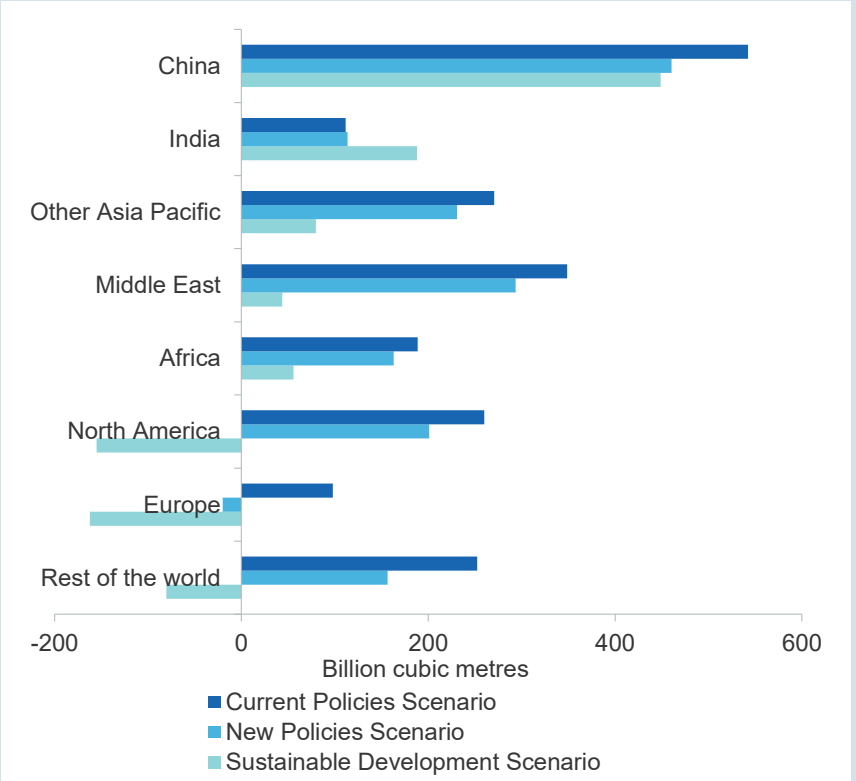
In the New Policies Scenario, China's gas consumption triples over the next two decades. Gas shifts from 7 per cent of China's energy mix in 2017 to 14 per cent in 2040. China's LNG imports more than quadruple from 36 million tonnes in 2017 to 151 million tonnes in 2040. By the mid-2020s, China has overtaken Japan as the world's largest LNG importer. India's gas demand also triples in this scenario, albeit off a low base. Gas' share of the energy mix rises from 5 per cent to 8 per cent by 2040, but falls short of the Government's target of 15 per cent. LNG imports increase from 18 million tonnes in 2017 to 63 million tonnes in 2040.

New LNG supply will come from the ramp up of existing projects in the US, and from Qatar's plans to expand its export capacity (see 'World exports' in this Chapter). Australia's LNG exports increase from 57 million tonnes in 2017 to 107 million tonnes in 2040 under the New Policies Scenario. East Africa looks set to commence new export projects, and Argentina may be drawn into the LNG market as it develops its unconventional gas resources.

The delivery of Russia's Yamal project on time and on budget encourages the development of gas resources in the Arctic.

However, challenges to the outlook for gas remain. Gas needs to deliver reliability and affordability while meeting economic and environmental objectives if policymakers are to commit to the infrastructure needed for the fuel. Signs of supply insecurity or price volatility could push gas to the margin and see Asia pursue coal and renewables instead.

Figure 7.11: Change in gas demand by IEA scenario, 2017 to 2040



Notes: The CPS considers the impact of policies and measures that are firmly enshrined in legislation as of mid-2018. The NPS incorporates current policies and also the likely effects of announced policies, including official targets. The SDS entails a pathway consistent with the goals of universal access to modern energy by 2030; emissions reduction in line with the Paris Agreement; and improving air quality.
Source: IEA (2018)

Table 7.1: Gas outlook

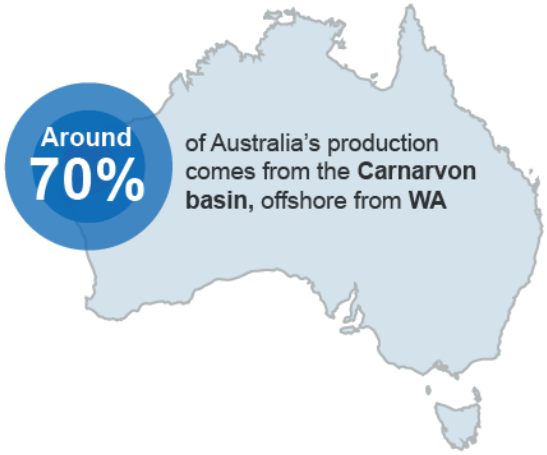
	Unit	2017	2018[f]	2019[f]	2020[f]	Annual percentage change 2018[f]	2019[f]	2020[f]
World								
JCC oil price[a]								
– nominal	US$/bbl	54.1	71.8	73.0	71.5	32.8	1.7	–2.1
– real[h]	US$/bbl	55.4	71.8	71.4	69.1	29.6	–0.5	–3.2
Gas production	Bcm	3,726.5	3,847.9	3,885.3	3,948.6	3.3	1.0	1.6
Gas consumption	Bcm	3,739.8	3,834.5	3,889.2	3,942.2	2.5	1.4	1.4
LNG trade	Mt[d]	289.9	329.1	349.6	367.4	13.5	6.2	5.1
	Unit	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Australia								
Production[b]	Bcm	105.3	120.3	137.5	142.3	14.2	14.3	3.5
– Eastern market	Bcm	54.3	55.0	55.0	53.1	1.3	0.0	–3.4
– Western market	Bcm	49.6	63.8	76.6	77.0	28.7	19.9	0.6
– Northern market[c]	Bcm	1.3	1.4	5.9	12.1	5.5	319.5	105.1
LNG export volume[d]	Mt	52.1	61.7	74.9	78.3	18.4	21.4	4.6
– nominal value	A$m	22,308	30,907	50,411	49,403	38.5	63.1	–2.0
– real value[e]	A$m	23,261	31,617	50,411	48,233	35.9	59.4	–4.3
LNG export unit value[g]								
– nominal value	A$/GJ	8.1	9.5	12.7	11.9	17.1	34.4	–6.3
– real value[e]	A$/GJ	8.5	9.7	12.7	11.7	14.8	31.3	–8.5
– nominal value	US$/MMBtu	6.5	7.8	9.8	9.6	20.3	26.2	–2.2
– real value[e]	US$/MMBtu	6.7	7.9	9.8	9.4	18.0	23.3	–4.5

Notes: **a** JCC stands for Japan Customs-cleared Crude; **b** Production includes both sales gas and gas used in the production process (i.e. plant use) and ethane. Historical gas product ion data was revised in the June quarter 2017 to align with Australian Petroleum Statistics published by the Department of Environment and Energy; **c** Gas production from Bayu-Undan Joint Production Development Area is not included in Australian production. Browse basin production associated with the Ichthys project is classified as Northern market; **d** 1 million tonnes of LNG is equivalent to approximately 1.36 billion cubic metres of gas; **e** In 2018–19 Australian dollars; **f** Forecast; **g** 1 MMBtu is equivalent to 1.055 GJ; **h** In 2018 US dollars; **s** Estimate.

Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Dept of Industry, Innovation and Science (2018); Company reports; Nexant World Gas Model (2018)

Oil

Resources and Energy Quarterly December 2018



of Australia's production comes from the **Carnarvon basin,** offshore from **WA**

Australia's petroleum production peaked in 2000, at

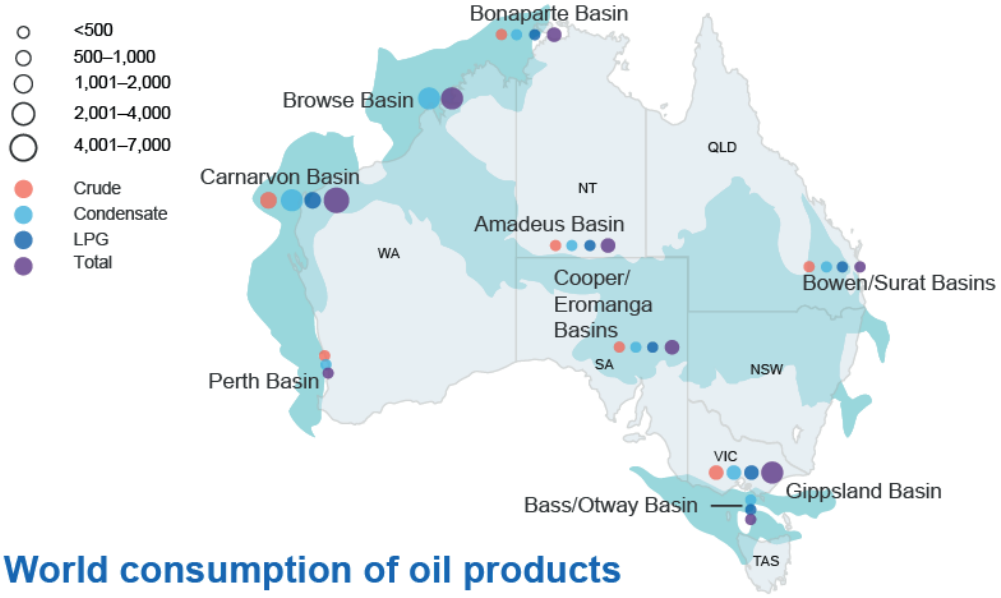
41,300 ML

Around **23%** of refinery feedstock is domestically produced, the remainder is imported

In the last 5 years the Brent spot price ranged from

US$27– US$115 a barrel

Australia's crude oil, condensate and LPG resources (PJ)

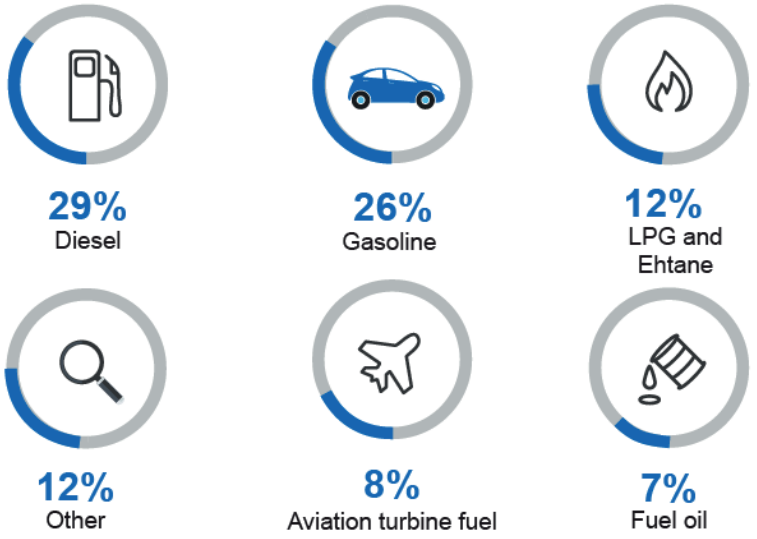


Key consumer markets of oil products

1 United States 20 mb/d	**2 Europe** 14 mb/d	**3 China** 13 mb/d	**5 Japan** 3.8 mb/d
21%	14%	13%	4%
		4 India 4.8 mb/d	**6 Russia** 3.4 mb/d
		5%	3%

Note: Measured in million barrels per day.

World consumption of oil products



29% Diesel

26% Gasoline

12% LPG and Ehtane

12% Other

8% Aviation turbine fuel

7% Fuel oil

8.1 Summary

- After price volatility in the December quarter, oil prices are expected to settle over the outlook period as production increases balance consumption growth. The Brent crude oil spot price is forecast to average US$72 a barrel in 2020.
- Australia's petroleum export volumes are forecast to increase from 226 thousand barrels a day in 2017–18 to 319 thousand barrels a day in 2019–20, supported by new LNG-related condensate capacity.
- Higher volumes growth is expected to support export earnings growth over the outlook period. Export earnings are forecast to rise from $7.0 billion in 2017–18 to $11 billion in 2019–20.

8.2 Prices

Fears of oil shortages addressed by record production

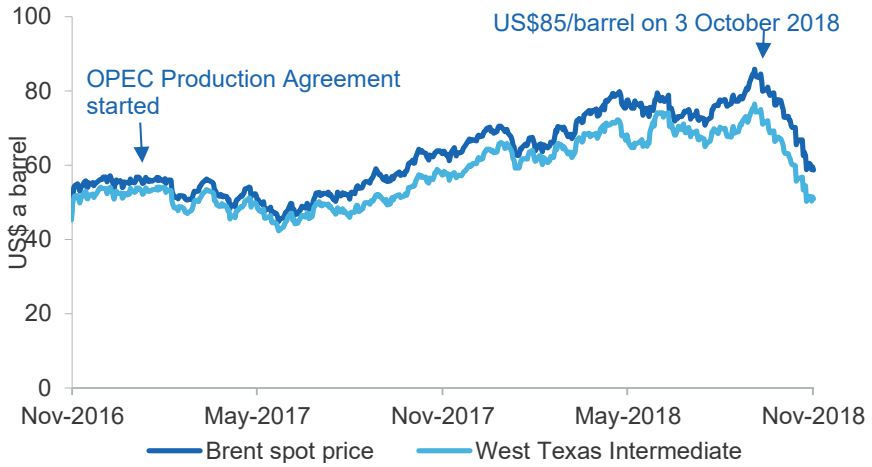
A dramatic quarter of oil price movements reflected expectations about world production shortages, which did not come to pass. In early October, the Brent spot price reached its highest point in four years, at US$86 a barrel (Figure 8.1). This price spike was supported by fears of production shortages due to renewed sanctions by the US against Iran, continued low Venezuelan production and falling OECD stocks. Since that point, prices have decreased sharply — to under US$60 a barrel in November — driven by significant production increases from Saudi Arabia, Russia and the US. Prices fell as fears of market shortages dissipated: production increases dampened the effect of reduced Iranian exports, as did US waivers that were granted to a number countries importing oil from Iran.

Higher oil production and lower consumption growth to weigh on prices

The Brent crude spot price is estimated to average $72 a barrel over the next two years (Figure 8.2). The renewed OPEC and non-OPEC production agreement is expected to bring certainty to the market and support oil prices.

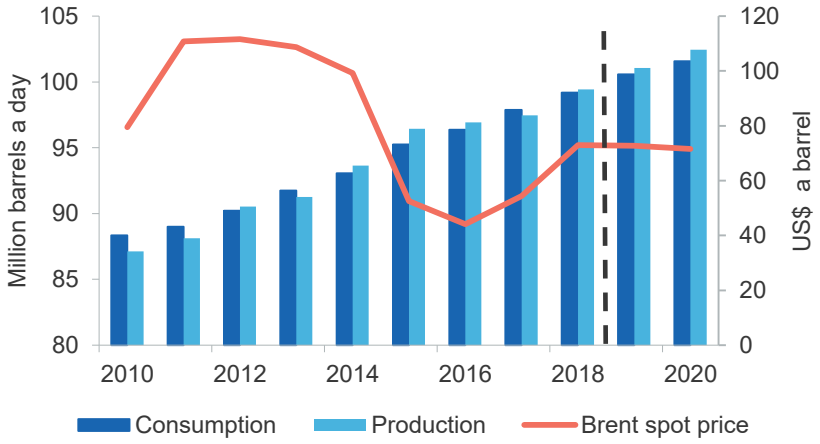
In addition to production uncertainties, a number of demand risks remain for oil prices: lower economic growth, particularly in China, could lower consumption growth and push prices lower.

Figure 8.1: Historical oil prices



Source: Bloomberg (2018); Department of Industry, Innovation and Science (2018)

Figure 8.2: World oil market balance and Brent spot price



Source: Bloomberg (2018); Department of Industry, Innovation and Science (2018)

8.3 World oil consumption

Oil consumption is expected to increase at an average annual rate of 1.3 per cent over the outlook period, from 99 million barrels a day in 2018 to a forecast 102 million barrels a day in 2020. There are a number of factors weighing on current and medium term consumption: lower economic growth, currency devaluations in oil-importing countries and consumer resistance to higher oil prices, as well energy efficiency improvements and fuel switching.

Oil consumption growth driven by Asia over the outlook

Non-OECD countries are expected to account for all of the growth in oil consumption over the outlook period, with non-OECD consumption forecast to reach 54 million barrels a day in 2020. Consumption in China is expected to reach 14 million barrels a day, increasing at an average annual rate of 3.7 per cent. In India, consumption is forecast to increase at an annual rate of 4.5 per cent, reaching 5.2 million barrels a day in 2020. OECD consumption is expected to be stagnant over the outlook period, as consumption increases are outweighed by efficiency improvements.

Box 8.1: Market impacts of regulatory changes on marine shipping

The International Maritime Organisation has introduced a new regulation to address sulphur oxide emissions in the shipping industry. This regulation, due to be introduced in 2020, will limit the sulphur content of shipping fuel to 0.5 per cent, from the current level of 3.5 per cent.

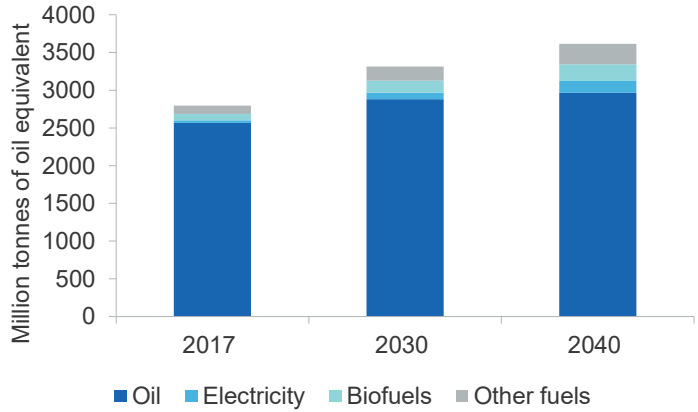
The regulation can be complied with by using low-sulphur fuel, or marine gasoil, rather than high-sulphur fuel. Equipment investments like installing gas cleaning systems (scrubbers), can be undertaken to meet the regulatory requirements. The regulatory change could also encourage a small shift to using LNG as a shipping fuel.

This regulation is expected to change the demand dynamics for refined products, with a significant and sudden increase in low-sulphur fuel oil and marine gasoil consumption. This change could result in higher prices for these products, as well as refinery feedstocks and diesel. Regardless of which compliance method is chosen, shipping costs are expected to increase.

Box 8.2: The outlook for oil consumption in road transportation

Road transport is the largest consumption market for oil, and changes in technology, environmental standards and government policies will have a significant influence on how consumption changes over the long term. Road transport and vehicle ownership is expected to continue its growth trajectory, particularly in China, India and the Middle East. In the IEA's latest *World Energy Outlook*, the share of oil used in road transport decreases across all scenarios. In the New Policies Scenario, which includes current and announced policies, oil used in car transport will not change significantly. This is despite expanding vehicle numbers (up 80 per cent by 2040) and higher consumption in non-OECD economies. Improvements in fuel efficiency, and to a lesser extent, substitution to alternative fuels contribute to stagnant consumption growth. Consumption in truck transport is projected to increase. Oil currently fuels 92 per cent of transport activity. In the New Policies Scenario, this share is projected to fall to 82 per cent by 2040 (Figure 8.3). The IEA's Sustainable Development Scenario projects what would be required to achieve the Paris Agreement goals and universal energy access. Under this scenario the share of oil in transport falls to 60 per cent in 2040.

Figure 8.3: IEA New Policies Scenario: Fuel used in transport



Source: International Energy Agency (2018); Department of Industry, Innovation and Science (2018)

8.4 World oil production

Oil production is forecast to increase modestly over the outlook period, increasing from almost 100 million barrels a day in 2018 to 102 million barrels a day in 2020.

In the US, improving well-efficiency continues to support growth, despite some infrastructure capacity constraints. The US is currently the largest producer in the world and is expected to drive production growth in the short-term (Figure 8.4). After growth in 2018, US production is forecast to increase at an average annual rate of 6.0 per cent, to reach 17 million barrels a day in 2020.

OPEC+ production increases outweigh losses from Iran and Venezuela

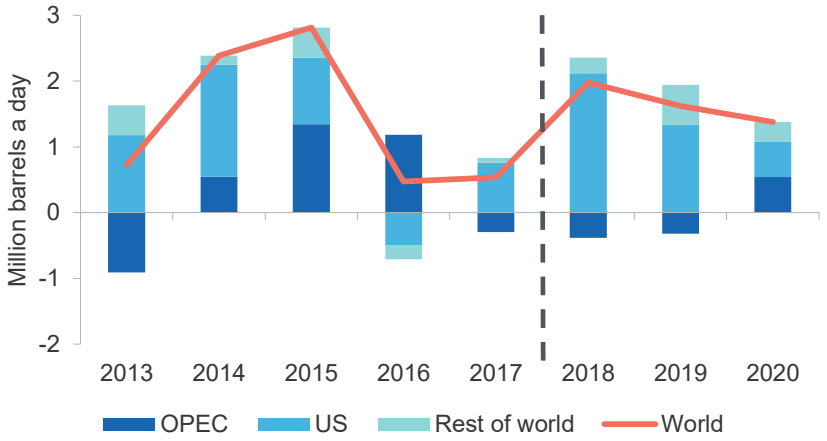
In the second half of 2018, OPEC production reached the highest level in almost two years, as Saudi Arabia increased output to counter losses from other producers. OPEC production was also boosted by Nigeria and Libya, and non-OPEC member Russia (Figure 8.5). The OPEC+ Production Agreement, which limits the output of each producer, has been in place for two years. In December, OPEC and other major producers agreed to production cuts of 1.2 million barrels a day for the first half of 2019; OPEC production is expected to lower by 0.8 million barrels a day, and non-OPEC production by 0.4 million barrels a day.

Sanctions on Iran have begun, but impacts are still to be felt

The reintroduction of US sanctions on Iran has been a significant influence on the oil market in 2018, fostering concerns of world production shortages. The sanctions, intended to cease Iran's oil exports, came into effect in November.

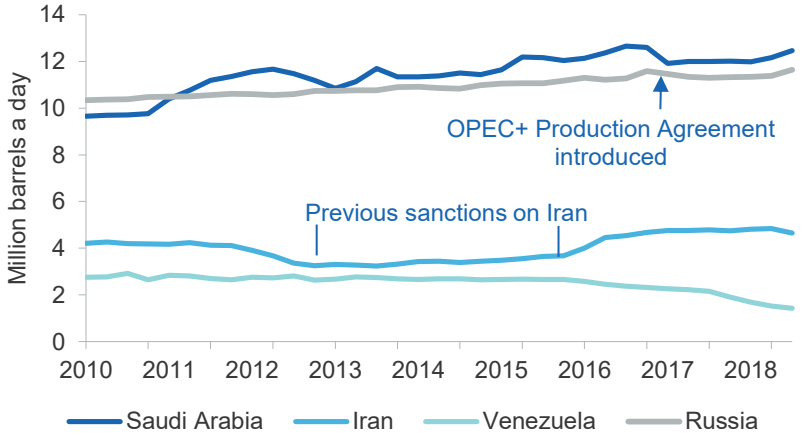
Prior to the sanctions being introduced, Iran's oil exports had been steadily increasing over 2018, to reach 1.8 million barrels a day in October. The US has granted import waivers to a number of countries, including China, India and Korea, allowing them to maintain a portion of imports for the next six months. It is unclear how significant the impact of the sanctions will be on world oil markets. Iran is currently excluded from the OPEC production controls.

Figure 8.4: Annual change in world oil production



Source: International Energy Agency (2018); Department of Industry; Innovation and Science (2018)

Figure 8.5: OPEC production and Iran's production under sanctions



Source: International Energy Agency (2018)

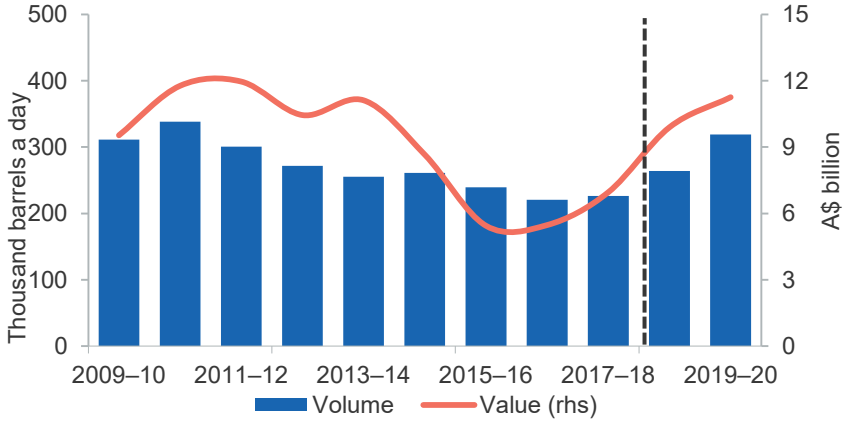
8.5 Australia's production and trade

Export earnings supported by oil prices and higher condensate output

Crude and condensate export earnings continued to grow in the September quarter, supported by higher oil prices and increased condensate volumes. Export earnings were $2.1 million in the September quarter, up 37 per cent over the year.

Over the outlook period, export earnings are expected to increase by almost 60 per cent, from $7.0 billion in 2017–18 to a forecast $11 billion in 2019–20 (Figure 8.6).

Figure 8.6: Australia's petroleum export volumes and values



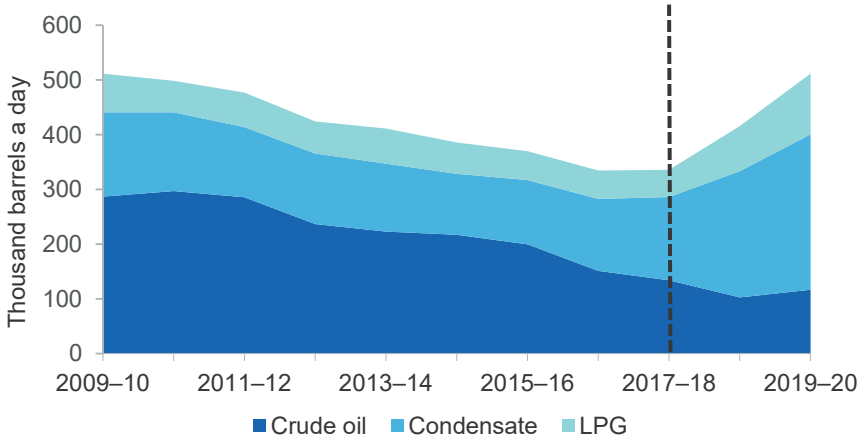
Source: ABS (2018); Department of Industry; Innovation and Science (2018)

Lower crude oil production outweighed by condensate production

Australia's petroleum production increased slightly in September quarter, up 2.3 per cent over the year as steep declines in oil production were outweighed by increases in condensate production. The growth in condensate production has been considerable. In the September quarter last year, crude oil and condensate production were roughly equal. Current condensate output is twice as big as crude oil. Some recent decreases in crude production are expected to be temporary. Planned maintenance at BHP's Pyrenees operations lowered production. At Woodside's Vincent and Enfield fields, production has temporarily ceased, in preparation for the Greater Enfield expansion. This project has a nameplate capacity of 40 thousand barrels a day and is expected to come online in 2019.

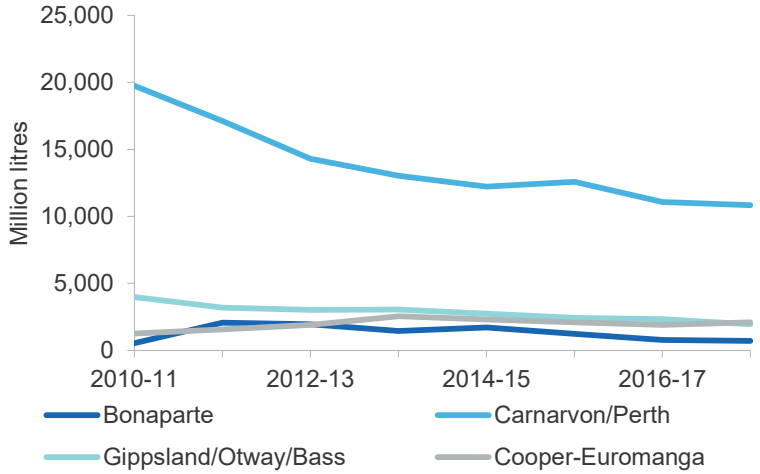
Growing condensate output is expected to drive Australia's petroleum production, and export earnings, going forward. Production is expected to increase at an average annual rate of 17 per cent over the outlook period, from 286 thousand barrels a day in 2017–18 to 392 thousand barrels a day in 2019–20 (Figure 8.7). In the September quarter new condensate production came online with the start-up of Train 1 at Inpex's Ichthys facility. Ichthys has a nameplate capacity of 100 thousand barrels a day of condensate, and Train 2 is expected to come online in 2019. Shell's Prelude facility has a nameplate capacity of 36 thousand barrels a day of condensate, which, at the time of writing was not operating. LPG production is also expected to increase over the outlook period, with strong production from a number of projects related to the Ichthys and Prelude projects.

Figure 8.7: Australia's petroleum production outlook update



Source: EnergyQuest (2018); Australian Petroleum Statistics (2018); Department of Industry, Innovation and Science (2018)

Figure 8.8: Petroleum production by major basin



Source: Australian Petroleum Statistics (2018)

Revisions to export earnings

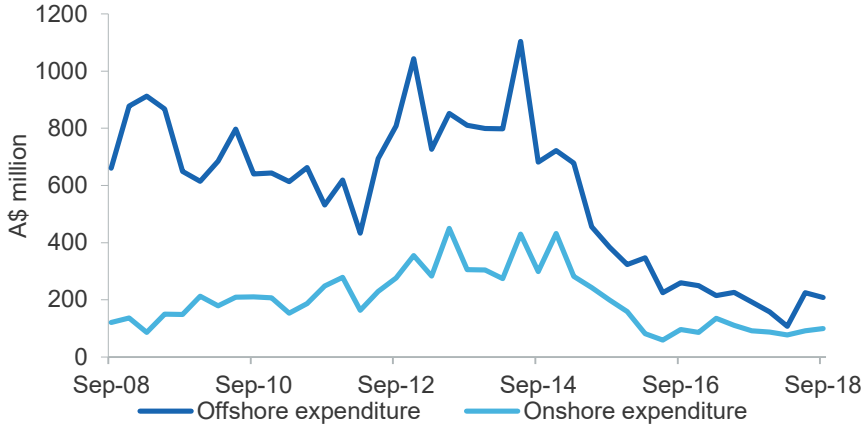
Since the September *Resources and Energy Quarterly* Petroleum export earnings have been revised up by $412 million in 2018–19 and $56 million in 2019–20. A downward revision to the Australian exchange rate has supported an increase in forecast export earnings for petroleum products.

Australia's exploration expenditure

Petroleum exploration expenditure was $308 million in the September quarter, which was slightly lower than the previous quarter and 8.6 per cent higher over the year (Figure 8.9).

Higher oil prices and expectations about future consumption growth have incentivised a recent uptick in exploration activity, although it remains below the historical trend.

Figure 8.9: Petroleum Exploration Expenditure



Source: ABS (2018) Mineral and Petroleum Exploration Expenditure, 8412.0

Australia's refinery production

Australia's refinery production was 474 thousand barrels a day in the September quarter, 4.0 per cent lower over the year. This production accounted for around 45 per cent of domestic consumption of total refined products, including around 33 per cent of diesel and 62 per cent automotive gasoline.

Australia's refineries continue to specialise with investments at existing facilities. Mobil have recently added a jet–fuel pipeline and storage capacity to their Altona refinery. Over the outlook period refinery production is expected to continue at current rates, with scheduled maintenance. In 2019–20 refinery production is forecast to be 486 thousand barrels a day.

Table 8.1: Oil outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018[f]**	**2019[f]**	**2020[f]**	**2018[f]**	**2019[f]**	**2020[f]**
Production[a]	mb/d	97.5	99.4	101.1	102.4	2.0	1.6	1.4
Consumption[a]	mb/d	97.9	99.2	100.6	101.6	1.3	1.4	1.0
WTI crude oil price								
– Nominal	US$/bbl	50.8	67.5	68.1	66.6	32.8	0.8	–2.1
– Real[b]	US$/bbl	52.1	67.5	66.6	64.4	29.6	–1.4	–3.2
Brent crude oil price								
– Nominal	US$/bbl	54.3	72.4	73.0	71.5	33.1	0.9	–2.1
– Real[b]	US$/bbl	55.7	72.4	71.4	69.1	29.9	–1.3	–3.2
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Crude and condensate								
Production[a]	kb/d	283	286	326	392	1.2	13.8	20.3
Export volume[a]	kb/d	221	226	264	319	2.6	16.7	20.7
– Nominal value	A$m	5,476	6,959	9,896	11,255	27.1	42.2	13.7
– Real value[g]	A$m	5,710	7,119	9,896	10,989	24.7	39.0	11.0
Imports[a]	kb/d	351	386	398	381	10.1	2.9	–4.1
LPG production[ac]	kb/d	52	50	74	102	–4.3	49.6	36.9
Refined products								
– Refinery production[a]	kb/d	471	494	498	486	4.8	0.8	–2.5
– Export volume[ad]	kb/d	18	18	17	18	–3.5	–1.1	1.0
– Import volume[a]	kb/d	616	644	647	662	4.5	0.5	2.4
– Consumption[d]	kb/d	1,005	1,041	1,072	1,092	3.5	3.1	1.8

Notes: **a** Number of days in a year is assumed to be exactly 365.25**; b** in 2018 calendar year dollars**; c** Primary products sold as LPG**; d** Domestic sales of marketable products**;** f forecast; g in 2018–19 financial year Australian dollars. A barrel of oil is equivalent to 158.987 litres. Source: ABS (2018), cat. No. 5464.0; International Energy Agency (2018); Department of Industry, Innovation and Science (2018)

Uranium

Resources and Energy Quarterly December 2018

Australia holds **31%** of the world's proven uranium reserves

Australia is the **3rd** largest producer of uranium in the world

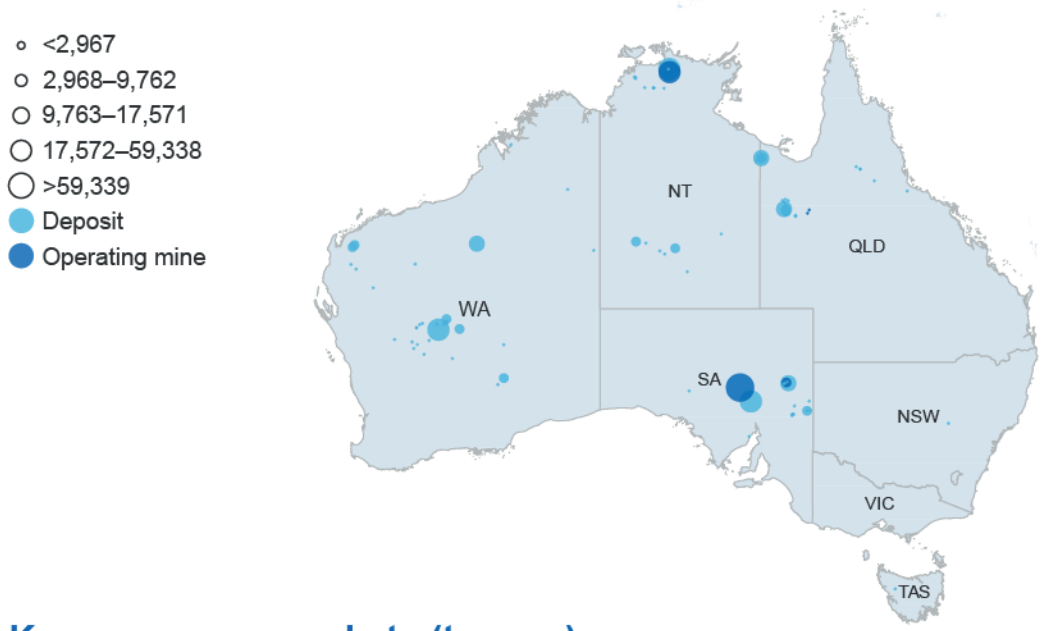
Australia produces and exports more than **7,000 tonnes** of uranium every year

Uranium makes up **11%** of global electricity generation

More than **450** nuclear power reactors across 30 countries

There are **245** civil research reactors operating across 55 countries

Major Australian uranium deposits (tonnes)



Key consumer markets (tonnes)

USA	France	Russia	China	South Korea	Japan
17,847	**9,216**	**7,767**	**7,757**	**4,816**	**2,517**

9.1 Summary

- Uranium spot prices appear to be on a sustained recovery, with the gains in the September quarter now appearing to be locked in. Prices are expected to build on this, rising gradually in the medium term to reach around US$28 a pound by 2020.
- Uranium production in Australia is expected to be largely steady at around 7,000 tonnes annually over the outlook period. Rising production at Olympic Dam should offset small declines in output from the Ranger mine, which is due to close before 2021.
- Australia's uranium export earnings are expected to lift from $650 million in 2017–18 to $715 million by 2019–20, supported by higher prices.

9.2 Prices

The long-awaited recovery in prices now appears locked in

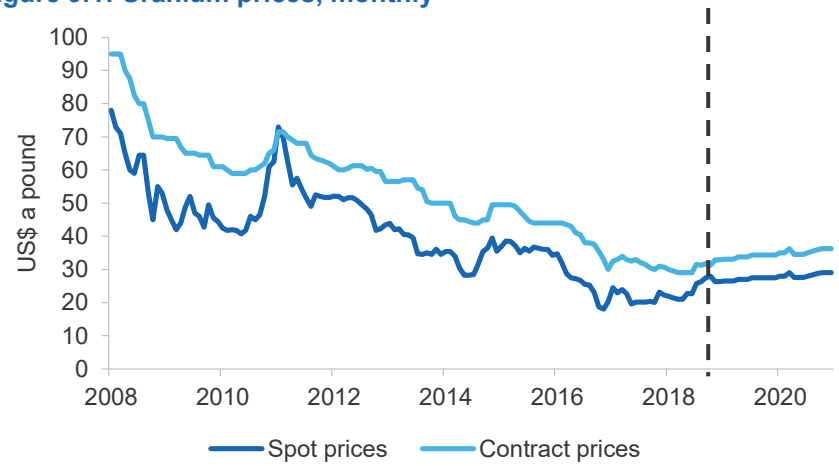
Uranium prices are recovering from a long period of historical lows. Prices lifted from US$22.65 in the June quarter to US$27.50 in the September quarter, with further gains evident early in the December quarter.

Prices previously hit a low of US$18 a pound in November 2016, and entered a long period of stagnation throughout 2017 and early 2018. Around three-quarters of uranium produced has been sold at a loss over the past two years, and large inventories accumulated after the Fukushima shut-down have stopped prices from correcting. Low prices led to new supply from prospective mines in Africa and elsewhere being curtailed and postponed. The recent lift in prices is thus highly significant for producers.

Supply cuts by major producers in Canada and Kazakhstan have been the main drivers of the recent lift, and with cuts expected to persist, it is likely that prices will hold their gains in a tighter market. The scale of inventories is expected to suppress further price growth to some degree (Figure 9.1), but risks have now clearly shifted towards price spikes.

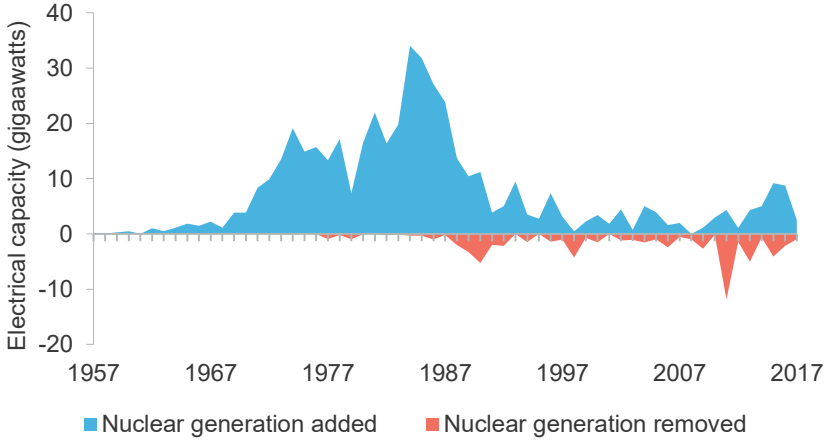
The longer-term effects of falling mine commencements and lower exploration on the uranium market have not yet become apparent.

Figure 9.1: Uranium prices, monthly



Source: Cameco Corporation (2018) Uranium Spot Price; Ux Consulting (2018) Uranium Market Outlook

Figure 9.2: World nuclear power generation



Source: International Energy Agency (2018); World Nuclear Association (2018); Department of Industry, Innovation and Science (2018)

9.3 World consumption

Nuclear power growth continues across Asia

Several recent developments have boosted uranium demand in Asia. In China, a string of new reactors have been connected to the grid over the past few months. Unit 4 of the Tianwan nuclear plant was grid-connected in early October, which resulted in global nuclear generation rising above 400 GWe for the first time. Unit 1 of the Haiyang nuclear power plant also moved closer to connection, following a successful completion of 168 hours of continuous generation. This follows the connection of unit 2 of the Sanmen nuclear plant in the September quarter.

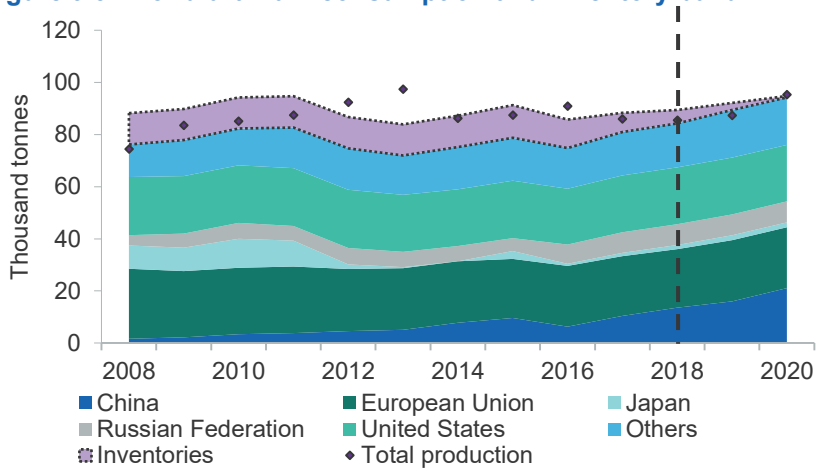
In Taiwan, the government held a referendum on its policy to phase out nuclear energy by 2025. The referendum produced a decisive result, with 59 per cent voting against the proposal, and in favour of retaining nuclear power into the future. Taiwan suffered a five-hour blackout in 2017 after an earlier reactor closure, and nuclear power remains by far the country's cheapest energy source, generating power at around one-fifth of the cost of LNG and one-third the cost of wind energy.

Japan's Nuclear Regulation Authority has approved the restart of unit 2 of the Tokai nuclear plant. An injunction on the re-connection of unit 3 of the Ikata power plant was rejected on October by the Hiroshima district court, clearing the way for another reactor to restart. Nine reactors have thus far been given approval to re-connect, with 18 in the process of approval. Since 2011, 15 older and smaller reactors have been confirmed for decommissioning.

Russian energy company Rosenergoatom announced in October that unit 1 of its Leningrad Phase II nuclear power plant is ready to connect, following the completion of its final testing. Unit 4 of the Rostov nuclear power plant also entered commercial operation in the December quarter.

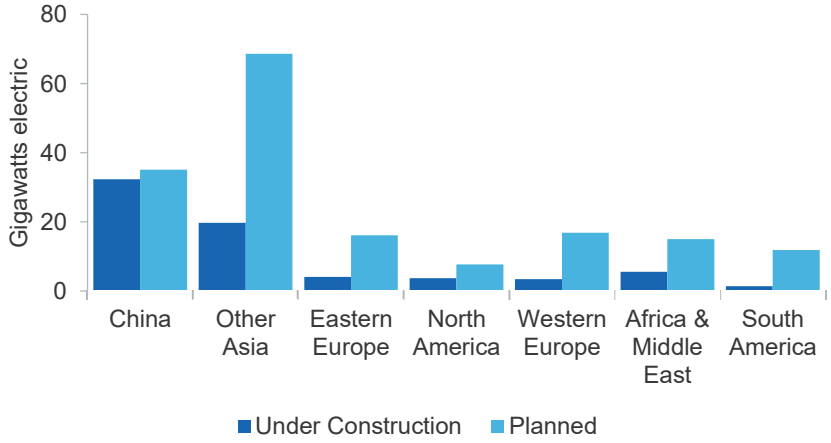
In the US, the Vogtle 3 and 4 reactor constructions have been cleared to proceed, with all four co-owners voting to continue construction. The first coolant pumps were also put in place during the December quarter, marking a major milestone in a much-delayed project.

Figure 9.3: World uranium consumption and inventory build



Source: International Energy Agency (2018); World Nuclear Association (2018); Ux Consulting (2018)

Figure 9.4: New nuclear capacity



Source: International Energy Agency (2018); World Nuclear Association (2018); Department of Industry, Innovation and Science (2018)

The use of reactors in producing medical isotopes is set to increase, with Bruce Power in Canada now generating medical-grade cobalt in all four of its Bruce B units. These units are expected to be capable of operating as medical suppliers until 2064. Canadian Nuclear Laboratories are also shifting towards commercial production of a rare medial radioisotope called actinium 225, which has high potential in cancer treatments.

Nuclear power generation has recorded solid growth in 2018, with nine substantial new reactors commencing operation, and promising new medical uses of nuclear energy emerging. Further reactor connections in China and India could still occur before the end of the year. Uranium consumption is accordingly expected to rise from 80,900 tonnes in 2017 to 84,300 tonnes in 2018. The scale of construction across Asia is forecast to add a further 10,000 tonnes to uranium demand by 2020 (Figure 9.3).

9.4 World production

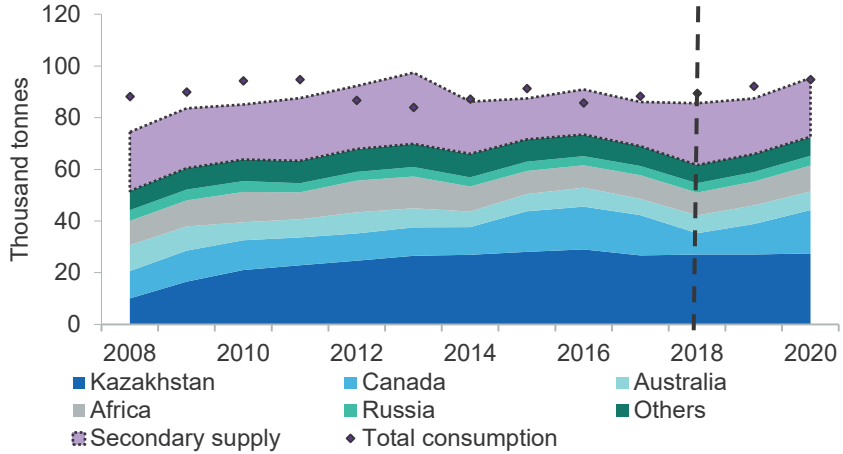
Conditions for uranium producers are belatedly improving

Since 2011, uranium supply has been largely stable or rising, while demand has consistently fallen short of expectations. This has led to significant downward price pressure and persistent growth in inventories.

Large supply cuts over 2018 have belatedly turned this around. A succession of production pauses in Canada, Niger, and Kazakhstan has resulted in a large reduction in global supply, from 69,000 tonnes in 2017 to 61,700 tonnes in 2018 (see Figure 9.4). Excessive enrichment capacity, which has added to growth in secondary (recycled) supplies, has partly offset this, but overall supply is nonetheless expected to be in some shortfall over the outlook period.

Production pauses at Cameco's huge McArthur River and Key Lake mines in Canada have been extended, meaning the largest uranium mine in the world effectively produced no output through 2018. In the longer term, rising demand (see Figure 9.5) plus project postponements in Africa and other regions are likely to increase price pressure and could lead to a supply crunch beyond the outlook period.

Figure 9.5: World uranium production and secondary supply



Source: Ux Consulting (2018) Uranium Market Outlook; World Nuclear Association (2018)

9.5 Australia

Australia's uranium exploration has virtually dried up

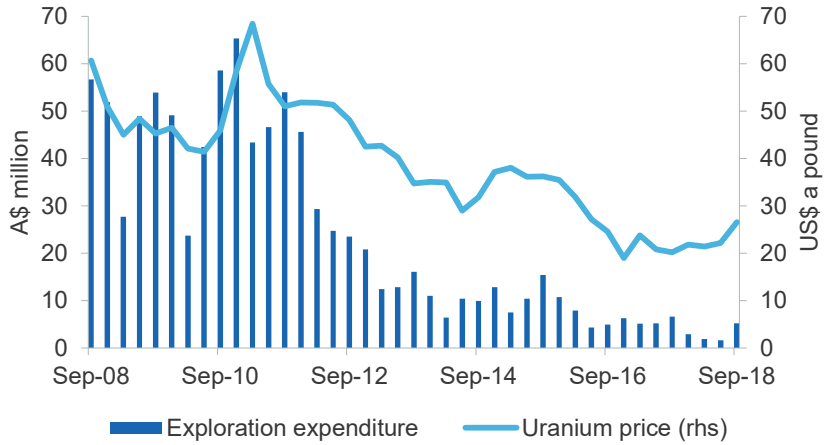
As Figure 9.6 shows, expenditure on uranium exploration has lifted from a low of $1.6 million in the June quarter 2018, to $5.2 million in the September quarter. This is still a relatively low level, but suggests recent price gains are expected by most producers to be retained, especially in an environment of potential long-term supply shortages.

Exploration remains largely confined to sites in the Northern Territory, Queensland, and South Australia.

Production is expected to remain largely steady over the next two years

As Figure 9.7 shows, Australian production is expected to lift from 6,654 tonnes in 2017–18 to 6,743 tonnes in 2018–19 and 7,240 tonnes in 2019–20.

Figure 9.6: Australia's uranium exploration expenditure



Source: ABS (2018) Mineral and Petroleum Exploration, cat. No. 8412.0; Cameco Corporation (2018) Uranium Spot Price

ERA's Ranger project — Australia's second largest uranium mine — is set to cease operations by January 2021, in line with long-planned project timeframes. Work on the closure feasibility study is almost complete, and is now expected to conclude before the end of 2018. ERA's Mine Closure Plan foresees revegetation of the site by 2024 and full rehabilitation by 2026. This will lead to a substantial fall in Australia's uranium exports from the early 2020s.

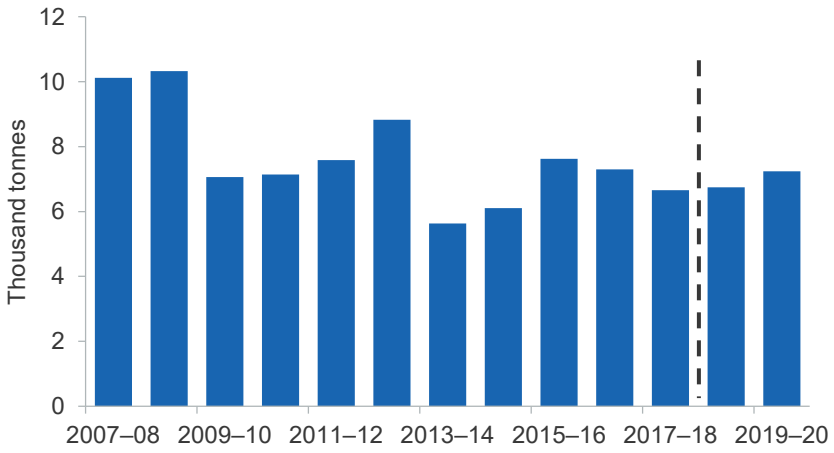
Conditions for exporters remain difficult, but Australia is still well placed

Price growth is expected to support rising export values in coming years, with earnings forecast to lift from $650 million in 2017–18 to $715 million by 2019–20 (Figure 9.8). Export volumes are expected to edge back from 8,118 tonnes in 2017–18 (a result inflated by the timing of shipments) to 6,743 tonnes by 2019–20.

Revisions to the outlook

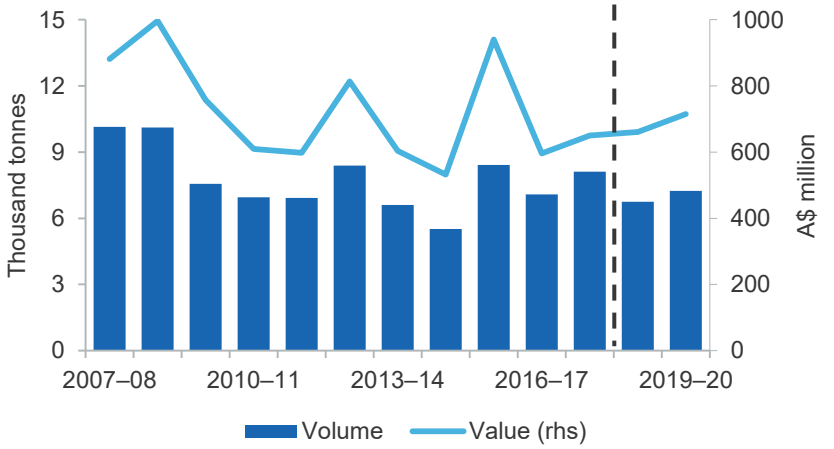
Australia's forecast uranium export earnings for 2018–19 remain largely unchanged from the September *Resources and Energy Quarterly*.

Figure 9.7: Australia's uranium production



Source: BHP (2018); Operational Review, DIIS (2018); Energy Resources of Australia (2018); ASX Announcements — Operations Review; company media announcements (2018)

Figure 9.8: Australia's uranium exports



Source: Department of Industry, Innovation and Science (2018)

Table 9.1 Uranium outlook

World	Unit	2017	2018[s]	2019[f]	2020[f]	Annual percentage change 2018[s]	2019[f]	2020[f]
Production	kt	69.0	61.7	65.9	72.5	–10.6	6.8	10.0
Africa[b]	kt	9.1	8.8	9.2	10.0	–3.4	4.8	8.6
Canada	kt	15.6	8.2	11.8	16.8	–47.2	43.3	42.3
Kazakhstan	kt	26.7	27.0	27.0	27.5	1.3	0.0	1.5
Russia	kt	3.6	3.7	3.7	3.8	2.3	0.0	3.1
Consumption	kt	80.9	84.3	89.4	94.3	4.2	6.1	5.4
China	kt	10.4	13.6	16.0	21.1	30.4	17.7	31.9
European Union 28	kt	22.9	22.5	23.5	23.3	–2.1	4.6	–0.6
Japan	kt	1.3	1.6	1.9	1.9	25.0	18.8	0.0
Russia	kt	7.9	8.0	8.0	8.1	1.0	0.1	0.8
United States	kt	21.8	21.8	21.8	21.7	0.0	0.0	–0.7
Spot price	US$/lb	21.7	24.1	26.2	28.0	11.4	8.7	6.9
real[c]	US$/lb	22.2	24.1	25.6	27.1	8.7	6.3	5.7
Australia	**Unit**	**2016–17**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**
Mine production	t	7,295	6,654	6,743	7,240	–8.8	1.3	7.4
Export volume	t	7,081	8,118	6,743	7,240	14.6	–16.9	7.4
– nominal value	A$m	596	650	661	715	9.0	1.8	8.1
– real value[d]	A$m	621	665	661	698	7.0	–0.5	5.6
Average price	A$/kg	84.2	80.0	98.0	98.7	–4.9	22.5	0.7
– real[d]	A$/kg	87.8	81.9	98.0	96.4	–6.7	19.7	–1.7

Notes: **b** Includes Niger, Namibia, South Africa, Malawi and Zambia; **c** In 2018 US dollars; **d** in 2018–19 Australian dollars; **f** forecast; **s** Estimate
Source: Australian Department of Industry, Innovation and Science (2018); Cameco Corporation (2018); Ux Consulting (2018) Uranium Market Outlook

Gold

Resources and Energy Quarterly December 2018

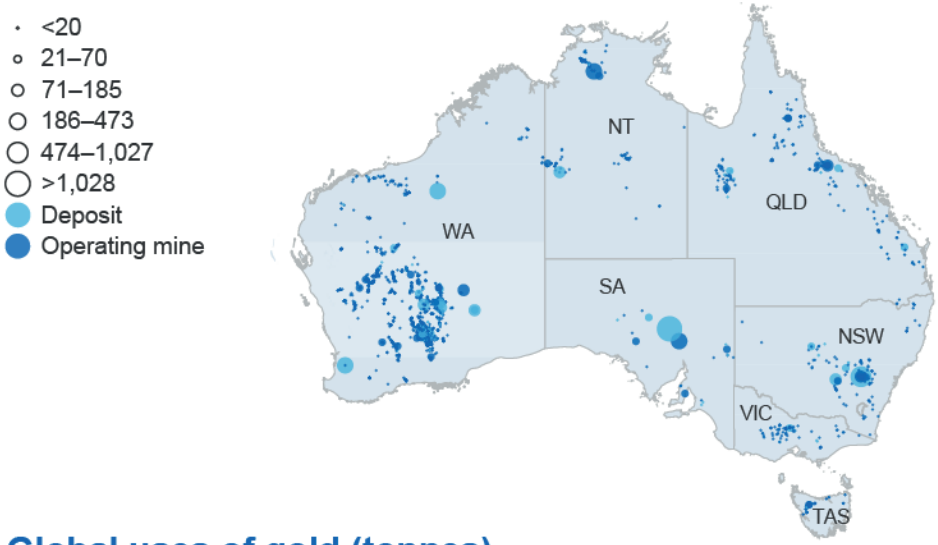
Australia is the **2nd largest** producer of gold in the world

303 tonnes
of gold produced by Australia in 2017–18

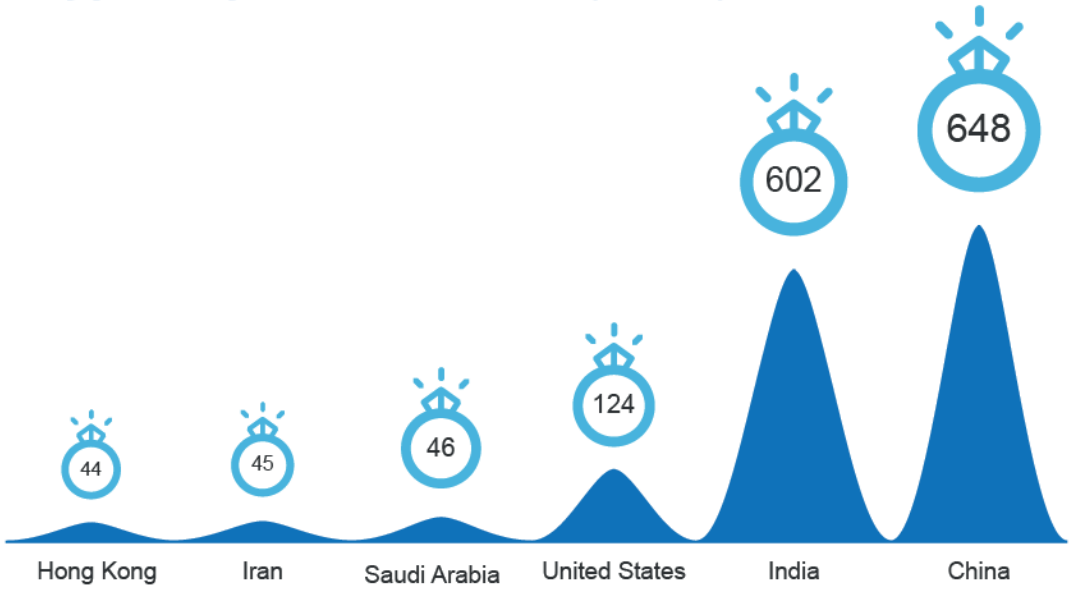
9%
of world mine gold supplied by Australia in 2017–18

world record find
Australia holds the record for the world's largest gold nugget weighing 72 kg, found in Victoria in 1869

Major Australian gold deposits (tonnes)



Key jewellery consumer markets (tonnes)



Global uses of gold (tonnes)

53%
Jewellery

25%
Gold coins and bars

9%
Central Bank Reserves

7%
Electronics and Industrial

5%
Global Backed Exchange Traded Funds

1%
Dental and medical

10.1 Market summary

- Gold prices have rebounded despite a further rise in the US dollar.
- The US and China trade tensions, and a softer US dollar are likely to support gold prices in 2019 and 2020.
- Australia's export earnings for gold are forecast to increase by 0.4 and 3.9 per cent in 2018–19 and 2019–20, to $19 billion and $20 billion, respectively. This is expected to be driven by higher gold prices and a lift in export volumes from 348 to 359 tonnes over the outlook period.

10.2 Prices

Gold prices recovered in October 2018

The gold price increased by 1.4 per cent month-on-month in October 2018, to average US$1,215 an ounce, on the back of equity market volatility and the US mid-term elections. In addition, the escalation of trade tensions between the US and China, and geopolitical factors in the Middle East — renewed US sanctions on Iran and the killing of Saudi journalist, Jamal Khashoggi — boosted demand for gold as a safe-haven asset (Figure 10.1).

The gold price is expected to remain stable for the remainder of 2018, averaging US$1,232 an ounce in the December quarter, supported by global economic slowdown, and weakness in world equity markets.

Gold prices to increase in 2019 and 2020

Gold is likely to benefit from a levelling out in the US dollar in 2019 and 2020, as US economic growth peaks, and the US interest rate cycle tops out. The US economy has been stoked by tax cuts and a flood of repatriated capital in 2018. With US monetary conditions tightening modestly over the next fifteen months, a correction in US equity markets remains a significant risk over the forecast period. Such a correction would likely result in fund flows into gold.

The political environment in the United States has become more uncertain following the mid-term elections in November 2018, with the Democratic

Figure 10.1: Gold price and US dollar

Source: LBMA (2018) Gold price PM; Thomson Reuters (2018) USD Trade Weighted Index

Party taking control of the House of Representatives, but Republicans retaining the Senate.

Gold prices are forecast to increase by 0.4 and 2.7 per cent in 2019 and 2020, to average US$1,275 and US$1,310 an ounce, respectively.

10.3 Consumption

World gold consumption increased slightly in the September quarter 2018

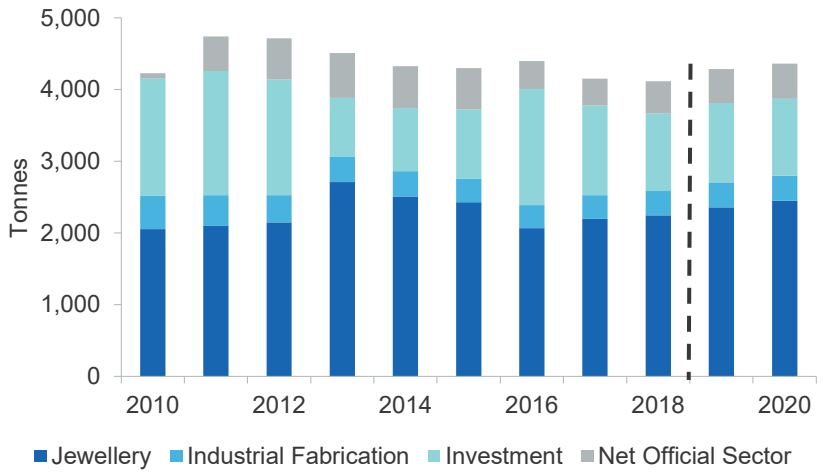
World gold demand rose by a modest 0.6 per cent year-on-year in the September quarter 2018, reaching 964 tonnes. Rising bar and coin investment (up 28 per cent year-on-year), central banks' purchase (up 22 per cent year-on-year), and increased jewellery consumption (up 6 per cent year-on-year) offset exchange traded fund (ETF) outflows. Indian jewellery demand grew by 10 per cent year-on-year, as lower gold prices attracted bargain hunters. Gold consumption in China also grew by 10 per cent year-on-year, driven by the Qixi Festival.

Despite these rises, world gold demand was largely reduced by a massive outflow from gold-backed ETFs, particularly in North America. A total of 116 tonnes of gold flowed out of the ETFs, as higher US interest rates and a stronger US dollar led global investors to seek higher returns elsewhere. The demand for gold is estimated to decrease by just 0.8 per cent in 2018, to 4,117 tonnes, as rising central banks' buying is likely to offset further ETF outflows, and an expected fall in demand from India during the 2018 wedding season (Figure 10.2).

World gold consumption forecast to increase in 2019 and 2020

World gold demand is forecast to increase by 4.0 per cent (to 4,284 tonnes) in 2019, and by a further 1.8 per cent (to 4,360 tonnes) in 2020. Demand is expected to be boosted by escalating trade tensions, rising inflation rates in some advanced economies (particularly the US), equity market volatility, and geopolitical tensions in the Middle East and east Asia. A heavy sell-off in stock and bond markets could trigger a jump in gold demand by both institutional and retail investors.

Figure 10.2: World gold consumption



Source: World Gold Council (2018) Demand Trends; Department of Industry, Innovation and Science (2018)

Lower economic growth in China is expected to have a negative impact on demand for gold, however, fears of further Chinese currency weakness are expected to be a strong catalyst for increased gold consumption in China. Economic growth in India is forecast to remain strong (with an annual GDP growth rate of close to 8 per cent), leading to higher income and wages, which should also support gold demand.

Jewellery demand for 2019 and 2020 is forecast to remain robust, supported by an expected increase in demand for premium 999, K-gold and 9999 purity gold from India and China. In India, jewellery consumption in rural areas is forecast to grow strongly, reflecting ongoing urbanisation, rising farm incomes, and a general strengthening of rural economies. At present, rural jewellery consumption accounts for 60 per cent of India's gold demand, and this share is expected to be higher in the coming years.

Central banks across the world are expected to increase their purchases of gold as some countries seek to diversify away from the US dollar. Russia has already sold the majority of its US Treasuries and added more gold to its reserves, with the Bank of Russia (the central bank of the Russian Federation) having purchased around 20 tonnes of gold on average every month since the start of 2018. Poland, Hungary, Kazakhstan, Mongolia, and a number of other emerging market countries are all expected to increase gold purchases and reserves over the next few years.

10.4 Production

World gold supply decreased in the September quarter 2018

Lower recycled output led to world gold supply decreasing by 2.0 per cent to 1,162 tonnes, year-on-year, in the September quarter 2018. Over this period, mine supply grew by 1.9 per cent year-on-year to 875 tonnes, as increased output at several mines pushed gold mine production to a new quarterly high. Output increased from the Brucejack, Rainy River and Moose River mines in Canada, and the Carlin, Fort Knox and Cripple Creek in the United States.

However, production in the September quarter 2018 in China — the world's largest gold producer — continued to decline, falling 6.0 per cent year-on-year. Environmental reforms introduced in 2017 have impacted the country's gold production. Newcrest's Lihir gold mine in Papua New Guinea decreased output by 40 per cent, to 182,068 ounces of gold, impacted by lower mill throughput due to a series of planned maintenance shutdowns. Its Gosowong gold mine in Indonesia also recorded a fall in production, down by 9.3 per cent to 47,270 ounces, due to reduced mill availability following an unplanned power outage. Gold mine production in South Africa fell by 10 per cent year-on-year in the September quarter, as the closure of the Evander, Tau Tona and Cooke gold mines, and a reduction in the South Deep gold mine output occurred.

Gold recycling decreased by 3.8 per cent year-on-year in the September quarter 2018, reaching 306 tonnes. Weaker gold prices during the quarter (down 5.1 per cent year-on-year) discouraged consumers (particularly Indian consumers) from selling back their jewellery to the markets.

World gold supply is estimated to increase by 1.4 per cent in 2018, to 4,517 tonnes, as rising mine production in the United States and Canada more than offsets declines from China and South Africa.

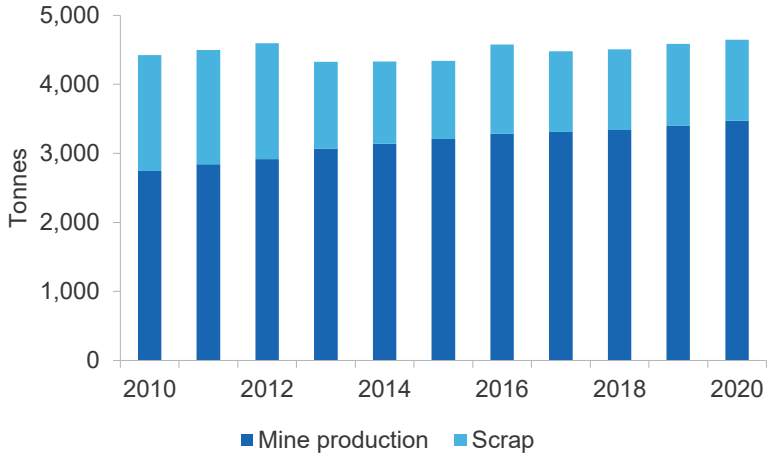
World gold supply forecast to grow between 2018 and 2020

World gold supply is forecast to increase at an average annual growth rate of 1.8 per cent in 2019 and 2020, reaching 4,680 tonnes in 2020. Supply growth in 2019 and 2020 is expected to be mainly driven by stronger mine production (Figure 10.3).

Global mine production is forecast to increase at an average annual rate of 2.0 per cent in 2019 and 2020, reaching 3,473 tonnes by 2020. High local currency gold prices and solid project pipelines in Australia, Canada, Ghana and Ecuador are expected to drive higher global gold output. In Canada, the 9.7 tonnes per year Meliadine gold mine project, the 6.2 tonnes per annum Back River gold project, and the 5.9 tonnes per year Eagle gold project are expected to commence production in 2019.

In Ecuador, the 11 tonnes per annum Fruta del Norte gold project is expected to be commissioned in 2019.

Figure 10.3: World primary and secondary gold production



Source: World Gold Council (2018) Supply Trends; Department of Industry, Innovation and Science (2018)

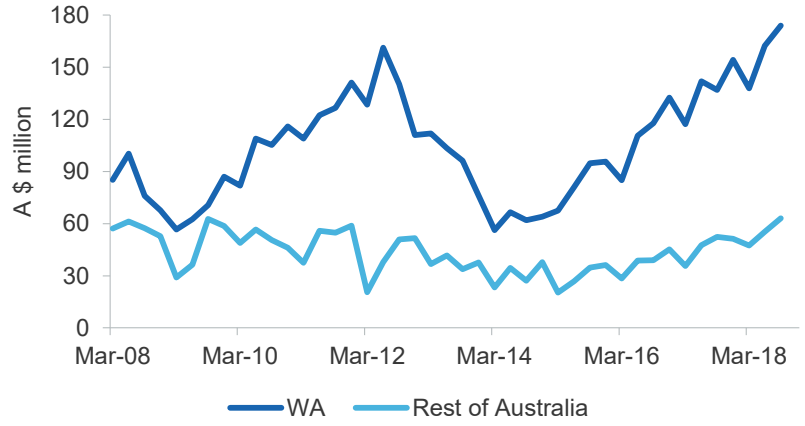
However, lower output is expected from South Africa, Tanzania, China and Indonesia. The shift of Indonesia's Grasberg gold mine's operations from open mine to underground is likely to reduce its annual output by 58 tonnes in 2019 and onwards. China's gold output is forecast to fall until stabilising in 2020, as the country's gold miners continue to adapt to new environmental legislation.

10.5 Australia

Exploration expenditure continues to increase in trend terms

Australia's gold exploration expenditure rose by 24 per cent year-on-year in the September quarter 2018, to $240 million, likely driven by an expected rise in gold prices in 2019 and beyond. Western Australia remained the centre of gold exploration activity in Australia, accounting for 73 per cent (or $174 million) of total gold exploration expenditure (Figure 10.4).

Figure 10.4: Australia's gold exploration



Source: ABS (2018) Mineral and Petroleum Exploration (cat. no. 8412.0)

Australian gold mine production increased in the September quarter 2018

Australia's gold mine production increased by 9.8 per cent year-on-year in the September quarter 2018, to nearly 80 tonnes, driven by increased production in existing gold mines, and the commissioning of new mines.

Newmont's Tanami gold mine production over the quarter rose by 8.0 per cent to 3.8 tonnes of gold, driven by higher ore grades. Newcrest's Cadia gold mine production increased by 37 per cent in the September quarter, to 6.6 tonnes of gold, after seismic activity had forced slower production in the June quarter. Kirkland Lake Gold's Fosterville mine in Victoria recorded a 17 per cent rise in gold mine production to 2.8 tonnes of gold in the September quarter, propelled by improved gold grades. Mincor Resources' Widgiemooltha gold project in Western Australia poured its first gold in July 2018, and produced 0.2 tonnes of gold in the September quarter.

A few large gold mines encountered operational problems over the September quarter. Newmont's Boddington gold mine production decreased by 5 per cent year-on-year, to 5.8 tonnes of gold, due to lower ore grades and a lower draw down of in-circuit inventory. Newmont and Barrick's Super Pit joint-venture gold mine production fell by 21 per cent year-on-year to 4.7 tonnes of gold, due to a failure in the east wall of the pit, leading to the processing of lower grade stockpiles. Newcrest's Telfer gold production fell by 12 per cent to 3.3 tonnes of gold, due to an unplanned outage at the operation's process water system and a rake failure in the tailings thickener.

Australian gold mine output forecast to grow moderately in the short term

Australia's gold mine production is forecast to grow by 3.6 per cent in 2018–19 and 1.9 per cent in 2019–20, reaching 320 tonnes. Growth is expected to be driven by mine expansions and new mines. Gold Roads' Gruyere gold mine (annual production of 8.4 tonnes) is expected to come online in the first half of 2019. Capricorn Metals' Karlawinda gold mine project (annual production of 4.0 tonnes) is expected to be commissioned in 2020. Newcrest's Cadia Valley expansion project, due to be completed in 2019, is expected to add 3.3 tonnes of gold a year. Northern Star's Jundee expansion project — adding around 1.1 tonnes of gold per annum — is expected to be completed by 2020.

In October 2018, Evolution Mining received approval from the New South Wales Government to increase its Cowal gold mine's processing rate by 31 per cent, from 7.5 to 9.8 million tonnes per year (increasing Cowal's annual gold production to over 9.3 tonnes per annum).

Evolution Mining is expected to commence its Cowal gold mine expansion in March 2019. The expansion project is due to be completed in March 2020, adding about 0.3 tonne of gold to the company's annual production.

In November 2018, the UK's Greatland Gold discovered a combined 275 metres of high grade gold mineralisation deep beneath the Paterson Range in Western Australia — east of Newcrest's Telfer gold mine.

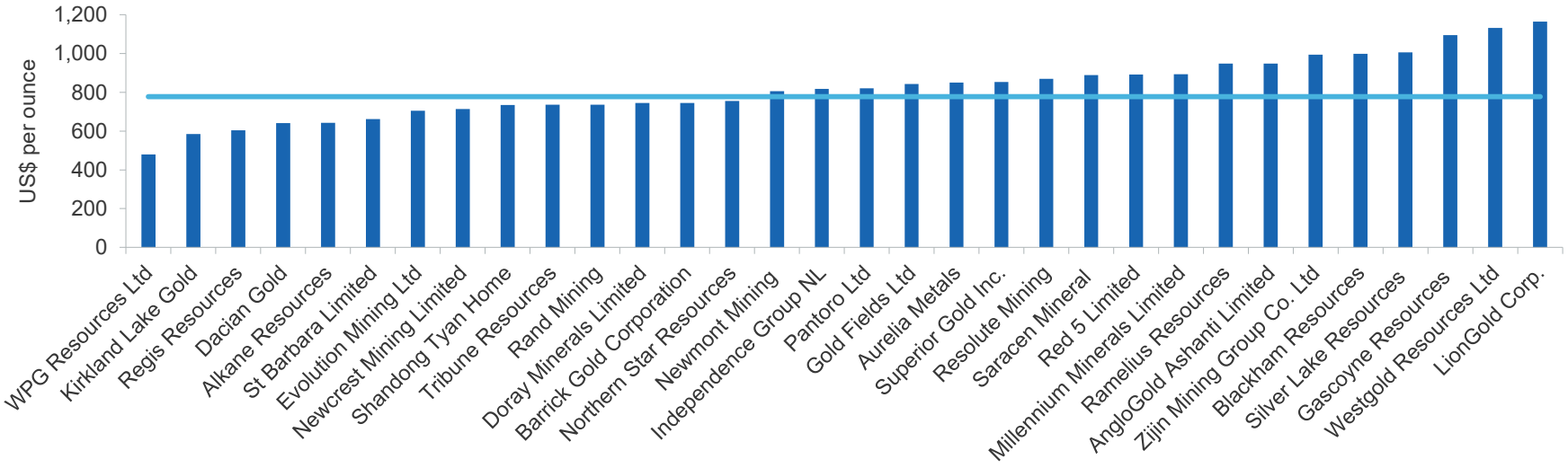
A substantial new ore body was discovered in the second half of 2018, with Havilah Resources announcing that its reserves at Kalkaroo are expected to exceed 450,000 tonnes of copper. The site is also estimated to hold more than 1.4 million ounces of co-located gold. This would make the company's Kalkaroo project the largest undeveloped copper-gold deposit currently known in Australia, and the second largest in the world after the Productora deposit in Chile.

Figure 10.5 shows gold production all-in sustaining costs (AISC) by company for Australia in 2018. About half of Australia's gold producers have an AISC below the world average of US$777 an ounce of gold.

Australian gold exports increased in the September quarter 2018

Australia's gold exports increased by 22 per cent year-on-year in the September quarter 2018, to over $4.9 billion, propelled by higher mine production (up 7.0 per cent year-on-year) and export volumes (up 16 per cent year-on-year). Perth Mint's refinery production rose by 7.0 per cent year-on-year nearly 86 tonnes. Hong Kong remained the largest export market for Australian gold, accounting for 37 per cent of Australia's total gold exports.

Figure 10.5: 2018 Gold mine AISC costs by company for Australia



Note: Blue horizontal line indicates world average all-in sustaining costs (AISC) by company.
Source: AME (2018)

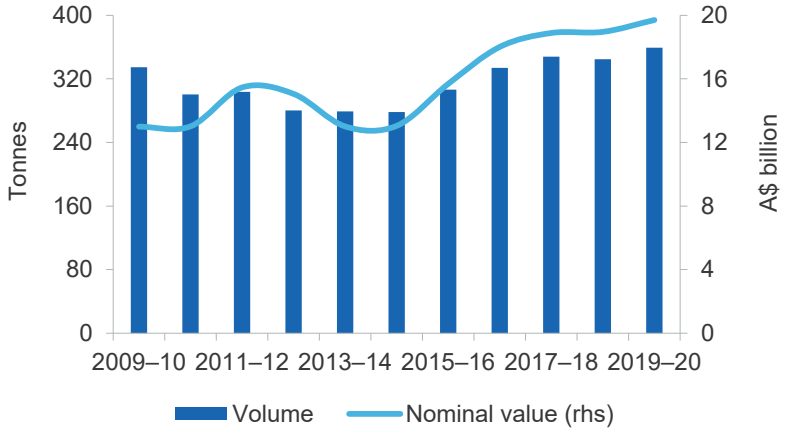
Exports forecast to increase in 2018–19 and 2019–20

Australia's gold export earnings are forecast to increase by 0.4 and 3.9 per cent in 2018–19 and 2019–20, to $19 billion and $20 billion, respectively. The growth is driven by increased export volumes and prices. Australia's gold producers are expected to experience good margins over the outlook period in an environment of high local-currency returns (Figure 10.6).

The outlook for Australia's gold export earnings in 2018–19 has been revised up by $526 million (2.9 per cent) from the September 2018 *Resources and Energy Quarterly*. The upward revision reflects a weaker outlook for the AUD-USD exchange rate and higher export volumes.

The forecast for Australia's gold export earnings in 2019–20 has been broadly unchanged from the September 2018 *Resources and Energy Quarterly*.

Figure 10.6: Australia's gold exports



Source: ABS (2018) International Trade, 5464.0; Department of Industry, Innovation and Science (2018)

Table 10.1: Gold outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018[s]**	**2019[f]**	**2020[f]**	**2018[s]**	**2019[f]**	**2020[f]**
Total demand	tonnes	4,152	4,117	4,284	4,360	–0.8	4.0	1.8
Fabrication consumption[b]	tonnes	2,527	2,585	2,703	2,801	2.3	4.5	3.6
Mine production	tonnes	3,312	3,339	3,405	3,473	0.8	2.0	2.0
Price[c]								
Nominal	US$/oz	1,257	1,270	1,275	1,310	1.0	0.4	2.7
Real[d]	US$/oz	1,288	1,270	1,247	1,267	–1.4	–1.8	1.6
Australia	**Unit**	**2016–17**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**
Mine production	tonnes	292	303	314	320	3.8	3.6	1.9
Export volume	tonnes	334	348	345	359	4.3	–1.0	4.3
Nominal value	A$m	18,013	18,888	18,959	19,704	4.9	0.4	3.9
Real value[e]	A$m	18,783	19,323	18,959	19,238	2.9	–1.9	1.5
Price								
Nominal	A$/oz	1,720	1,665	1,709	1,705	–3.2	2.6	–0.2
Real[e]	A$/oz	1,793	1,703	1,709	1,664	–5.0	0.3	–2.6

Notes: **b** includes jewellery consumption and industrial applications; **c** London Bullion Market Association PM price; **d** In 2018 calendar year US dollars; **e** In 2017–18 financial year Australian dollars; **f** Forecast; **s** Estimate.

Source: ABS (2018) International Trade, 5465.0; London Bullion Market Association (2018) gold price PM; World Gold Council (2018); Department of Industry, Innovation and Science (2018)

Aluminium

Resources and Energy Quarterly December 2018

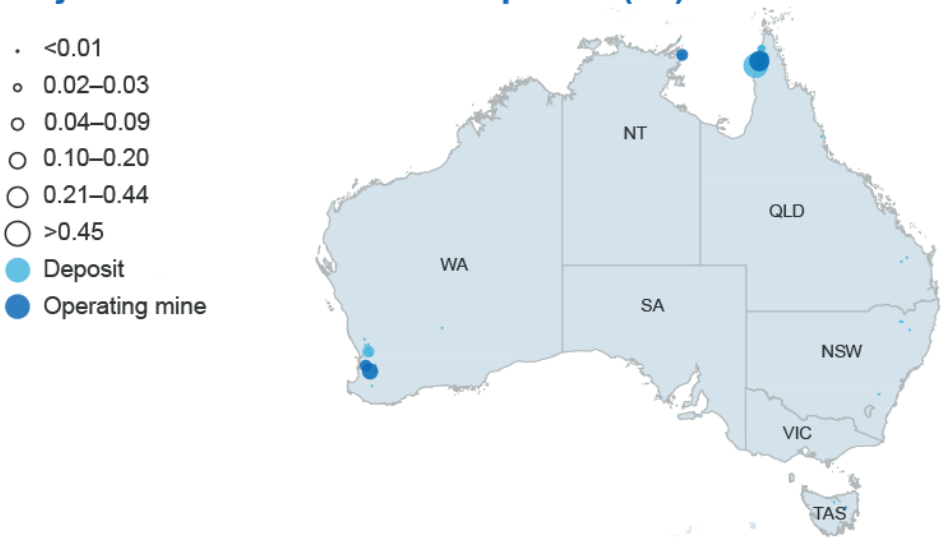
Australia's global ranking

- **1st** — Alumina exporter
- **1st** — Bauxite producer
- **2nd** — Alumina producer

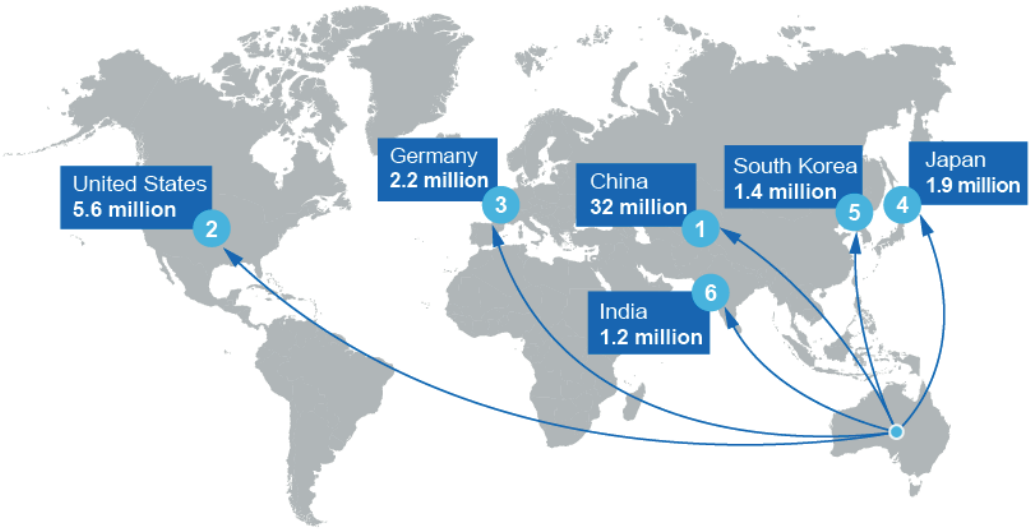
3 stages of producing aluminium

1. **Mining** bauxite ore
2. **Refining** to recover alumina
3. **Smelting** to make aluminium

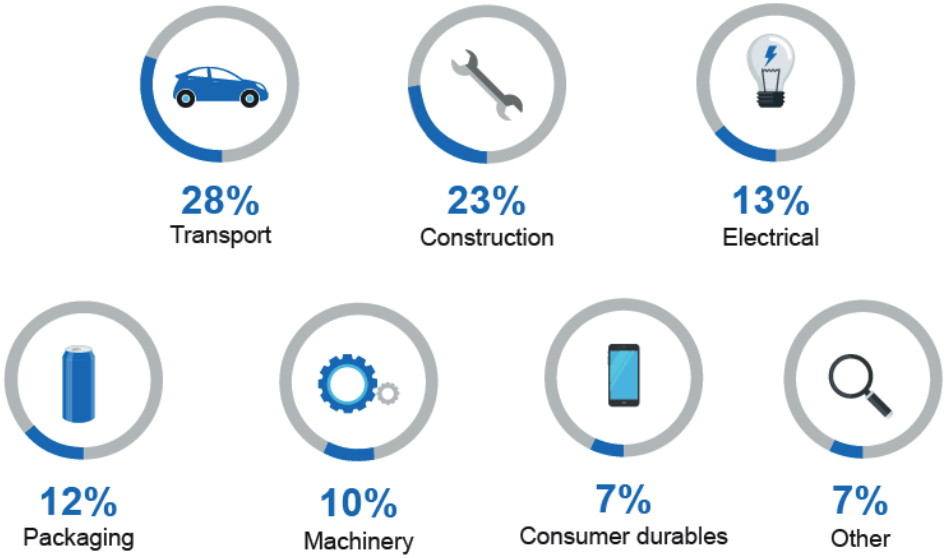
Major Australian alumina deposits (Gt)



Key consumer markets for aluminium (tonnes)



Global uses of aluminium



11.1 Summary

- Prices are forecast to ease from elevated levels in 2018 which arose from supply concerns. Prices are forecast to decline to US$2,098 a tonne for aluminium and US$354 a tonne for alumina by 2020.
- Australia's aluminium and alumina exports are expected to be steady through to 2019–20, at 1.4 million tonnes and over 17 million tonnes per annum, respectively. Bauxite exports are forecast to increase from 32 million tonnes in 2018–19 to 36 million tonnes in 2019–20.
- Total Australian export earnings for aluminium, alumina and bauxite are forecast to decline from $15 billion in 2018–19 to $14 billion in 2019–20, reflecting a decline in aluminium and alumina prices.

11.2 Prices

Easing prices after volatility in 2018

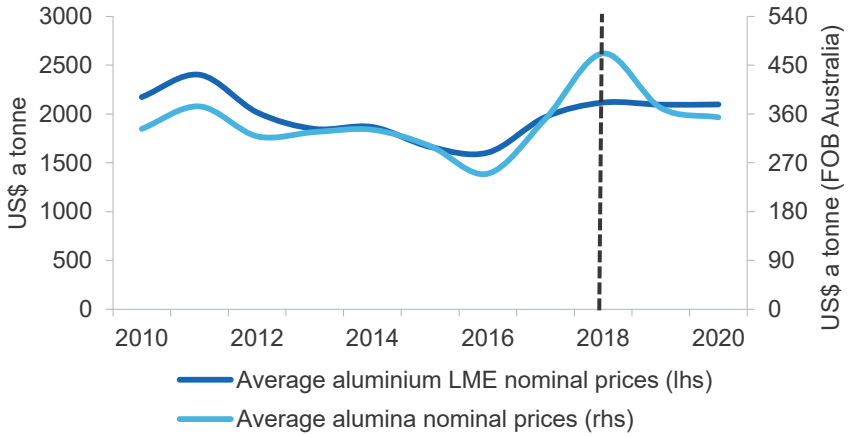
Aluminium spot prices on the London Metal Exchange (LME) eased at the end of 2018, after reaching a seven-year high during the June quarter. Uncertainty in the market early in the year was caused by the US Administration's sanctions on major aluminium and alumina supplier, United Company Rusal. The sanctions have not been lifted, however, the period for resolution has been extended to January 2019, alleviating some supply concerns and causing prices to ease.

The alumina price fell further in the December 2018 quarter after reaching a historical high in May, although ongoing supply issues have kept it relatively elevated. While a workers' strike at Australia's Alcoa operations during the September quarter was resolved, the situation at the Alunorte refinery in Brazil — where production has been curtailed by 50 per cent since February 2018 — remains unresolved.

The LME aluminium spot price and the FOB Australian alumina price are both forecast to fall from 2018 levels over the forecast period as supply concerns ease. The aluminium price is forecast to average US$2,095 a tonne in 2019 and US$2,098 a tonne in 2020. The alumina price is forecast to fall from elevated levels averaged in 2018 to US$371 a tonne in 2019 and $US354 a tonne in 2020 (Figure 11.1).

Over 2019 and 2020, capacity controls and restrictions on Chinese production (due to air pollution concerns) are expected to keep the market tight. A risk to the price forecast is the potential slow-down in Chinese consumption as US tariffs on Chinese goods take effect.

Figure 11.1: World aluminium and alumina prices



Source: LME (2018) spot prices; Metals Bulletin (2018) Alumina monthly price; Department of Industry, Innovation and Science (2018).

11.3 Consumption

China driving global consumption

Global aluminium consumption slowed during the first eight months of 2018, declining 0.4 per cent year-on-year. Chinese consumption rose by 0.6 per cent year-on-year, which offset a decline in US consumption of 17 per cent year-on-year. The decline in US consumption potentially reflects higher prices caused by the import tariffs implemented in early 2018. Global aluminium consumption for 2018 is expected to finish at 60 million tonnes, up 0.6 per cent. Consumption is expected to grow at an annual average rate of 2.4 per cent over the forecast period to reach 61 million tonnes in 2019 and 62 million tonnes in 2020 (Figure 11.2).

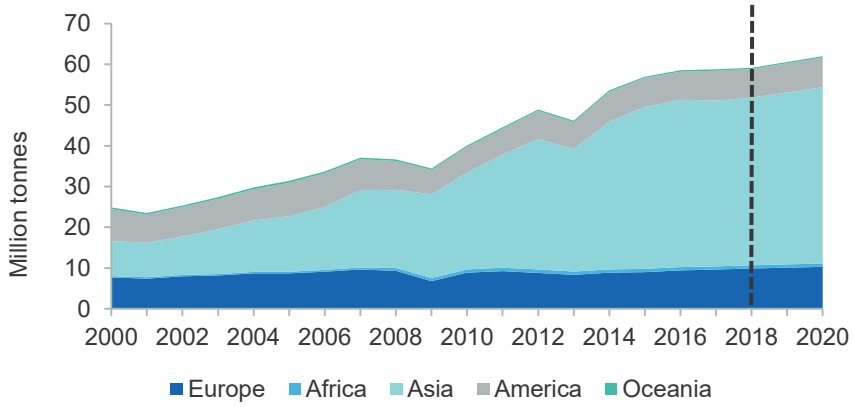
Alumina consumption is estimated to have increased by 5.2 per cent to 118 million tonnes in 2018, staying closely in line with aluminium

production. Alumina consumption is forecast to increase at an annual rate of 2.1 per cent over the forecast period, reaching 118 million tonnes in 2019 and 120 million tonnes in 2020.

Global industrial production, an indicator for aluminium demand, is forecast to increase by 3.0 per cent per annum (Figure 11.3) over the outlook period. The production of automobiles is expected to be a significant driver of aluminium demand, particularly energy-efficient vehicles with an increasing portion of aluminium components. China is expected to be a major driver of increasing energy-efficient vehicle production, with a new energy vehicle (NEV) credit mandate taking effect in 2018. The mandate has a NEV target of 10 per cent of the passenger car market in 2019 and 12 per cent in 2020. This is an increase from an estimated 2 per cent of China's NEV share of new passenger vehicle sales during 2017.

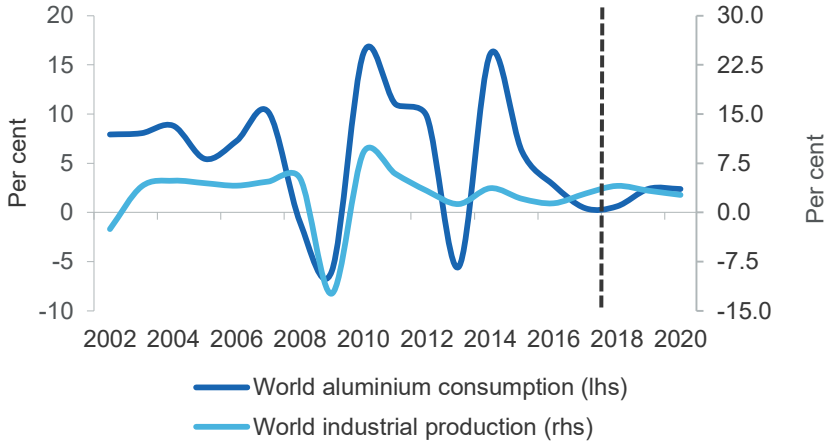
The key uncertainty to the outlook is demand from China, which historically has consumed around half of all aluminium. The imposition of US tariffs on a number of Chinese goods could decrease consumption, as goods with aluminium content become more expensive for US consumers.

Figure 11.2: World aluminium consumption



Source: World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)

Figure 11.3: Growth in world aluminium usage and industrial production



Source: World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)

11.4 Production

Slower production growth for aluminium and alumina

World aluminium is forecast to reach 63 million tonnes in 2018. Year-on-year through to October 2018, production increased by 0.7 per cent. Year-on-year declines in North America (down 5.0 per cent) and South America (down 15 per cent), have been more than offset by production ramping up in Asia (excluding China) (an increase of 13 per cent), primarily driven by higher Indian production.

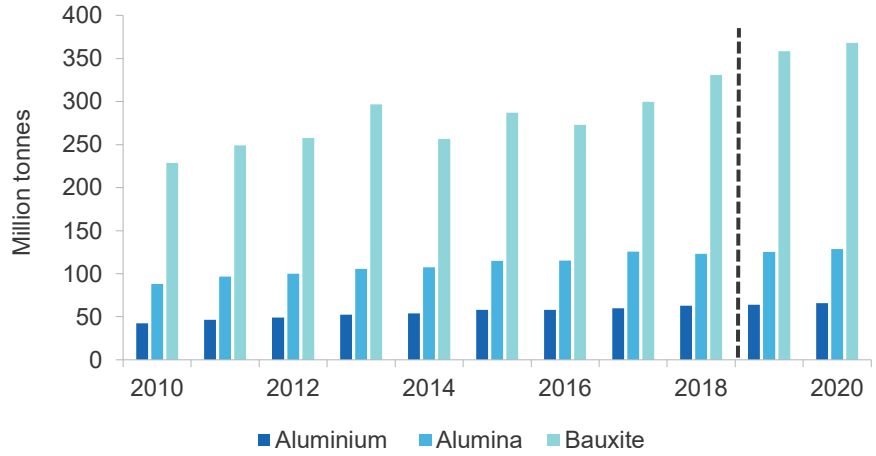
World alumina production declined by 2.5 per cent year-on-year over the first nine months of 2018. Disruptions to alumina supply and high alumina prices appear to have weighed down aluminium production during 2018. Significant decreases in alumina production came from China (down 2.3 per cent) and South America (down 21 per cent) due to the curtailment of production at the Alunorte refinery in Brazil. Global alumina production is expected decline by 2.1 per cent to 123 million tonnes in 2018.

Over 2019 and 2020, the majority of new and expanded aluminium capacity is to come from China, although growth in supply is expected to

be slowed by the country's environmental policies. Outside of China, new aluminium capacity is due to come online in India, the United Arab Emirates, Russia and Bahrain. In the US, previously idled smelter capacity has been restarted, as aluminium import tariffs take effect at the Hawesville, Warrick and New Madrid smelters. World aluminium production is forecast to reach 64 million tonnes in 2019 and 66 million tonnes in 2020 (Figure 11.4).

Like aluminium, growth in world alumina production is expected to slow, due to China's environmental reforms. World alumina production is forecast to increase to 125 million tonnes in 2019 and 128 million tonnes in 2020. A key uncertainty is the forthcoming winter production cuts in China for the 2018–19 season, and subsequent cuts under China's environmental policies. The 2018–19 production cuts were modified, so that local authorities can carry out production cuts based on individual situations, instead of adopting blanket cuts.

Figure 11.4: World aluminium, alumina and bauxite production



Source: International Aluminium Institute (2018); World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)

Australia and Guinea driving growth in bauxite production

Global bauxite production increased by 11 per cent year-on-year in the first 8 months of 2018. The increase in production was driven by developments in Guinea, where production increased by 13 million tonnes, or 46 per cent year-on-year. Global bauxite production is forecast to reach 331 million tonnes in 2018, a 10 per cent increase from 2017.

World bauxite production is expected to grow at an average annual rate of 7.1 per cent in the forecast period, to reach 359 million tonnes in 2019 and 368 million tonnes by 2020. The gains will be driven by new capacity coming online in Australia and Guinea.

11.5 Australia's exports and production

Export earnings to reach 12 year highs in 2018–19 before declining

Aluminium, alumina and bauxite export earnings are forecast to increase to $15 billion during 2018–19 — their highest point in 12 years. The increase is expected to be driven by high alumina prices over the first half of 2018–19. Export values are expected to decline to $14 billion in 2019–20. This decline is due to an expected softening of prices for alumina over the outlook period, which will be partially offset by increased export volumes of bauxite.

Environmental priorities are likely to remain an important influence on the Chinese aluminium, alumina and bauxite industries, with flow-on effects for Australian alumina and bauxite exporters. The Chinese government is committed to curbing air pollution in major Chinese cities, and is expected to close smelters and refineries that fail to meet new regulations. While this is expected to tighten global aluminium and alumina supply, it could also reduce demand for Australian alumina and bauxite in the short term.

Trade tensions between the US and China are another key uncertainty over the outlook period. As a versatile material, aluminium is used in numerous goods to which new US tariffs now apply. While the full effect is not yet apparent, there is potential for global demand to slow and prices to fall in the short-term, affecting Australian export earnings. Trade flows can be expected to re-arrange in the long-term.

Export earnings revised upwards

Total forecast earnings for aluminium, alumina and bauxite in 2018–19 have been revised up by $1.2 billion from the September 2018 *Resources*

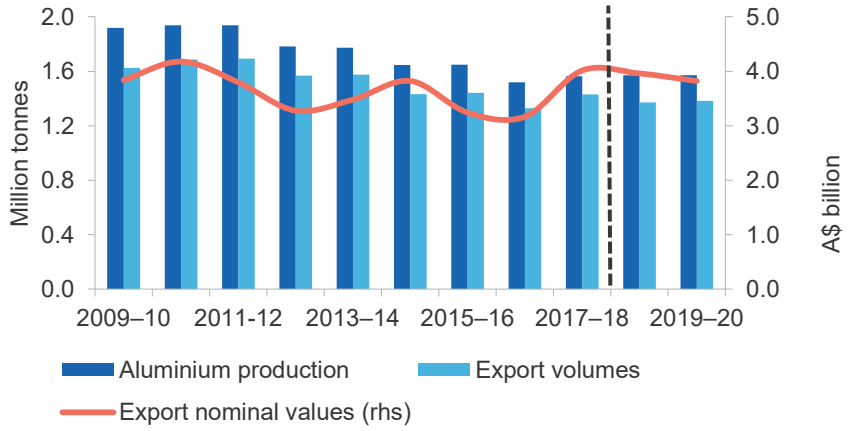
and Energy Quarterly. The upward revision largely reflects higher than expected alumina prices over the first half of the financial year.

Steady aluminium/alumina production, but moderate growth in bauxite

In 2018–19 and 2019–20 Australian output is forecast to remain at 1.6 million tonnes per annum for aluminium and 20 million tonnes for alumina (Figure 11.5 and Figure 11.6). The workers' strike at Alcoa Australia of early August 2018 was resolved in late September. The strike had a relatively minor impact on production, reducing output by 15,000 tonnes.

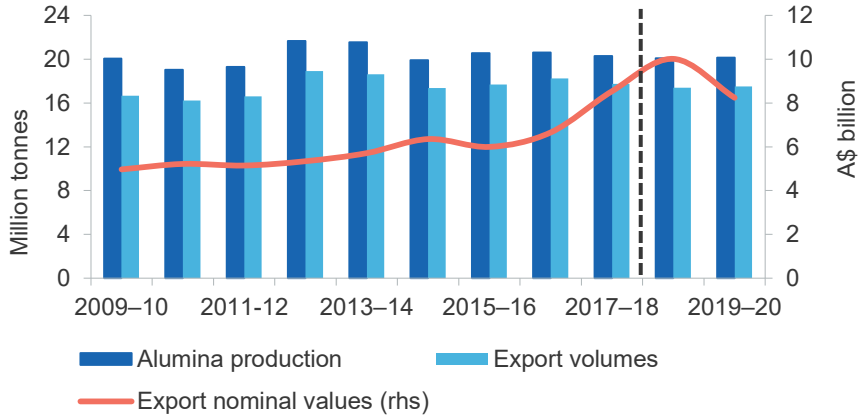
In 2019–20 Australia's bauxite production is projected to grow at an annual average rate of 12 per cent, to 119 million tonnes (Figure 11.7). Metro Mining's Bauxite Hills Mine announced intentions to increase planned bauxite production over 2019 by 500 thousand tonnes. Rio Tinto's Amrun project ran ahead of schedule, with first shipment occurring in the fourth quarter of 2018, rather than early 2019. A full production rate for Amrun is expected to be achieved during 2019.

Figure 11.5: Australia's aluminium exports and production



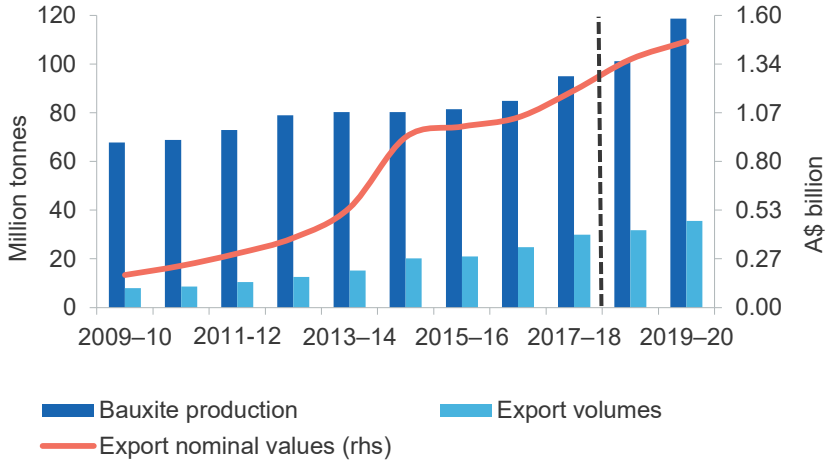
Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Figure 11.6: Australia's alumina exports and production



Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Figure 11.7: Australia's bauxite exports and production



Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Table 11.1: Aluminium, alumina and bauxite outlook

Annual percentage change

World	Unit	2017	2018[f]	2019[f]	2020[f]	2018[f]	2019[f]	2020[f]
Primary aluminium								
Production	kt	59,755	62,659	64,113	65,798	4.9	2.3	2.6
Consumption	kt	59,235	59,603	61,037	62,489	0.6	2.4	2.4
Closing stocks[b]	kt	2,282	2,284	2,115	1,962	0.1	–7.4	–7.2
– weeks of consumption		2.0	2.0	1.8	1.6	–0.5	–9.6	–9.4
Prices aluminium[c]								
– nominal	US$/t	1,969	2,117	2,095	2,098	7.5	–1.0	0.1
– real[d]	US$/t	2,018	2,117	2,049	2,028	4.9	–3.2	–1.0
Prices alumina spot								
– nominal	US$/t	351	472	371	354	34.3	–21.3	–4.7
– real[d]	US$/t	360	472	363	342	31.1	–23.0	–5.8
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Production								
Primary aluminium	kt	1,519	1,564	1,572	1,572	3.0	0.5	0.0
Alumina	kt	20,599	20,280	20,089	20,142	–1.6	–0.9	0.3
Bauxite	Mt	85	95	101	119	11.9	6.5	17.3
Consumption								
Primary aluminium	kt	189	172	189	189	–9.0	9.6	0.0
Exports								
Primary aluminium	kt	1,329	1,431	1,372	1,383	7.6	–4.1	0.8
– nominal value	A$m	3,167	4,014	3,960	3,821	26.8	–1.3	–3.5
– real value[e]	A$m	3,302	4,107	3,960	3,730	24.4	–3.6	–5.8
Alumina	kt	18,230	17,746	17,400	17,511	–2.7	–2.0	0.6
– nominal value	A$m	6,655	8,537	10,012	8,237	28.3	17.3	–17.7
– real value[e]	A$m	6,940	8,733	10,012	8,042	25.8	14.6	–19.7
Bauxite	kt	24,851	29,880	31,709	35,585	20.2	6.1	12.2
– nominal value	A$m	1,042	1,190	1,360	1,459	14.2	14.3	7.3
– real value[e]	A$m	1,087	1,217	1,360	1,424	12.0	11.7	4.7
Total value								
– nominal value	A$m	10,864	13,741	15,333	13,517	26.5	11.6	–11.8
– real value[e]	A$m	11,329	14,057	15,333	13,196	24.1	9.1	–13.9

Notes: **b** Producer and LME stocks; **c** LME cash prices for primary aluminium; **d** In 2018 calendar year US dollars; **e** In 2018–19 financial year Australian dollars; **f** Forecast.
Source: ABS (2018) International Trade in Goods and Services, 5368.0; AME Group (2018); LME (2018); Department of Industry, Innovation and Science (2018); International Aluminium Institute (2018); World Bureau of Metal Statistics (2018)

Copper

Resources and Energy Quarterly December 2018

Australia is the world's **3rd largest exporter** of copper ores and concentrates

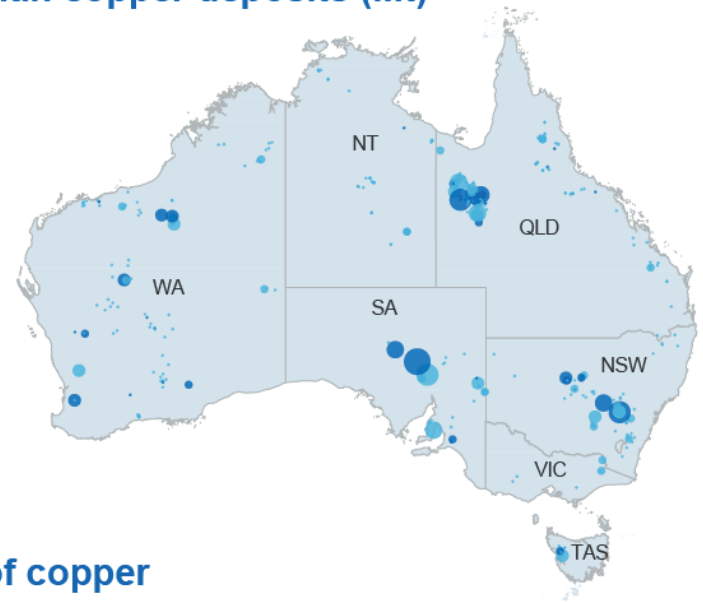
Australia is the **7th largest** producer of copper in the world

Copper is **100% recyclable** and nearly **80%** of the copper that has ever been produced is still in use today

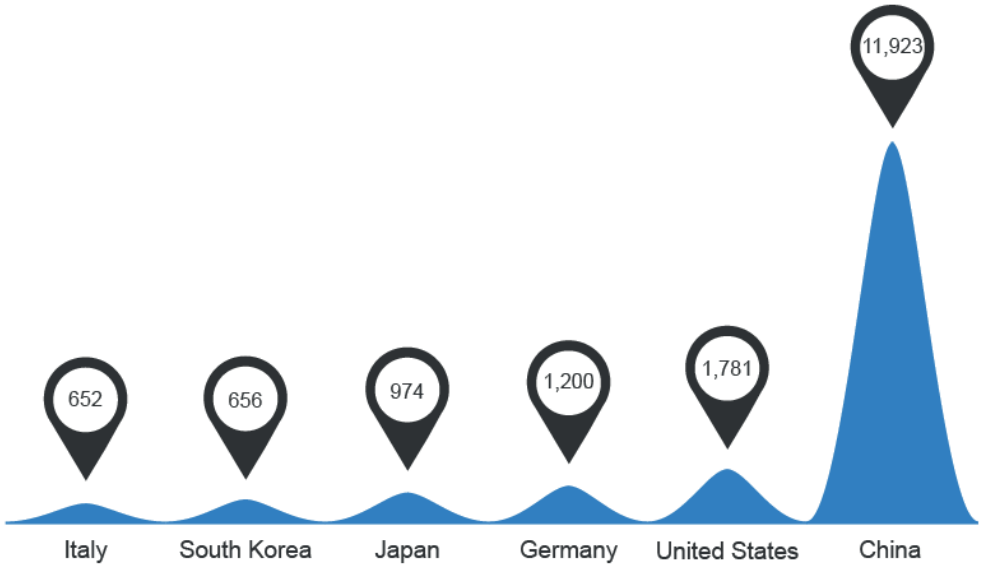
The average home contains **180 kg** of copper

Major Australian copper deposits (Mt)

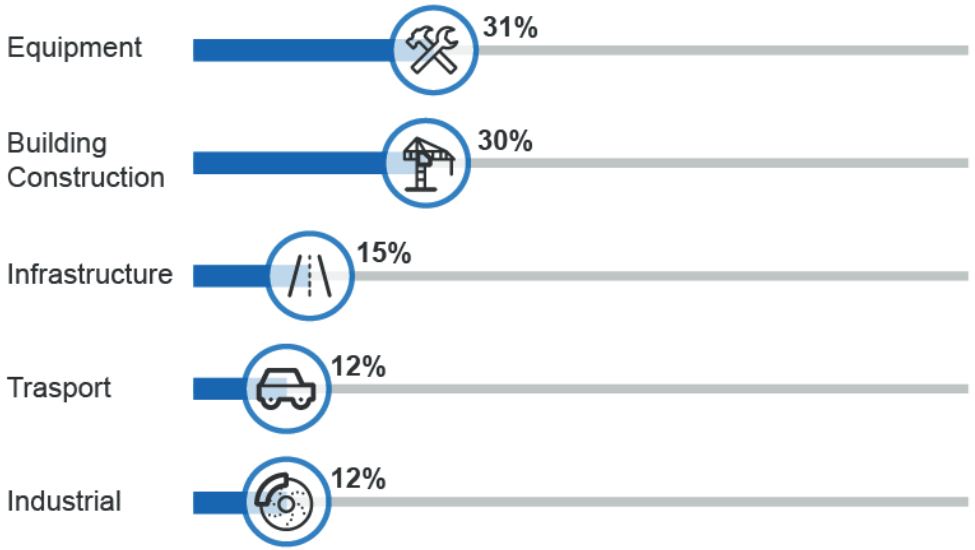
- <0.01
- 0.02
- 0.03–0.8
- 0.9–2.1
- 2.2–6.8
- >6.9
- Deposit
- Operating mine



Key copper consumer markets (thousand tonnes)



Global uses of copper



12.1 Summary

- Recent trade tensions have left copper prices well below levels seen during early 2018, but signs of recovery have become evident as market fundamentals re-assert themselves. Supply shortfalls are expected over the outlook period, with prices forecast to rise from US$6,430 a tonne in 2018 to US$8,013 by 2020.
- Australia's copper exports are forecast to rise from 892,000 tonnes in 2017–18 to over 1 million tonnes (in metal content terms) by 2019–20.
- Australia's copper export earnings are forecast to lift from $8.4 billion in 2017–18 to $10.9 billion by 2019–20. Export earnings should benefit from price growth as well as rising production at several mines.

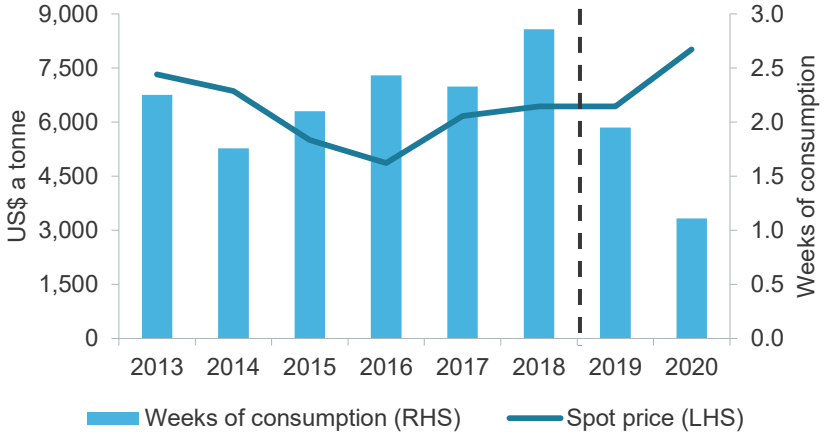
12.2 Prices

Copper prices are starting to recover

The monthly average copper price rose to over US$7,000 at the start of 2018, but has subsequently fallen significantly. Prices dropped particularly sharply in July and August, reaching around US$6,000. Some recovery has been evident in the December quarter, with prices lifting to US$6,300 in November. Much of the fall in prices reflects ongoing trade tensions between the US and China, which represent a significant risk for the global economic outlook (see chapter two on trade tensions). However, there are signs that copper markets may be shifting to a more long-term view in light of emerging issues with supply, which is expected to be in deficit in 2019 and 2020. Copper supply is expected to remain relatively flat over the outlook period, while demand rises (Figure 12.2), supported by resilient Chinese imports and increases in electric vehicle sales.

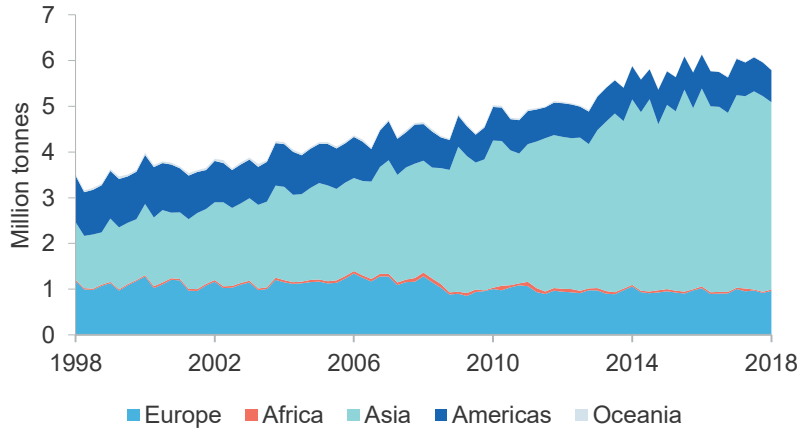
As market fundamentals re-assert, copper prices are expected to rise to US$6,434 a tonne in 2019 and US$8,013 in 2020 (Figure 12.1). This would effectively bring prices back above the recent peak (at just over US$7,000 a tonne) of early 2018. Should market deficits persist, copper prices could approach the historical highs of 2011.

Figure 12.1: Outlook for copper stocks and prices



Source: LME (2018) official cash price; Department of Industry, Innovation and Science (2018)

Figure 12.2: Long-term change in quarterly copper consumption



Source: World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)

12.3 World consumption

Copper consumption is set for solid growth over the next two years

Global copper consumption is projected to rise from 23.8 million tonnes in 2018 to 25.6 million tonnes by 2020. Solid growth in industrial production is ongoing (Figure 12.3), and copper consumption is rising as the development of new consumer wireless technology and battery systems accelerate. Recent solid growth in global GDP may also have encouraged global manufacturers to recommit to purchases previously placed on hiatus.

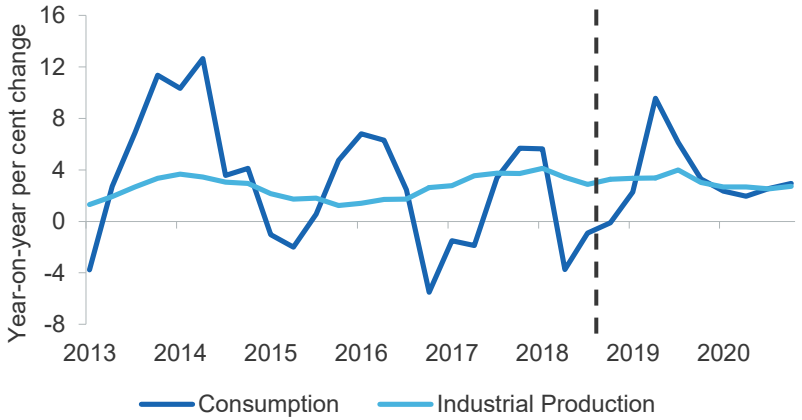
Thus far, Chinese copper demand has largely withstood the threat of trade tensions, remaining solid despite two rounds of sanctions. China uses around half of all copper produced globally, and a solid pace of residential construction continues to underpin solid rises in Chinese copper use. Chinese fixed asset investment is also starting to show tentative signs of turning, after some sharp declines (Figure 12.4).

Chinese manufacturers have stepped up output over the last few months, attempting to maximise export revenues ahead of the third round of US tariffs, whose ultimate impact remains unclear for the time being. Chinese copper imports are expected to remain steady over the final quarter of 2018, but there is potential for declines in 2019 should US tariffs remain in place (see chapter two on trade tensions).

Copper markets are likely to evolve over time, with rising electric vehicle production leading to surging copper demand across a number of facilities and countries. This should help to broaden the base for copper consumption, reducing the current heavy dependency on China and adding some resilience to global copper markets.

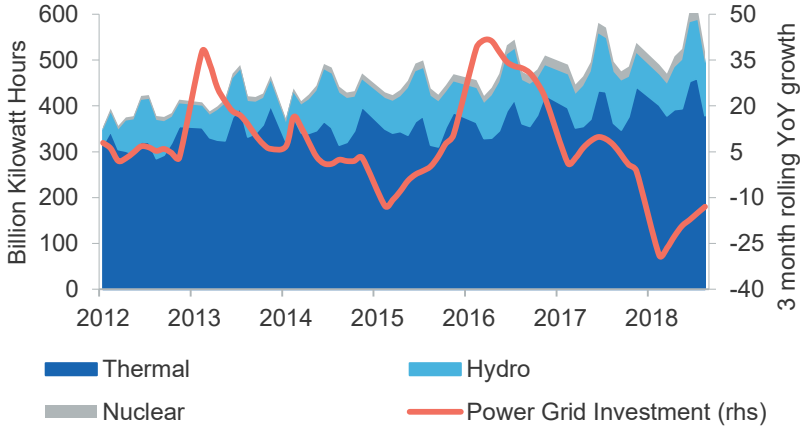
A broader market with less vulnerability to bilateral tensions could improve the investment climate, supporting long-term planning and helping to keep demand and supply more closely matched over the longer term.

Figure 12.3: World copper consumption and industrial production



Source: World Bureau of Metal Statistics (2018); Bloomberg (2018) Netherland CPB; Department of Industry, Innovation and Science (2018)

Figure 12.4: Growth in China's energy sector



Source: Bloomberg (2018) National Bureau of Statistics China; Department of Industry, Innovation and Science (2018)

12.4 World production

World copper mine production has been constrained by supply disruptions

Copper production continues to face disruptions: industrial action in Chile, export curbs in Indonesia and cuts in recycled supply from China all affected production in the first half of 2018. More recent disruptions include a dispute over export duties between Katanga mining and the government of the Democratic Republic of Congo, which halted a large flow of copper exports from the country.

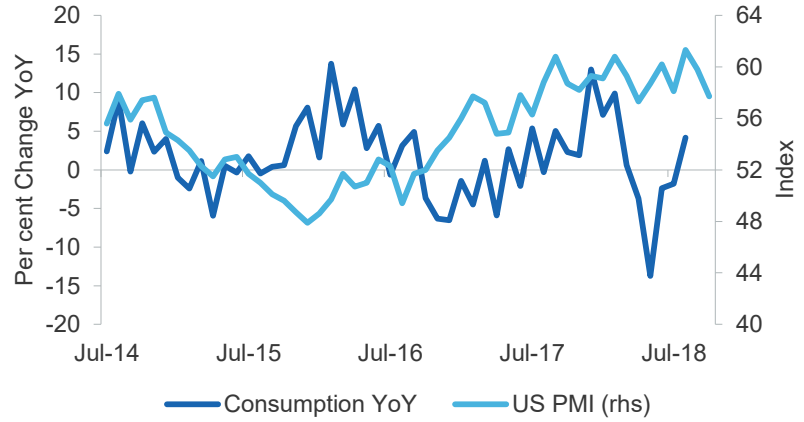
Chile — the world's largest copper supplier — faces mixed supply conditions and a recent trend of disruption. Output from Chile appears to be increasing, with supply over the nine months to September up by more than 7 per cent from the corresponding period a year ago. However, several potential constraints on production in Chile are emerging. Among these, Codelco has reported a significant decline in ore quality at most of its Chilean mines over the September quarter, with quarterly metal output falling significantly as a result. Several potential upgrades to mining facilities in Chile have also been postponed — as a result of volatile prices and trade tensions — which have clouded supply forecasts.

On the upside, the threat of industrial action at Escondida — the world's largest copper mine — appears to have virtually vanished, after a deal was reached in August. This should help to improve stability of supply over the outlook period. Trade tensions are persistent, however, and remain the most significant risk factor in the short term.

Mine production growth is not expected to match demand

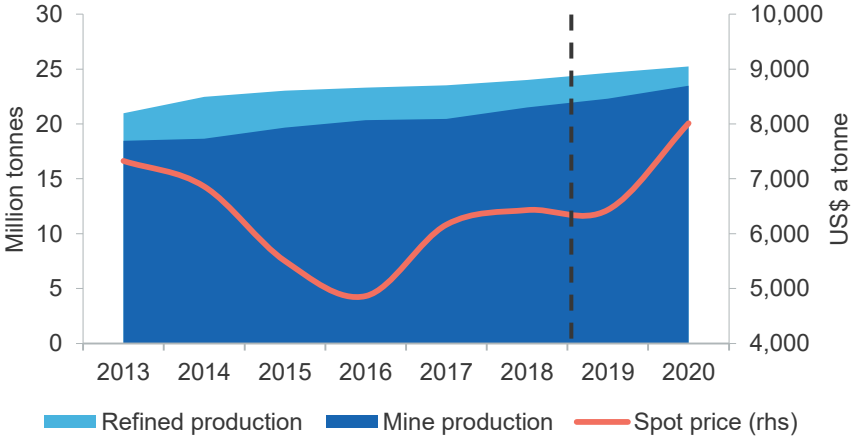
Rising output from South Asia and South America should support a lift in global copper mine production, which is forecast to rise from 21.5 million tonnes in 2018 to 23.5 million tonnes in 2020 (Figure 12.6). The largest drivers of growth are expected to be First Quantum Minerals' new Cobre Panama mine (expected to produce 330,000 tonnes annually from 2019) and Qulong's new copper mine in Tibet (supplying 120,000 tonnes).

Figure 12.5: World copper demand growth vs. US PMI



Source: Bloomberg (2018); Department of Industry, Innovation and Science (2018)

Figure 12.6: World copper production and prices



Source: World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)

Outside of this, the pipeline of new copper mines remains relatively constrained, and dominated by Chinese participation. Rising Chinese investment in Estonia and central Africa reflects recent stagnant growth in its domestic copper output, where efforts have been made to curb production at the most environmentally-damaging facilities.

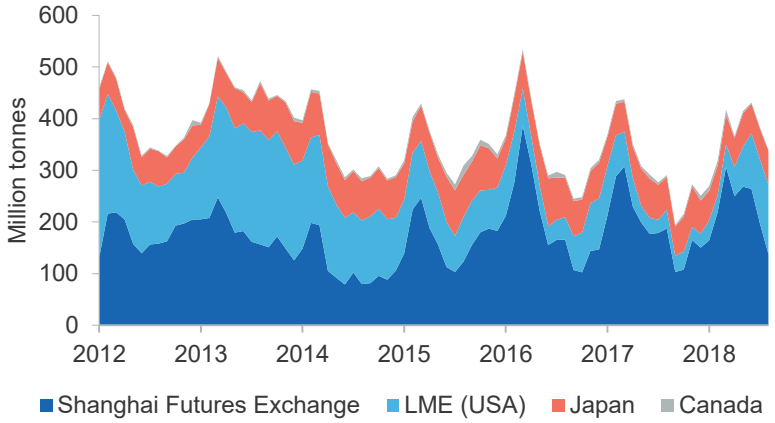
Ramp-ups at other marginal facilities around the world may potentially be postponed or paused, in light of rising trade tensions between the US and its trading partners. Volatile prices and broader trade uncertainties have deprived potential mines of capital and forced a shift towards alternative sources such as private equity. A supply shortfall of about 300,000 tonnes is expected in 2019, with stocks already declining (Figure 12.7). This shortfall may rise after 2020 as demand grows for electric vehicles.

However, this looming shortfall is now starting to drive significant new interest in copper exploration, with around US$10 billion expected to be invested in 2018. This is around 20 per cent higher than the total for 2017. Recent research by S&P Global Market Intelligence suggests that the cost of buying existing mines has, on balance, started to exceed the cost of developing new ones. The cost to purchase acquired reserves rose by almost $750 a tonne between 2007 and 2016, compared to the previous ten years. The average unit cost of exploration-derived reserves rose by only a little over US$50 per metric tonne over the same period. This shift may help to switch the investment incentive more towards discovery of new deposits in the years to come.

World refined copper output is expected to rise over the outlook period

World refined copper output is forecast to grow from 24.0 million tonnes in 2018 to 25.2 million tonnes in 2020. Output is rising most rapidly in Africa and South America, with some growth also evident in Indonesia. Secondary production is falling in China, following a reduction in Chinese imports of low grade scrap (Figure 12.8). This has created opportunities for Thailand and the Philippines to move into this market, and could reduce the impact of US-China trade tensions in the long term.

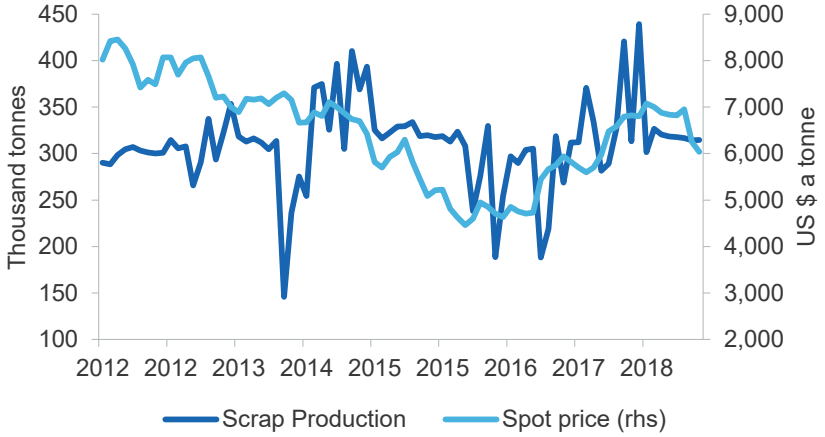
Figure 12.7: Copper stocks by location



Note: Selected key producers are forecast to increase production over the outlook

Source: AME (2018) Strategic Study 4Q 2017; Department of Industry, Innovation and Science (2018)

Figure 12.8: Secondary copper production and price



Source: Bloomberg Statistics (2018); Department of Industry, Innovation and Science (2018)

12.5 Australia

Mine production will be supported by rising output from existing mines

Australian production is projected to rise from 885,000 tonnes in 2017–18 to just over 1 million tonnes in 2019 and 2020. Higher output is expected from Newcrest's Cadia Valley mine and CoDeco's Rocklands project in Queensland. Sterlite Industries' Mount Lytell mine, which is emerging from care and maintenance, is also expected to return to full operation in 2019.

A substantial new ore body was discovered in the second half of 2018, with Havilah Resources announcing that its reserves at Kalkaroo are expected to exceed 450,000 tonnes. The site is also estimated to hold more than 1.4 million ounces of co-located gold. This would make the company's Kalkaroo project the largest undeveloped copper-gold deposit currently known in Australia, and the second largest in the world after the Productora deposit in Chile. The site is expected to yield a higher copper-equivalent grade of 0.74 per cent, above that of most Australian sites, with prospects further enhanced by the availability of gold at the same site.

BHP is also assessing the options for a potential $2.1 billion expansion of its Olympic Dam mine. This expansion would lift copper output from the facility by around 50 per cent to over 300,000 tonnes per year.

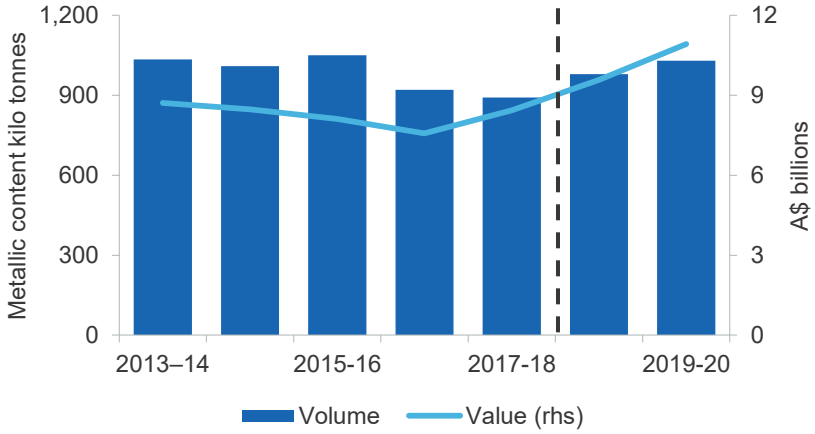
Although the long-term prospects for Olympic Dam remain strong, the mine has had some mixed results this year, with copper production disrupted in August by the failure of boiler tubes at its acid plant. This led to some further technical difficulties, which are expected to hinder production for around two months. BHP has reduced its production target for 2019 by 18 per cent, leaving the mine once again short of the 200,000 tonnes of copper that has long been viewed as its potential output.

Copper exports are expected to keep rising over the outlook period

Australia's copper export earnings are expected to increase from $8.4 billion in 2017–18 to $10.9 billion in 2019–20 (Figure 12.9). Most of this is likely to be a volume effect reflecting the ramp-up at the Cadia Valley in NSW and Rocklands in Queensland.

Some price growth is also likely to boost exports values in 2019–20 and after, with earnings forecast to continue growing even after mine and export production level out.

Figure 12.9: Australia's copper exports



Source: Department of Industry, Innovation and Science (2018)

Exploration expenditure is picking up, with broad growth across states

Exploration spending lifted from $59.8 million in the June quarter to $74.1 million in the September quarter 2018. This is the third successive quarter of rising expenditure, and comes amidst a period of increasingly tight global copper supply and rising demand.

Finance for copper exploration remains tight in Australia, however, with a lot of investment still directed to recycling existing deposits. Greenfields exploration has been impacted adversely in recent years by price volatility and poor sentiment among potential investors. This may change should prices lift further in the coming years.

Revisions to the outlook

Australia's forecast copper export earnings for 2018–19 have been revised down by around $300 million as a result of falling prices.

Table 12.1: Copper outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018[s]**	**2019[f]**	**2020[f]**	2018[s]	**2019[f]**	**2020[f]**
Production								
–mine	kt	20,193	21,080	22,303	23,482	4.4	5.8	5.3
–refined	kt	23,522	24,008	24,651	25,240	2.1	2.7	2.4
Consumption	kt	23,733	23,764	25,018	25,631	0.1	5.3	2.5
Closing stocks	kt	1 063	878	608	447	–17.4	–30.8	–26.4
–weeks of consumption		2.3	1.9	1.3	0.9	–17.5	–34.3	–28.1
Prices LME								
–nominal	US$/t	6,164	6,430	6,434	8,013	4.3	0.1	24.5
	USc/lb	280	292	292	363	4.3	0.1	24.5
–real [b]	US$/t	6,317	6,430	6,292	7,748	1.8	–2.1	23.1
	USc/lb	287	292	285	351	1.8	–2.1	23.1
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**
Mine output	kt	917	885	1,019	1,034	–3.5	15.1	1.5
Refined output	kt	448	367	409	397	–18.0	11.3	–3.0
Exports								
–ores and cons.[c]	kt	1,752	1,985	2,093	2,336	13.3	5.4	11.6
–refined	kt	413	317	383	364	–23.2	20.7	–5.0
–total metallic content	kt	920	892	979	1 030	–3.1	9.8	5.2
Export value								
–nominal	A$m	7,569	8,434	9,577	10,929	11.4	13.6	14.1
–real[d]	A$m	7,892	8,628	9,577	10,670	9.3	11.0	11.4

Notes: b In 2018 calendar year US dollars; c Quantities refer to gross weight of all ores and concentrates; d In 2018–19 financial year Australian dollars; **f** Forecast; **s** Estimate

Source: ABS (2018) International Trade, 5465.0; LME (2018) spot price; World Bureau of Metal Statistics (2018) World Metal Statistics; Department of Industry, Innovation and Science (2018)

Nickel

Resources and Energy Quarterly December 2018

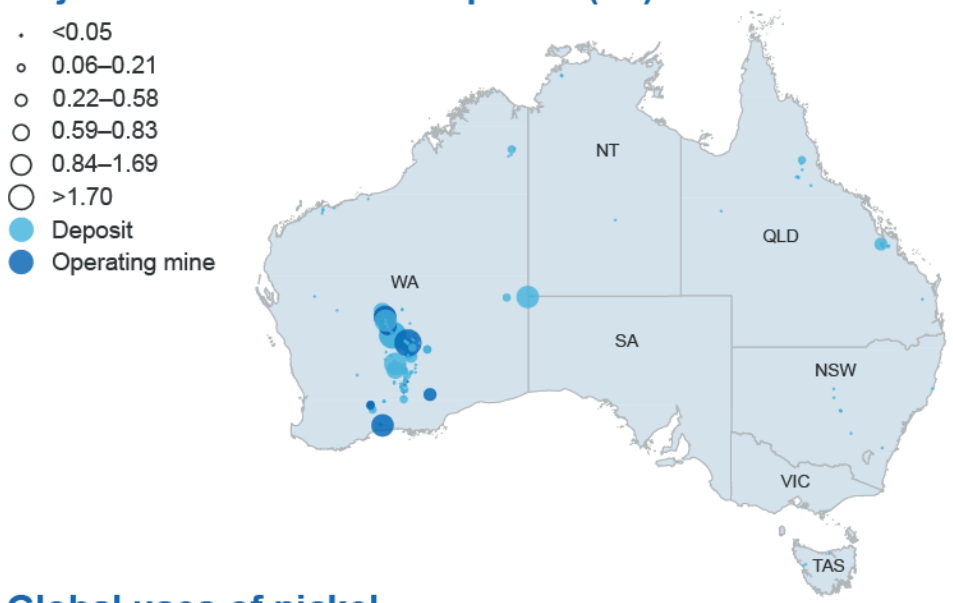
5th largest miner in the world

Australia produces **>200** thousand tonnes of nickel each year

Nickel exports contribute more than **$3b** to Australia's economy

10% of world nickel mined is in Australia

Major Australian nickel deposits (Mt)



Key nickel consumer markets (tonnes)

Global uses of nickel

68% Stainless steel

16% Alloys

9% Plating

3% Casting

3% Batteries

1% Other

13.1 Summary

- A large rise in nickel output has helped to push down nickel prices in the December quarter. Prices are expected to ease further — to US$13,950 in 2019 and US$13,750 in 2020 — but demand is expected to increase beyond the outlook period, as use of nickel in batteries picks up rapidly.
- Several new mines in Western Australia and a significant upgrade to the Kwinana nickel refinery should see Australia's primary and refined production rise — with refined output set to increase from 135,000 tonnes in 2017–18 to 157,000 tonnes by 2019–20.
- Rising mined and refined production, should boost Australia's nickel export earnings from $2.8 billion in 2017–18 to $3.8 billion in 2019–20.

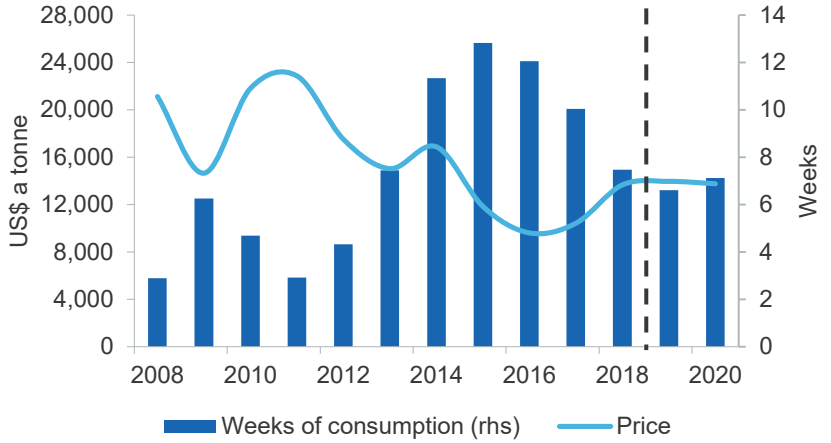
13.2 Prices

Nickel prices are still edging back from the peak in June

Nickel prices have continued to fall from the 3–year high reached in the June quarter. The recent surge in stainless steel production, which pushed prices up to $US15,600 a tonne in early June, abated somewhat in the September quarter. The price drop follows announcements of several large new nickel projects, including Tshingshan's proposed ore plant in Indonesia, which could potentially start in late 2019. Other projects may also proliferate in coming years, seeking to support the growing electric vehicle market. This extra supply should help to restrain nickel prices over the outlook period, though price pressures may emerge subsequently as demand for electric vehicle batteries rises exponentially.

Prices are expected to remain relatively stable in the short-term, easing from US$13,950 in 2019 to US$13,750 in 2020 (Figure 13.1). Prices face countervailing pressures from large short-term supply growth and high long-term growth in demand, which could lead to some volatility in the medium term.

Figure 13.1: Nickel LME spot prices and stocks



Source: Bloomberg (2018) London Metal Exchange; International Nickel Study Group (2018); Department of Industry, Innovation and Science (2018)

13.3 World consumption

Rising stainless steel output is driving nickel usage

Nickel consumption is expected to rise from 2.3 million tonnes in 2018 to 2.5 million tonnes by 2020. Over time, the driver for growth in nickel production is expected to steadily shift from stainless steel (which is moving toward oversupply despite healthy demand growth) towards batteries for electric vehicles.

Part of the recent growth in nickel demand relates to rising electric vehicle sales. However, it also reflects some significant evolutions in battery composition. Lithium nickel manganese cobalt (NMC) cathodes, which use significant proportions of nickel, are expected to double their share of batteries (from around 30 per cent to around 60 per cent) over the next 10 years. Production of car batteries is forecast to require 65,000 tonnes of nickel in 2019, up from 18,000 tonnes in 2018.

13.4 World production

New mines are driving nickel production growth

World nickel supply has responded swiftly to rising stainless steel demand and the potential for strong growth in battery use (Figure 13.2). Mined nickel output is projected to rise from 2.3 million tonnes in 2018 to 2.4 million tonnes in 2019, and then to 2.6 million tonnes in 2020.

Urbanisation in China and other parts of Asia is leading to rising demand for stainless steel, which has important functions in consumer goods, water distribution infrastructure, and transportation. To support ongoing urbanisation, Chinese companies (most notably Tsingshan) have invested significant sums in order to unlock deposits in Indonesia, with large facilities to process the ore now expected to be constructed by late 2019.

This new supply is expected to shift the market into a marginal surplus by 2020, with tightness in stocks easing slightly. However, further rapid rises in production will subsequently be needed to preserve these stocks and keep pace with expected rapid growth in electric vehicle demand.

Short-term prospects remain mixed, with supply expected to be largely stable over the remainder of 2018. Key risks include the rapidly evolving trade dispute between the United States and China, which may hurt nickel production and trade.

13.5 Australia

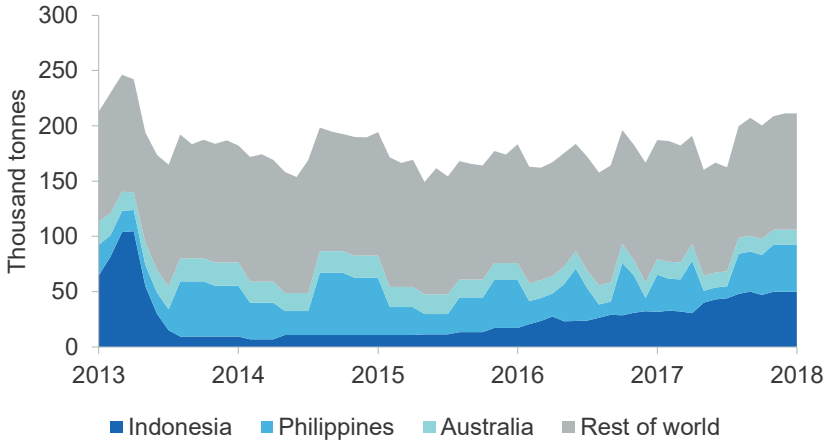
Exploration expenditure has eased back after a string of strong results

Exploration for nickel and cobalt fell back in the September quarter, dropping from $65 million to $47 million. This breaks a positive run of quarterly results, but exploration nonetheless remains well above its level of two years ago, when it was only $18 million (Figure 13.3).

Australian production continues to rebound from a low point

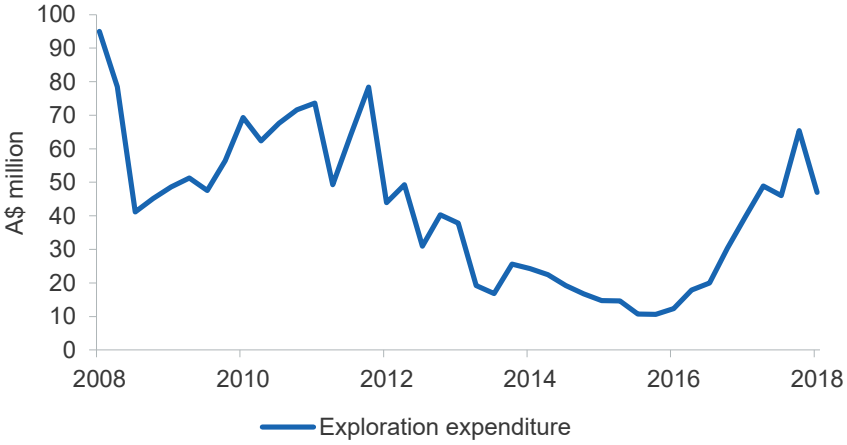
Australia's nickel production has recovered and stabilised following mine and facility closures in 2016 and 2017. However, output is now expected to plateau briefly, with mine production expected to edge up from 162,000 tonnes in 2017–18 to 166,000 tonnes in 2018–19. Flat production is due in large part to the closure of the Long Nickel mine in Western Australia, which entered care and maintenance in the December quarter.

Figure 13.2: World mined nickel production, monthly



Source: International Nickel Study Group (2018)

Figure 13.3: Australian nickel and cobalt exploration expenditure, quarterly



Source: ABS (2018) Mineral and Petroleum Exploration 8412.0

Production is subsequently expected to rise to 178,000 tonnes in 2019–20 (Figure 13.4) with Kambalda's Mincor mine expected to open in Western Australia in the second half of 2019. Poseidon Nickel's Mount Windarra mine is then expected to start producing in the first half of 2020. BHP's large mine at Yakabindie should open in the second half of 2020, driving a further rise in production, to 222,000 tonnes by 2020–21.

Australia's annual refined and intermediate nickel production is expected to rise to 137,000 tonnes in 2018–19, and to 157,000 tonnes by 2019–20. This is largely the result of a projected rise in output from BHP's Kwinana plant in Western Australia, where upgrades are expected to lift nameplate capacity to 100,000 tonnes a year from April 2019.

The December quarter saw some significant efforts to unlock additional supply. Independence, which owns the Nova mine in Western Australia, has undertaken a seismic survey to better explore its lease: this may lead to some extra ore deposits being developed after 2019. The company has also made moves towards establishing a processing plant.

Western Areas, which owns the large Forrestania mine, is also studying its relatively undeveloped Odysseus deposit in Western Australia, with plans underway to convert more waste tailings to feed the global battery market.

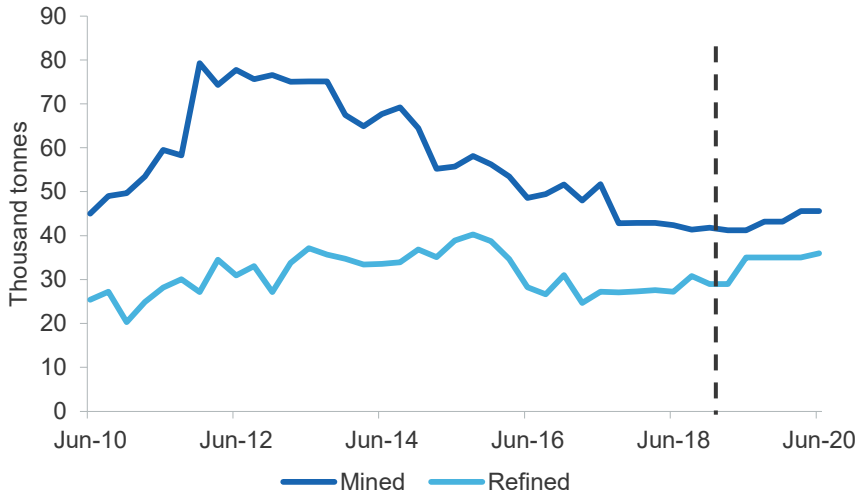
Export earnings are expected to rebound in line with production

Total nickel export earnings are forecast to rise to $3.8 billion in 2019–20 (see Figure 13.5), up from $2.8 billion in 2017–18. Higher production from new mines is expected to more than offset the impact of a temporary easing in global prices — resulting from rising Indonesian production. The expansion of the Kwinana refinery should work to ensure that refined exports keep approximate pace with growth in mined output.

Revisions to the outlook

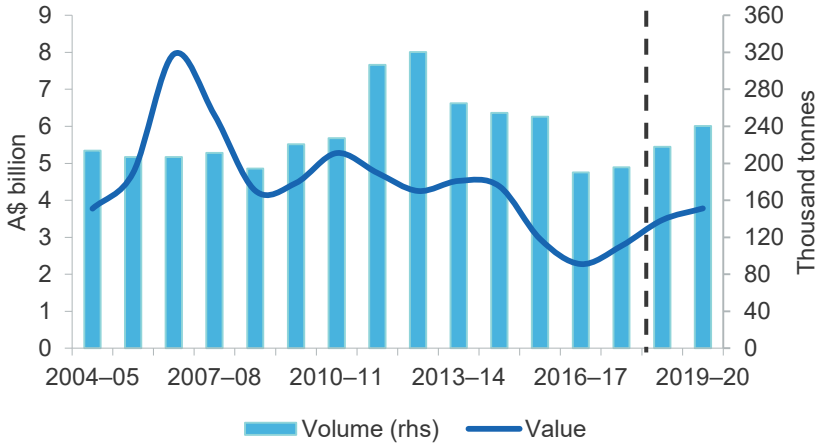
Australia's nickel export earnings for 2018–19 have been revised up by around $300 million as a result of strong production in recent months.

Figure 13.4: Australia's nickel production



Source: Department of Industry, Innovation and Science (2018)

Figure 13.5: Australia's nickel export volumes and values



Source: ABS (2018) International Trade in Goods and Services, 5368.0; Department of Industry, Innovation and Science (2018)

Table 13.1: Nickel outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018**	**2019[f]**	**2020[f]**	**2018**	**2019[f]**	**2020[f]**
Production								
– mine	kt	2,145	2,253	2,432	2,616	5.0	8.0	7.6
– refined	kt	2,079	2,183	2,357	2,519	5.0	8.0	6.9
Consumption	kt	2,162	2,274	2,381	2,482	5.2	4.7	4.2
Stocks	kt	417	326	302	339	–21.8	–7.3	12.3
– weeks of consumption		10.0	7.4	6.6	7.1	–25.7	–11.5	7.8
Price LME								
– nominal	US$/t	10,404	13,655	13,950	13,750	31.2	2.2	–1.4
	Usc/lb	472	619	633	624	31.2	2.2	–1.4
– real [b]	US$/t	10,662	13,655	13,643	13,295	28.1	–0.1	–2.5
	Usc/lb	484	619	619	603	28.1	–0.1	–2.5
Australia	**Unit**	**2016–17**	**2017–18**	**2018–19[f]**	**2019–20[f]**	**2017–18**	**2018–19[f]**	**2019–20[f]**
Production								
– mine[cs]	kt	201	162	166	178	–19.2	2.0	7.3
– refined	kt	112	109	124	141	–2.3	13.4	13.9
– intermediate		37	26	14	16	–29.9	–47.1	17.6
Export volume[ds]	kt	190	196	218	240	2.9	11.3	10.3
– nominal value[s]	kt	2,275	2,767	3,466	3,781	21.6	25.2	9.1
– real value[es]	kt	2,372	2,831	3,466	3,691	19.3	22.4	6.5

Notes: **b** In 2018 calendar year US dollars; **c** Nickel content of domestic mine production; **d** Includes metal content of ores and concentrates, intermediate products and nickel metal; **e** In 2018–19 financial year Australian dollars; **f** Forecast, **s** Estimate

Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Company reports; Department of Industry, Innovation and Science; International Nickel Study Group (2018); LME (2018); World Bureau of Metal Statistics (2018)

Zinc

Resources and Energy Quarterly December 2018

Australia produces more than
800,000 tonnes
of each year

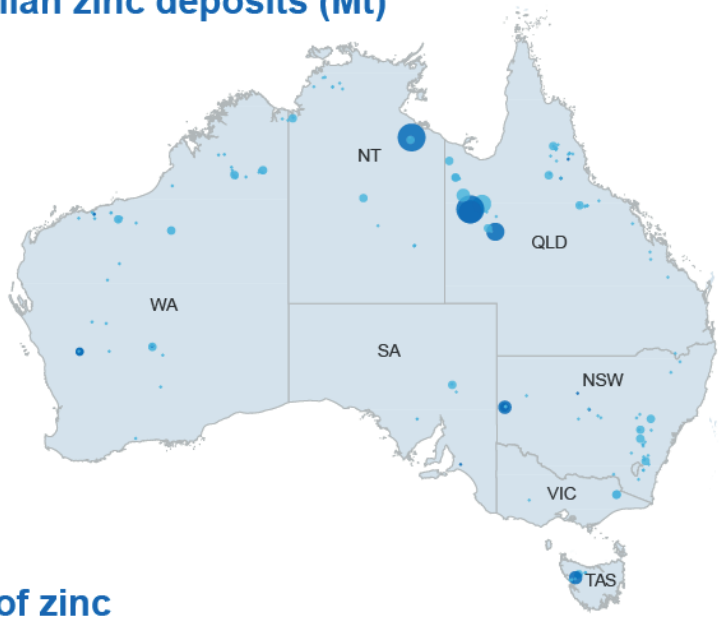
Zinc exports contribute more than
$3 billion
to the Australian economy

Australia is the
3rd highest
producer of zinc in the world

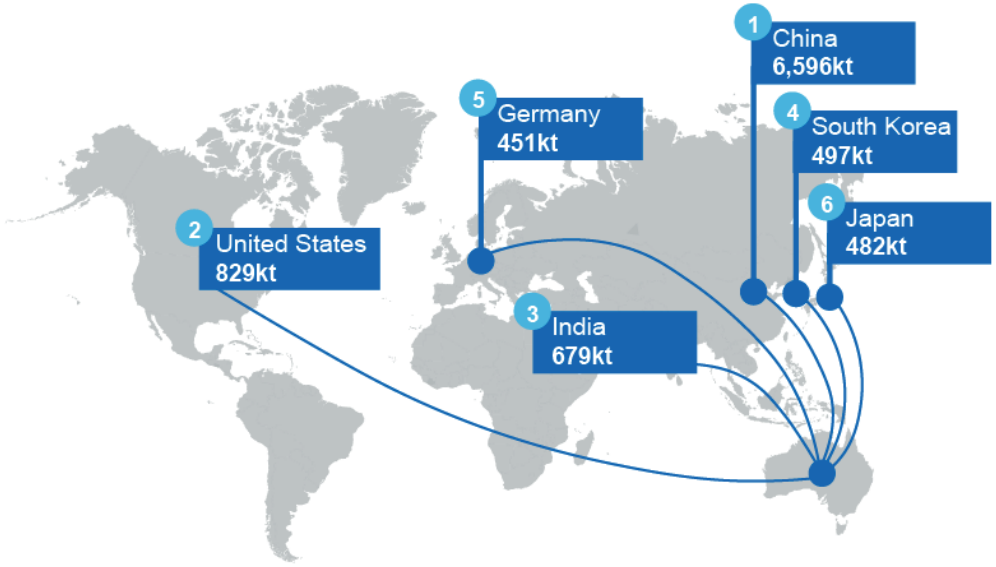
Australia holds
28%
of the worlds known zinc resources

Major Australian zinc deposits (Mt)

- <0.01
- 0.02–0.03
- 0.04–0.09
- 0.10–0.20
- 0.21–0.44
- >0.45
- Deposit
- Operating mine



Key zinc consumer markets



Global uses of zinc

50%
galvanise steel

17%
diecasting

17%
make brass and bronze alloys

6%
rolled zinc

6%
chemicals

4%
other

14.1 Summary

- After hitting an 11-year peak in early 2018, zinc prices declined in the second half of 2018. Prices are expected to rebound modestly in the near term, as fears ease over both oversupply and trade tensions. Prices are expected to slowly ease over the outlook period, to average US$2,775 a tonne in 2019 and US$2,625 a tonne in 2020.
- Australia's output is expected to lift over the next two years, as production ramps up at the re-opened Century mine in Queensland. Export volumes of ores and concentrates are forecast to rise from 1.7 million tonnes in 2017–18 to 2.8 million tonnes by 2019–20.
- Export values are expected to lock in the substantial gains recorded in 2017–18, remaining above $3.7 billion annually over the outlook period.

14.2 Prices

Zinc prices forecast to decline after a peak in 2018

After strong prices during the beginning of 2018, the London Metal Exchange (LME) zinc spot price eased over the second half of the year. Prices averaged US$2,537 a tonne over the September quarter, but rebounded towards the end of the year (Figure 14.1).

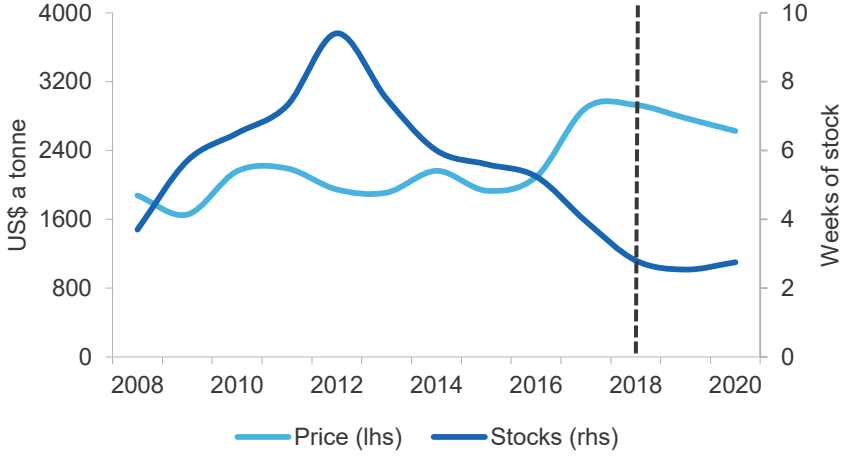
Inventories remain tight, with LME stocks reaching 10-year lows over the December 2018 quarter. Similarly Shanghai Futures Exchange (SHFE) inventories reached their lowest levels in more than 10 years at the end of September, with stocks remaining low relative to historical levels through the December 2018 quarter. The low level of stocks are attributed to lower smelter output levels in China and Europe over the period, and are expected to keep the price elevated in the short-term.

Prices are forecast to ease further over the outlook period, due to new concentrate production from mines entering the market. Prices are forecast to average US$2,775 a tonne in 2019 and US$2,625 a tonne by 2020 (Figure 14.2) as the market continues to rebalance and inventories bottom out.

Figure 14.1: Zinc monthly spot prices

Source: London Metal Exchange (2018)

Figure 14.2: Zinc prices and stocks



Source: London Metal Exchange (2018) and Department of Industry, Innovation and Science (2018)

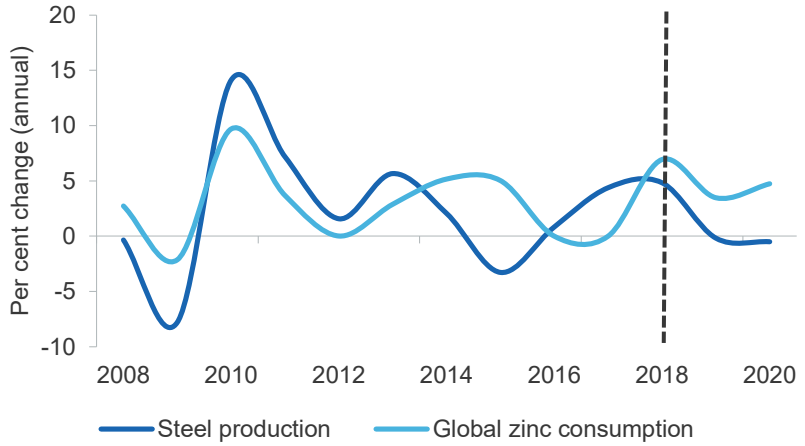
14.3 World consumption

Consumption growth is expected to moderate over the outlook period

Global refined zinc consumption is forecast to increase moderately over the outlook period reaching 14.2 million tonnes in 2018 and 15.3 million tonnes in 2020. Zinc's primary use is galvanizing steel, so consumption is heavily linked to steel use (Figure 14.3), and in turn, vehicle production and infrastructure development. China remains the key player in global zinc demand, accounting for around half of all zinc consumption. Moderating demand during 2018 is linked to a reduction in the output of galvanised steel from China.

Consumption in China presents a key uncertainty to the outlook. The imposition of the US tariffs on a number of Chinese goods has the potential to decrease zinc demand, as export goods containing zinc, or galvanized steel become more expensive for US consumers. The trade impact will potentially be offset by measures taken by the Chinese government to stimulate domestic growth with higher infrastructure spending.

Figure 14.3: Annual change in global steelmaking and zinc use



Source: International Monetary fund (2018), Department of Innovation, Industry and Science estimates

14.4 World production

Mine output to rise over the next two years

Global mine output is expected to grow steadily over the outlook period; a surge in investment in mines followed a sharp rebound in prices during 2017 and early 2018. Several large mines are expected to enter the market in the short-term as a result of the renewed investment.

Major mine projects coming online during the outlook period include the 250ktpa capacity Vendanta Gamsberg mine in South Africa (at the end of 2018) and the Xinjiang Guanghui's 590ktpa Huoshaoyun mine in 2020. Australia also has significant mine capacity ramping up over the outlook period (see below). World production is forecast to rise from 13.5 million tonnes in 2018 to 14.3 million tonnes in 2019, and further to 14.9 million tonnes in 2020.

Refined production to lift with mine output

Refinery production is expected to keep pace with mine output over the outlook period. Refined output is forecast to rise from 13.9 million tonnes in 2018 to 14.7 million tonnes in 2019, and 15.4 million tonnes by 2020. This is broadly in line with demand, and should keep the market in rough balance.

China accounts for the vast majority of global refined production, producing 44 per cent of total output during 2017. The next largest global producers are South Korea and China, which account for approximately 6 per cent of global output each. A majority of refined capacity coming online over the outlook period is expected to come from China.

A key uncertainty to the outlook is refined output from China. During 2018, global refining capacity faced some disruption as a result of cuts in output from Chinese facilities. The Chinese government is seeking to reduce environmental degradation. This focus on environmental outcomes could lead to slower expansion of refinery capacity over the outlook period.

14.5 Australia

Australian mined production is recovering, due to a surge in investment

Australia's zinc production increased in the September quarter — rising from 247,000 tonnes to 293,000 tonnes in metal content terms. The increase has been driven by the ramping up of Glencore's Lady Loretta mine and the re-opening of New Century Resources' mine. Australia's zinc production is forecast to lift from 952,000 tonnes in 2017–18 to 1.3 million tonnes in 2018–19, and 1.4 million tonnes by 2019–20 (Figure 14.4).

The forecast rise in Australian output over the outlook period stems primarily from New Century Resources' Century mine in Queensland. Hydraulic mining in the tailings dam commenced in August, and the first shipment of concentrate to China was announced in October. The company is targeting a full ramp up mining rate by the end of 2019. Full capacity at the operation is 264,000 tonnes per annum. Some rise in output is also expected from MMG's Dugald River mine in Queensland. The mine commenced operations in late 2017, and is ahead of schedule for ramping up to full capacity of 170,000 tonnes.

Australia's exploration spending for silver, lead and zinc dropped to $26 million in the September 2018 quarter from $28 million in the June quarter.

Zinc exports are expected to grow in line with rising production

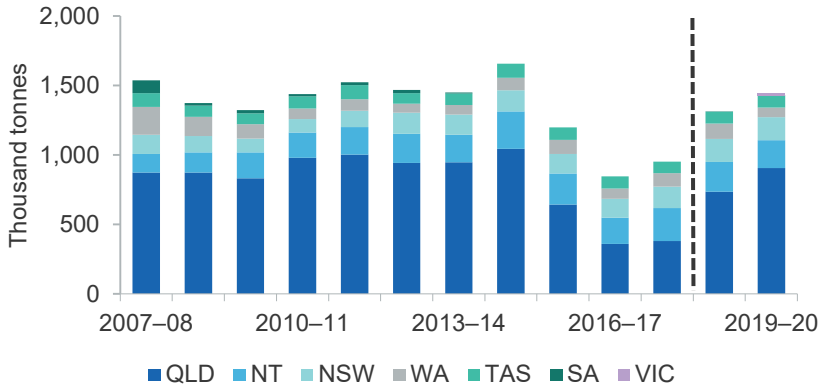
Export volumes are expected to largely track the production outlook, with export ores and concentrates expected to rise from 1.7 million tonnes in 2017–18 to 2.8 million tonnes by 2019–20. Increased earnings from the impact of higher volumes of zinc exports are expected to be offset by declining prices over the outlook period. As Figure 14.5 shows, earnings are projected to be $3.9 billion in 2018–19, before settling back to $3.8 billion as prices ease in 2019–20.

A risk to the export earnings outlook is the trade tensions between the US and China. While the full effect of the tariffs on the demand for zinc is not yet fully apparent, there is potential for global demand to slow and prices to fall, before trade flows are re-arranged. This has the potential to impact Australia's export earnings in the short-term.

Export earnings revisions

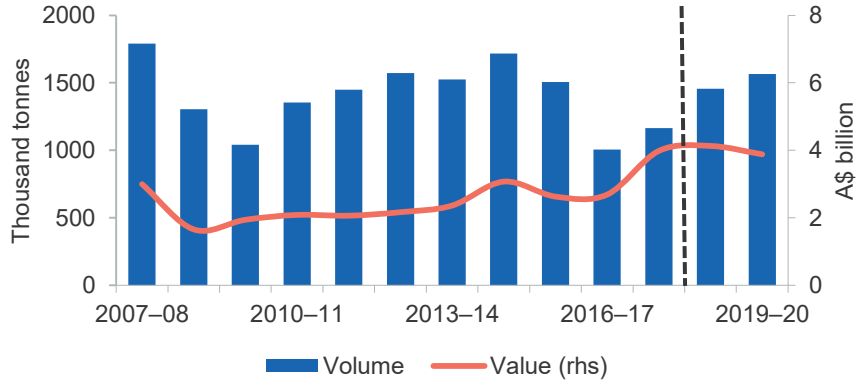
Since the September *Resources and Energy Quarterly* zinc export earnings have been revised down by $224 million in 2018–19 and $120 million in 2019–20. This is due to lower than expected prices for the end of 2018 and minor downward revisions to prices over the outlook.

Figure 14.4: Australia's zinc production by main producing state



Source: Company reports; Department of Innovation, Industry and Science (2018)

Figure 14.5: Australia's zinc exports, metallic content



Source: ABS (2018) International Trade in Goods and Services, 5368.0, Department of Innovation, Industry and Science (2018)

Table 14.1: Zinc outlook

						Annual percentage change		
World	**Unit**	**2017**	**2018[s]**	**2019[f]**	**2020[f]**	**2018[s]**	**2019[f]**	**2020[f]**
Production								
– mine	kt	13,306	13,546	14,269	14,940	1.8	5.3	4.7
– refined	kt	13,597	13,921	14,694	15,407	2.4	5.6	4.9
Consumption	kt	13,686	14,192	14,739	15,317	3.7	3.9	3.9
Closing stocks	kt	1,034	763	718	808	–26.2	–5.9	12.6
– weeks of consumption		4	3	3	3	–28.9	–9.4	8.4
Price								
– nominal	US$/t	2,894	2,928	2,775	2,625	1.2	–5.2	–5.4
	USc/lb	131	133	126	119	1.2	–5.2	–5.4
– real[b]	US$/t	2,966	2,928	2,714	2,538	–1.3	–7.3	–6.5
	USc/lb	135	133	123	115	–1.3	–7.3	–6.5
Australia	**Unit**	**2016–17**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**
Mine output	kt	843	952	1,314	1,446	13.0	38.0	10.0
Refined output	kt	466	474	501	500	1.7	5.6	–0.1
Export volume								
– ore and concentrate [c]	kt	1,479	1,737	2,512	2,805	17.5	44.6	11.7
– refined	kt	372	417	383	364	12.0	–8.2	–4.9
– total metallic content	kt	1,008	1,164	1,456	1,565	15.5	25.1	7.5
Export value								
– nominal	A$m	2,688	3,975	3,905	3,761	47.9	–1.8	–3.7
– real[d]	A$m	2,802	4,067	3,905	3,672	45.1	–4.0	–6.0

Notes: **b** In 2018 US dollars; **c** Quantities refer to gross weight of all ores and concentrates; **d** In 2018–19 Australian dollars; **f** Forecasts; **s** Estimate
Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Company reports; Department of Industry, Innovation and Science; International Lead Zinc Study Group (2018); LME (2018); World Bureau of Metal Statistics (2018)

Lithium

Resources and Energy Quarterly December 2018

Lithium, hydrogen and helium were the three key elements produced in the big bang

Lithium's unique properties make it vital for emerging technology such as electric vehicles.

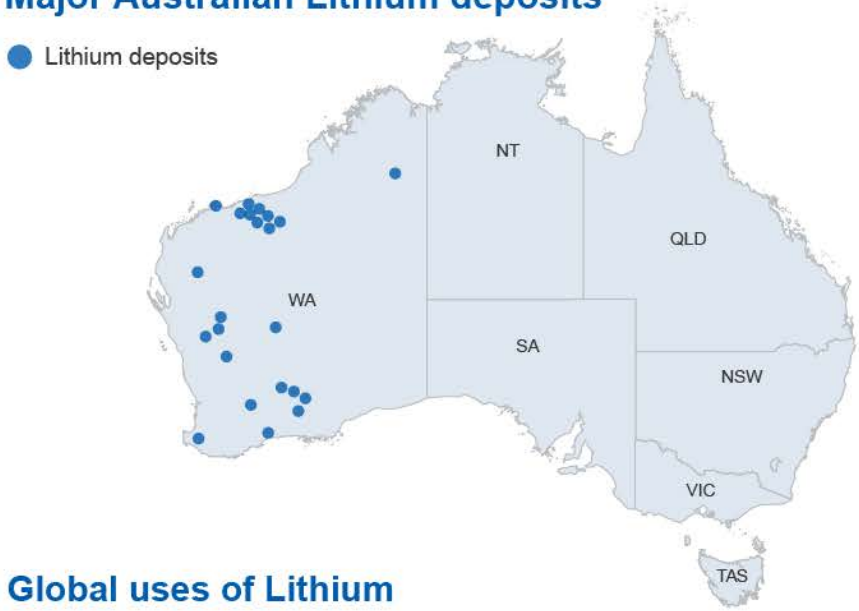
Lithium is the lightest and densest metal, and has huge potential for power generation

Australia has **17%** of the world's lithium and is the world's biggest exporter

Australian lithium exports tripled to be worth **$780** million in 2017

Global electric vehicle sales are expected to increase from 2 million to **50** million by 2030

Major Australian Lithium deposits



Global uses of Lithium

46% Rechargeable batteries

26% Ceramics & glass

11% Greases & polymers

11% Other uses

4% Industrial powders

2% Air treatments

15.1 Summary

- Lithium hydroxide prices are expected to trend down — from around US$16,500 a tonne in 2018 to US$12,700 a tonne by 2020 — as supply growth outpaces demand. The supply surplus will likely reverse after 2020, as battery demand accelerates.
- Australian lithium production is expected to increase from 229,000 tonnes (in lithium carbonate equivalent terms) in 2017–18 to around 311,000 tonnes by 2019–20, as the Greenbushes mine is upgraded and several newer mines ramp up. All production is expected to be exported.
- Rising production is forecast to push export revenue up from $905 million in 2017–19 to $1.2 billion by 2019–20.

15.2 Prices

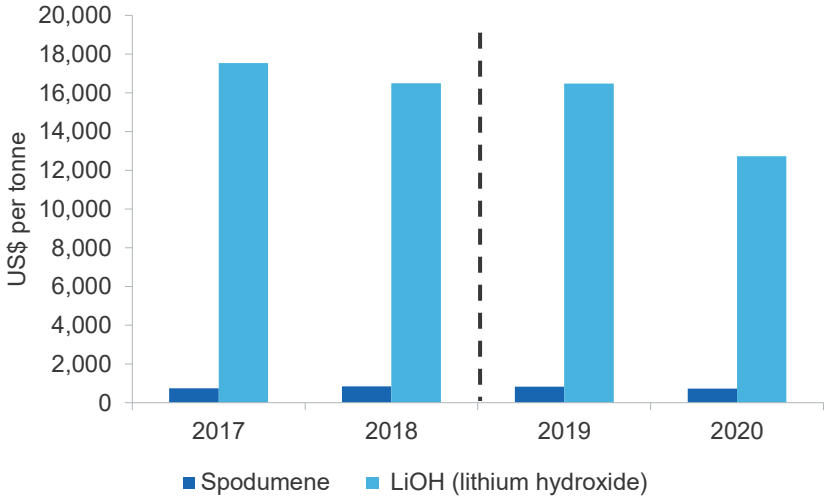
Prices are on a downward trend — for now

After peaking at around US$20,000 (in mid-2016) amidst fears of supply shortages, lithium hydroxide prices have retreated as substantial new supply has entered the market. From averaging around US$16,500 per tonne in 2018, prices are forecast to fall to around US$12,700 a tonne by 2020. Prices for the lithium precursor mineral (spodumene ore), which Australia exports, are expected to follow a similar trend (Figure 15.1).

Rising electric vehicle sales (Figure 15.2) remain crucial to lithium prices. Price falls for lithium hydroxide have been driven by China, which has recently scaled back subsidies for short-range electric vehicles, while increasing support vehicles with a longer range. As China is the world's largest consumer of electric vehicles, changes to its incentive schemes have added significant volatility and uncertainty to lithium prices in recent months.

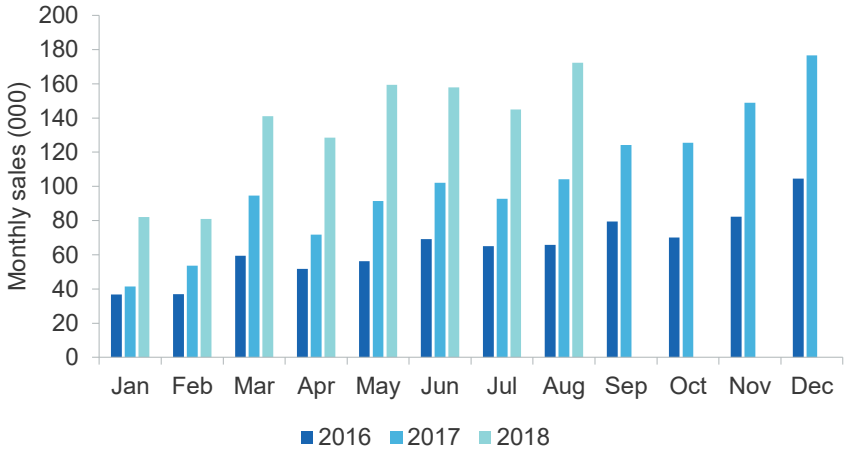
The recent massive surge in spodumene/lithium supply from Australia will have implications for lithium prices in the short-term. However, by 2020, rising demand for electric vehicles may outstrip this added supply, pushing prices back up again over the longer term.

Figure 15.1: Comparative price, spodumene ore / lithium hydroxide



Source: Roskill (2018); Department of Industry, Innovation and Science (2018)

Figure 15.2: Monthly electric vehicle sales



Source: Inside EVs (2018) Monthly Sales Scorecard. Based on reconciled monthly or quarterly total sales data reported by major plug-in automakers.

15.3 World consumption

Lithium demand is rising rapidly — and the growth rate is set to increase

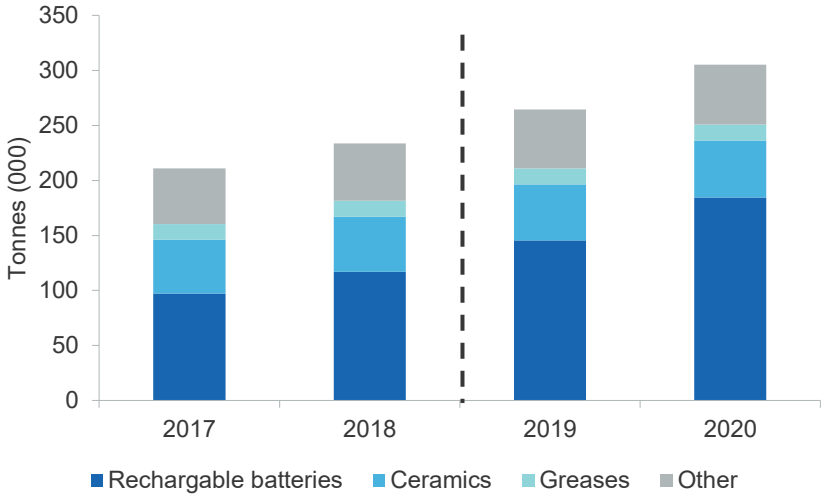
Electric vehicle batteries currently account for a minority of lithium demand, with other categories (including ceramics and greases) still accounting for the majority of use. However, rising electric vehicle sales are now accounting for virtually all growth in lithium demand (Figure 15.3), and are expected to dominate lithium use within a few years. In recent months, imports of battery grade lithium have increased sharply in Japan, South Korea, and Taiwan, as electric vehicle sales rise in those countries. China is also increasing its imports of lower grade lithium.

The two trends appear to be connected, with China using the lower grade material to feed its growing refinery network and expand its previously minimal export markets, as elements of the supply chain begin to solidify. However, China is yet to move strongly into scaled up production of battery grade material, an area which remains relatively undeveloped.

Demand for battery materials is set to grow, as large automakers scale up their output of electric vehicles. Tesla lifted its weekly output of Model 3s to more than 6,000 in the September — up from less than 4,000 per week in the first half of 2018. BYD and BMW announced large investments in new electric vehicle and battery facilities (with a combined investment value of more than US$3 billion) in the September quarter. Daimler has announced that battery manufacturing capabilities will be added to two key automotive plants, in order to accelerate a transition to electric cars. Jaguar Land Rover announced new investments in electric vehicle production facilities in September, with an aim to ensure that every car model produced by the manufacturer will have an electric version available by 2025. Volkswagen has set a target of one million electric vehicle sales annually by 2025.

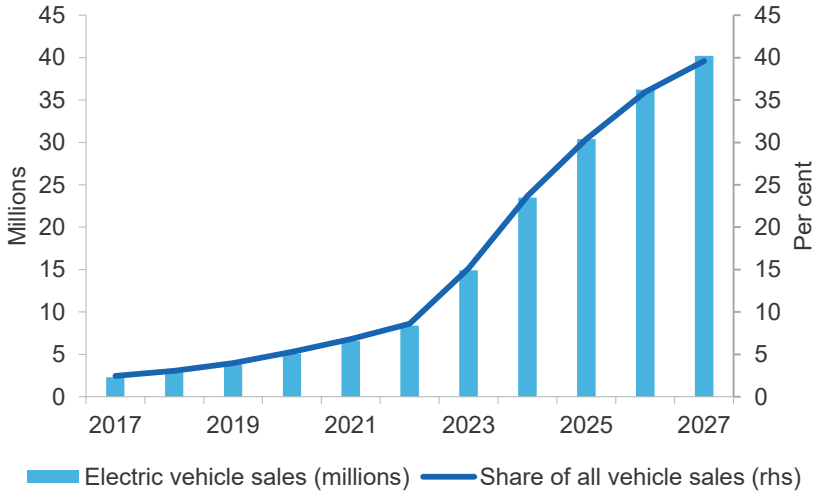
This rising demand is expected to increase lithium consumption from around 211,000 tonnes in 2017 to 305,000 tonnes by 2020. However, far more rapid growth in vehicle demand is expected in the subsequent 3–5 years, and considerable new supply is likely to be needed in the longer term (Figure 15.4).

Figure 15.3: Lithium usage by product



Source: Roskill (2018); Department of Industry, Innovation and Science (2018). 'Other' includes glass, powders, primary batteries, and air treatments.

Figure 15.4: Long-term electric vehicle sales projection



Source: Roskill (2018); Department of Industry, Innovation and Science (2018)

15.4 World production

A wave of new supply is likely to boost lithium stocks in the outlook period

Mined supply has momentarily outstripped demand as a result of large investments that have unlocked significant new lithium deposits over the last two years. Spodumene ore production grew by almost 70 per cent (to 366,000 tonnes) in 2017, and further projects and ramp-ups are forecast to push output up further, to 411,000 tonnes by 2020 (Figure 15.5).

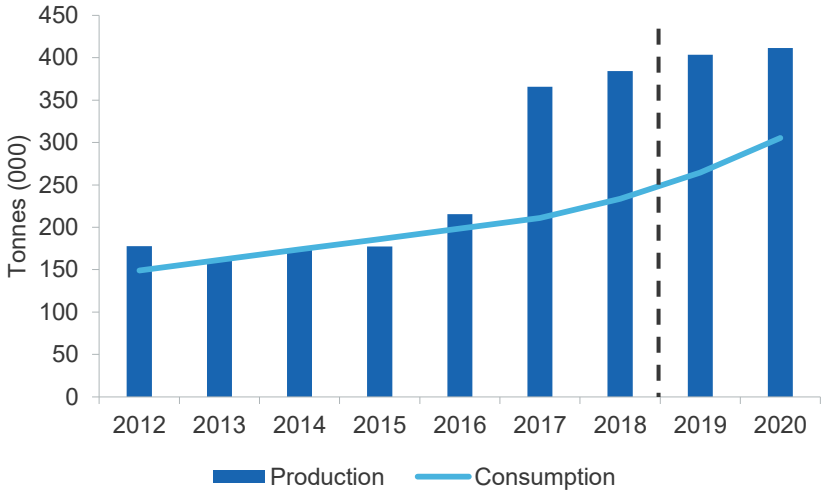
The largest contribution to this increase is rising output from Australia — where Greenbushes is ramping up towards its full capacity — and Chile, which holds the world's largest deposits (Figure 15.6), and where Albermarle is increasing output from its brine projects. Chinese brine production is also on the rise, though it remains significantly behind Chile and Australia as a producer.

Falling prices for lithium carbonate have, however, led to the suspension of operations at Desert Lion's mine facilities in Namibia. This will partly offset growth elsewhere, though supply will still remain ahead of demand in the short term.

Refined lithium supply is also on the rise, with China adding significant new capacity over the past 12 months. Refined lithium output from China is expected to have risen by 23 per cent between 2017 and 2018, with further rises in prospect over subsequent years. The largest growth source in the near term is likely to be in Tianqi's substantial Chinese facilities, where extensive debottlenecking is planned for 2019.

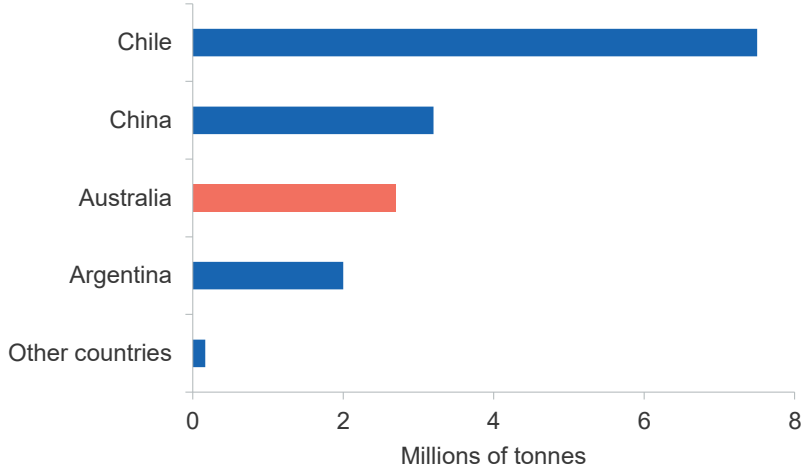
A surplus in both mined and refined supply is likely over the outlook period, with stockpiles set to rise. However, demand growth is expected to outstrip supply beyond 2020, with stocks potentially coming under significant pressure from 2022. Recycling and secondary markets remain nascent for lithium: only around 2 per cent of lithium battery products are recycled in Australia, compared to 98 per cent of lithium battery products. Better waste management is likely to become increasingly essential as a means to broaden lithium supply sources and reduce volatility and risks.

Figure 15.5: Lithium production and use



Source: Roskill (2018); Department of Industry, Innovation and Science (2018).

Figure 15.6: Lithium reserves



Source: US Geological Survey (2018); Department of Industry, Innovation and Science (2018).

15.5 Australia

Production is expected to grow further over the next two years

Australia recorded a huge increase in spodumene ore output in 2017 and early 2018, taking a dominant position among global producers and leading to a global lithium supply surplus. Output growth is expected to continue over the outlook period (Figure 15.7).

The first lithium mine outside of Western Australia is now in prospect, with Core Exploration moving closer to commencing a new mine at Finniss in the Northern Territory. Regulatory processes have largely concluded and the project is likely to benefit from high ore grades, low transportation costs, and binding offtake agreements with firms in China. The mine is expected to commence in the September quarter of 2019, ramping up to around 200,000 tonnes of annual spodumene production by 2021.

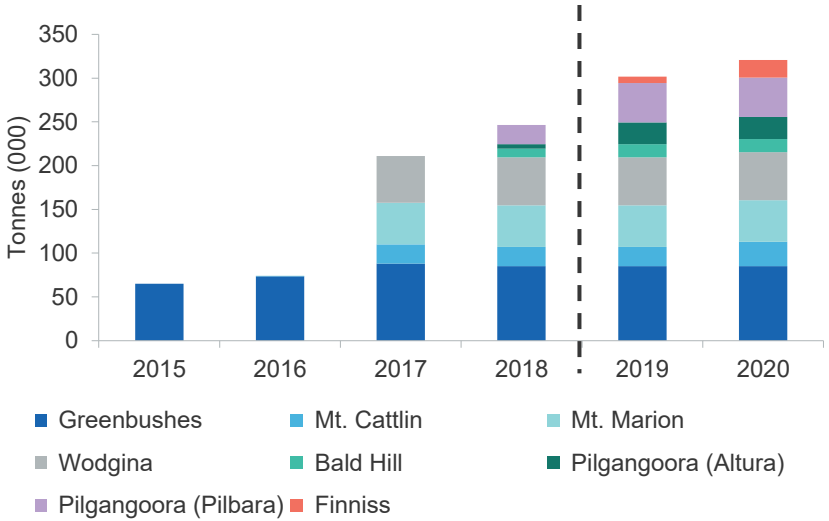
Talison Lithium has formally approved a $516 million expansion of its Greenbushes mine. This mine — previously the only one operating in Australia — will triple its production capacity once the expansion is completed. The first phase will increase annual spodumene output to 1.34 million tonnes; a concentration plant will then be added in 2020, with a further expansion in capacity to 1.95 million tonnes to follow.

Output growth across new and existing projects should increase Australia's production to around 311,000 tonnes (in lithium carbonate equivalent terms) by 2019–20, with Australia set to account for around 80 per cent of global supply from hard rock deposits.

Exports are set to grow strongly over the outlook period

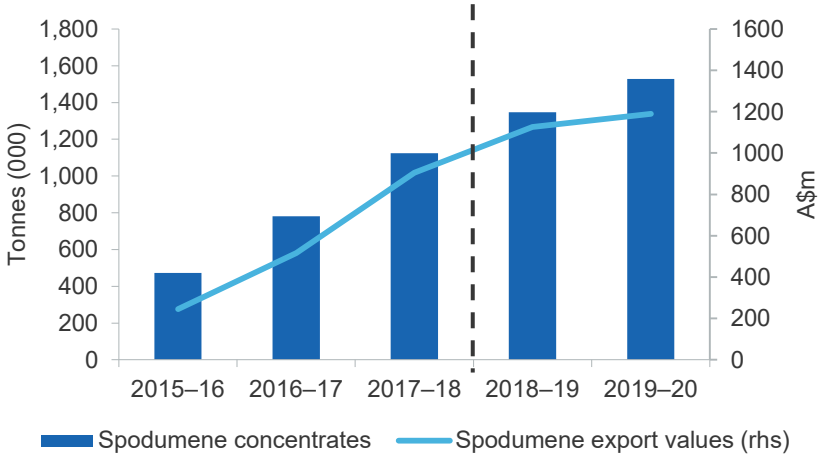
Exports grew somewhat more slowly than production in 2017, as not all new production was exported in that year. However, this deferred growth is expected to lead to a strong rise in export revenue, which is forecast to lift from $900 million in 2017–18 to $1.2 billion by 2019–20 (Figure 15.8). Several new mines have begun exporting: Pilbara Minerals' new mine at Pilgangoora marked its first shipment in August, while the Altura mine loaded its first transport to its offtake partners in October.

Figure 15.7: Australian spodumene ore production (LCE*)



Source: Company reports, Roskill (2018); Department of Industry, Innovation and Science (2018). *LCE denotes lithium carbonate equivalent measure.

Figure 15.8: Australian spodumene exports

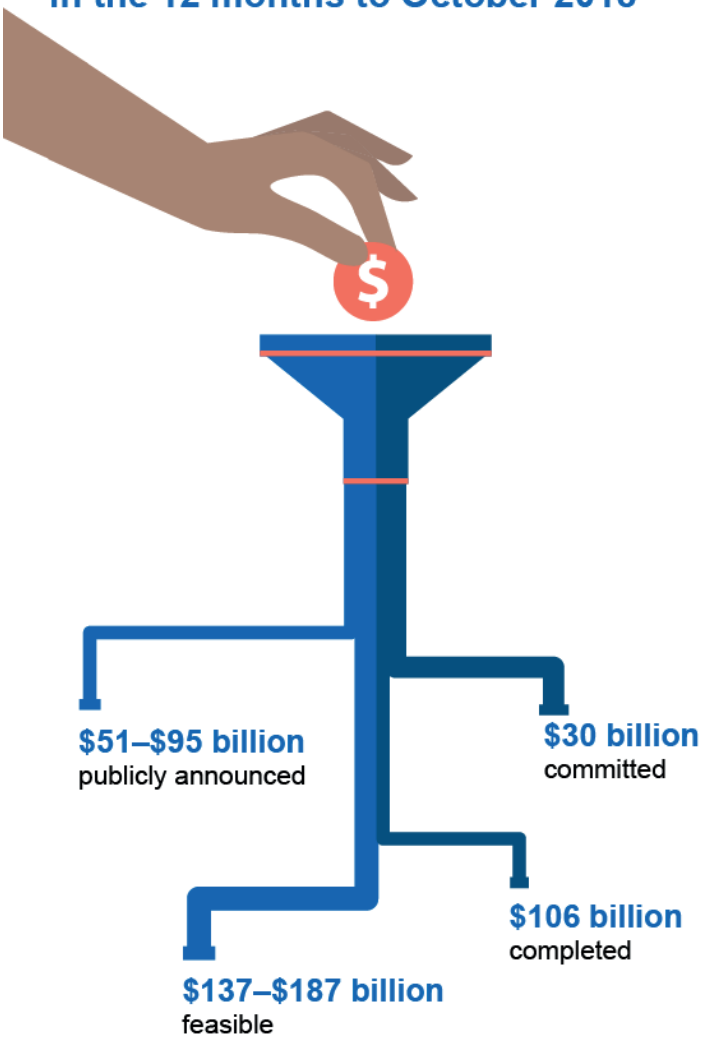


Source: Roskill (2018); Department of Industry, Innovation and Science (2018); Government of Western Australia Department of Mines, Industry Regulation and Safety (2018)

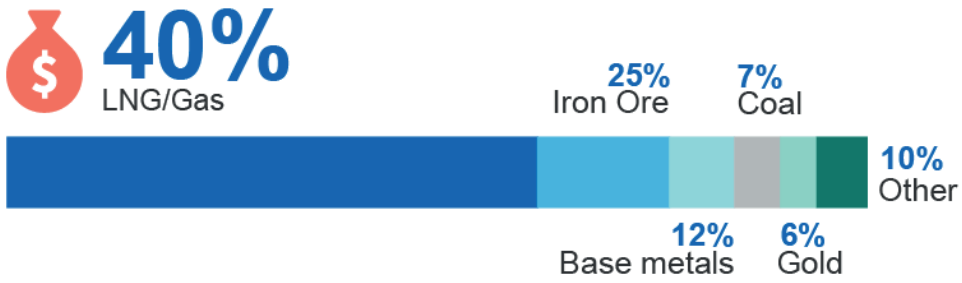
Major Projects

Resources and Energy Quarterly December 2018

Value of resource and energy projects in the investment pipeline in the 12 months to October 2018



Per cent share of value of committed projects by commodity groups



$45 billion Wheatstone LNG project
Australia's largest resource project to be completed in 2018

Major projects include over **30 different mineral varieties**

16.1 Introduction

Resources and Energy Major Projects is a review of projects which extend, increase, or improve the output of mineral and energy commodities in Australia. These projects include new mines, processing facilities, and other connected infrastructure. This edition of the report presents an update on project developments over the 12 months from 1 November 2017 to 31 October 2018. Its purpose is to measure the value of current and potential investment in the resources and energy sector, and to provide an analysis of key trends and issues.

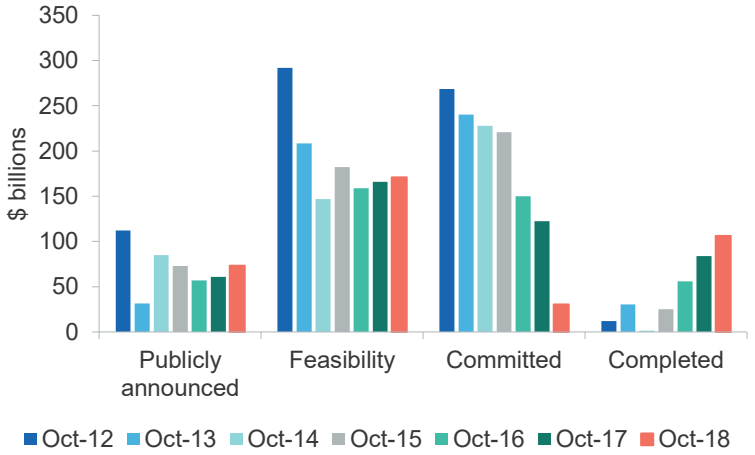
16.2 Overview and outlook

A year on from the release of our last publication, the value of 'committed' resource and energy projects — those where a final investment decision (FID) has been taken and construction activity is likely underway — has fallen dramatically. The value of committed projects at the end of October 2018 stood at just $30 billion, down from $122 billion a year earlier.

The decline has been driven by the substantial completion of the final three projects in Australia's recent wave of LNG investment, together valued at around $100 billion: Ichthys, Prelude and Wheatstone. The flow of projects from the 'feasibility' stage to the 'committed' stage has been comparatively poor, with a number of new coal projects, in particular, still awaiting an FID.

These headline figures, however, mask a modest improvement in the resources and energy investment environment over the past 12 months. The value of 'publicly announced' projects, as well as the number and value of projects being examined for 'feasibility', has increased slightly over the past 12 months. This pick-up in investment activity likely reflects the impact of higher commodity prices, a lower Australian dollar and growing confidence about the long-term outlook for global commodity demand. These same factors have driven an increase in exploration expenditure, particularly across base and precious metals. These developments represent a turnaround from the period of low prices over 2015 and 2016, which saw companies delay projects and focus on cutting costs.

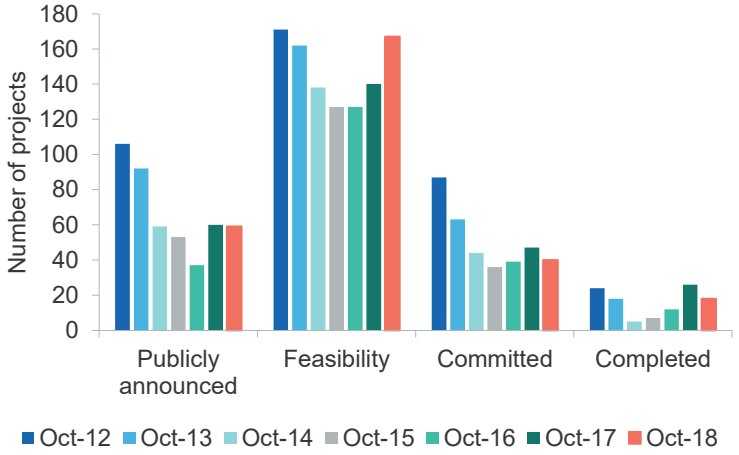
Figure 16.1: Value of projects in the investment pipeline, 2012–2018



Notes: The value of publicly announced and feasibility projects is estimated as the mid-point of the range.

Source: Department of Industry, Innovation and Science (2018)

Figure 16.2: Number of projects in the investment pipeline, 2012–2018



Source: Department of Industry, Innovation and Science (2018)

The value of committed projects is expected to decline further in 2019, driven by the completion of several new mines and expansion projects, including Woodside's $2.6 billion investment in Greater Enfield, expected to be completed in 2019. Several gold and copper projects are also due to be completed by the end of 2019, including Oz Minerals' $910 million Carrapateena copper and gold project. The $621 million Gruyere gold project being developed by Gold Road and Gold Fields is also expected to pour first gold in 2019.

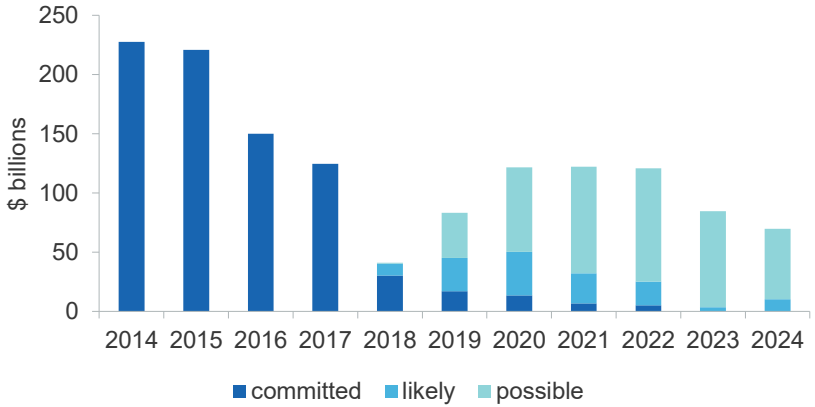
The value of projects currently at the feasible stage and rated as 'likely' and 'possible' (see methodology section below) to proceed to the construction phase — worth around $170 billion — suggests the potential for a significant rebound in committed investment. Over $36 billion of investment projects are rated as 'likely' to reach an FID over the six years to 2024. A further $134 billion have been rated as 'possible' over the same six year period. However, this potential investment depends heavily on the progression of just 10 key mega projects (each involving over $5 billion of investment). These projects include the Browse Basin gas project, the Alpha coal project, and the West Pilbara iron ore project. It is thus possible that 2018 represents the bottom of the mining investment cycle.

Australia's largest export commodities, namely iron ore, coal and LNG/gas/petroleum, account for most of the expected potential investment (publicly announced and feasible projects). Together, these three groups account for $182 billion of potential investment rated as 'likely' or 'possible' to progress to the 'committed' stage over the next five years.

Investment in precious, base metals and other commodities is expected to increase over the outlook, with $32 billion of publicly announced and feasible projects rated as 'likely' or 'possible' to progress to the 'committed' stage. There are nine large-scale gold projects with annual capacity of over 2.8 tonnes (100,000 ounces) rated as 'likely' or 'possible'. Several projects related to lithium, cobalt and nickel are expected to progress rapidly through the investment pipeline. These projects involve $12 billion in potential investment, and are mostly expected to reach an FID by 2022. Growing demand for electric vehicle battery technology has seen the prices of these commodities rise rapidly in recent years, and projected growth in electric vehicles looks set to drive a major expansion in the supply of these commodities.

While the improvement in the outlook will not see investment return to the levels seen during the last investment phase (which peaked in 2012 with $268 billion in committed projects), it points to some significant emerging opportunities for Australia's resources and energy sector.

Figure 16.3: Outlook for committed project investment



Source: Department of Industry, Innovation and Science (2018)

Table 16.1: New and expansion projects by rating

	Unlikely	Likely	Possible	Committed	Completed
New project					
A$ billion	16	40	153	11	101
Number	10	35	149	19	11
Expansion					
A$ billion		16	19	19	4
Number		11	18	20	5

Source: Department of Industry, Innovation and Science (2018)

Table 16.2: Summary of projects in the investment pipeline as at 31 October 2018

	Publicly announced		Feasibility		Committed		Completed	
	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m
Aluminium, Bauxite, Alumina					1	1,900	1	73
Coal	12	8,500–14,489+	48	59,999–70,224+	2	2,256	1	100
Copper	1	250–499	6	814–1,561+	3	1,839		
Gold	1	0–249	12	3,174	7	1,721	4	496
Infrastructure	11	6,250–11,489	5	2,450–2,948	2	310	1	180
Iron ore	9	8,500–16,491+	13	18,574–25,117+	5	7,543	1	120
Lead, Zinc, Silver	1	0–249	2	316			1	563
LNG, Gas, Petroleum	10	22,250–38,493+	15	32,109–59,705+	11	12,078	6	103,789
Nickel	6	3,500–7,494	8	1,487				
Uranium	1	2,000–4,243+	4	1,915+			1	378
Other Commodities	7	500–999	54	16,885–20,125+	9	2,616	2	270
Total	**57**	**51,750–94,695+**	**167**	**137,723–186,572+**	**40**	**30,263**	**18**	**105,969**

Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.
Source: Department of Industry, Innovation and Science (2018)

16.3 Methodology

Each year, the Department of Industry, Innovation and Science (DIIS) collects information about the investment pipeline for major resource and energy projects. Information on major projects is gathered from a number of sources, including company websites, Australian Stock Exchange reports, media releases, and from direct contact with company representatives. Although there is substantial investment by mining and energy companies in replenishing equipment, plant and other property, the focus of this report is on 'major' investments — those valued at over $50 million. Smaller scale operations are also an important contributor to the sector and the broader Australian economy. However gathering data on such projects is challenging, as many are undertaken by private companies, which have fewer obligations to report progress.

Developers of resources and energy projects often use different planning processes and assessment methods to support an FID. Thus, there is no standard project development model with clearly defined stages and terminology that can be applied to every resources and energy project.

To broadly represent the general lifecycle of a project, DIIS uses a four-stage model of the investment pipeline to measure the potential investment in Australia's resources and energy sectors. Earlier stages of developing mining and energy projects, such as identifying deposits and exploration activities, are not included in the assessment. While these activities remain important, it is beyond the scope of this report to assess exploration activities on a project-by-project basis. Instead, a summary and analysis of aggregate exploration expenditure is provided. To be included on the major projects list that accompanies this report, there must be evidence of project activities that support the project progressing to an FID within the next five years.

The four stages in the DIIS investment pipeline model are:

(1) Publicly announced stage

Projects at the publicly announced stage are usually very early in their development, and are typically undergoing an initial feasibility study to assess the commercial aspects of developing an identified resource. To include a project on the list at this stage, preliminary information on the project schedule, planned output or cost must be publicly available. Projects that have stalled in progressing towards an FID, and that are investigating alternative development options, are also classified as Publicly Announced to reflect their longer planning times.

As they are still in the early planning stage, projects at the publicly announced stage may not have finalised the engineering designs or estimates of construction costs. To reflect this uncertainty, project costs are quoted as a cost band in the Major Projects list. In most cases, this is based upon an estimate developed by DIIS using industry averages for similar construction activities. The cost bands used by DIIS in this report for publicly announced projects are:

- $0 – $249m
- $250m – $499m
- $500m – $999m
- $1,000m – $1,499m
- $1,500m – $2,499m
- $2,500m – $4,999m
- $5,000m+

(2) Feasibility stage

This stage of the project development cycle is when the initial feasibility study for a project has been completed and the results support further development. Projects that have progressed to the feasibility stage have undertaken initial project definition studies and commenced more detailed planning work. This work includes Front-End Engineering Design (FEED) studies, Bankable Feasibility Studies, developing the final project scope, commercial plans and environmental surveys (in support of finalising an Environmental Impact Statement).

While there is an opportunity to progress projects at the feasibility stage to the committed stage, this is not guaranteed to occur, as the evaluation of commercial prospects has not yet been finalised and all regulatory approvals are yet to be received. Projects at the feasibility stage have not been committed to, and are only potential investments that may occur under the appropriate conditions. Therefore, the total value of projects at

the feasibility stage cannot be directly compared to the value of the projects at the committed stage in order to forecast the future of capital investment in Australia's resources and energy sectors.

Project ratings

Projects at the publicly announced and feasibility stages can only be viewed as potential investments, as not all projects will progress through to construction.

Resources and Energy Major Projects employs a project-level analysis to provide a profile of future investment. Projects at the feasibility and publicly announced stages are rated as either 'unlikely' (0 – 20%), 'possible' (20 – 60%) or 'likely' (60 – 100%) to progress to the committed stage.

This assessment is based on a range of internal and external factors as well as market and company commentary. Where data is available, projects are assessed based on their position on the relevant commodity's production cost curve. The timing of when projects are likely to progress to the committed stage is based on schedules announced by the project's developers. Projects that have been assessed as 'unlikely' to proceed are not included in the forward projection of the value of committed investment.

Although assessments are made at a project level, these are not made public in the Resources and Energy Major Projects data set because some of the information used is treated as commercial in confidence.

(3) Committed stage

Projects at the committed stage have completed all commercial, engineering and environmental studies, received all necessary government regulatory approvals, and finalised the financing of the project to allow construction. Such projects are considered to have received a positive FID from the owner(s). In most cases, projects at this stage of development have already started construction, as there are typically pre-works undertaken as part of exploration and design activities.

Projects at the committed stage typically have cost estimates, schedules, and mine outputs that are well defined and often publicly released. Most projects that progress to the committed stage will eventually commence production. Nevertheless, post-FID, there are still technical and financial risks that, if realised, can result in delays, scope changes and cost overruns, or even affect the commercial viability of a project and possibly lead to its cancellation.

(4) Completed stage

A project reaches the completed stage when construction and commissioning activities are substantially completed. As many projects include multiple stages and scope elements that can be independent of each other, the timing around when a project reaches the completed stage can be difficult to assess. In this report, the Ichthys and Prelude projects are considered to have reached substantial completion.

Table 16.3: Current number of projects by stage of investment and rating

	Unlikely	Possible	Likely	Committed	Completed
Publicly announced	8	44	7		
Feasible	3	125	39		
Committed				40	
Completed					18
Total	**11**	**169**	**46**	**40**	**18**

Notes: Projects at the publicly announced and feasibility stages are rated as either 'unlikely' (0 – 20%), 'possible' (20 – 60%) or 'likely' (60 – 100%) to progress to the committed stage.

Source: Department of Industry, Innovation and Science (2018)

16.4 Exploration

Exploration is a key stage in the mining project development cycle. It is an investment in knowledge about the location, type, quantity and quality of deposits, which helps to inform future development. Before making the decision to undertake exploration activities, resources and energy companies consider a range of factors to ensure that the benefits of exploration activities exceed the costs. Factors to be considered include prevailing and expected commodity prices, regulatory environments, geological prospects, and tax and royalty arrangements.

Exploration expenditure increased in 2017–18

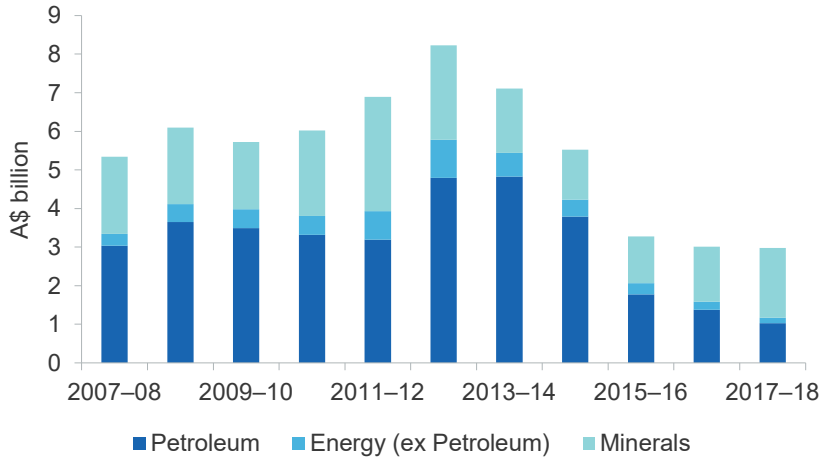
Australian exploration expenditure increased by 2 per cent in 2017–18, to $3.0 billion (Figure 16.4). The main contributor to the increase was expenditure on mineral exploration, which increased by 27 per cent to $1.8 billion. The mineral exploration expenditure was primarily on existing deposits, however the share of expenditure on new deposits increased marginally to reach 34 per cent of total mineral exploration expenditure (Figure 16.5). Minerals exploration expenditure increased from 48 per cent of total expenditure a year ago to 60 per cent in 2017–18.

Gold exploration expenditure increased by 18 per cent in 2017–18 to $813 million — accounting for 45 per cent of Australia's total minerals exploration expenditure over the year (Figure 16.6). Exploration activity has been encouraged by still relatively high Australian dollar gold prices.

Base metals exploration expenditure rose by 89 per cent in 2017–18 to $496 million, supported by higher commodity prices. This is a substantial rise in base metal exploration, which had been in decline over the four years to 2016–17. The increase in base metals exploration was largely driven by nickel, cobalt, and copper, all of which were subject to recent favourable movements in world prices (Figure 16.6).

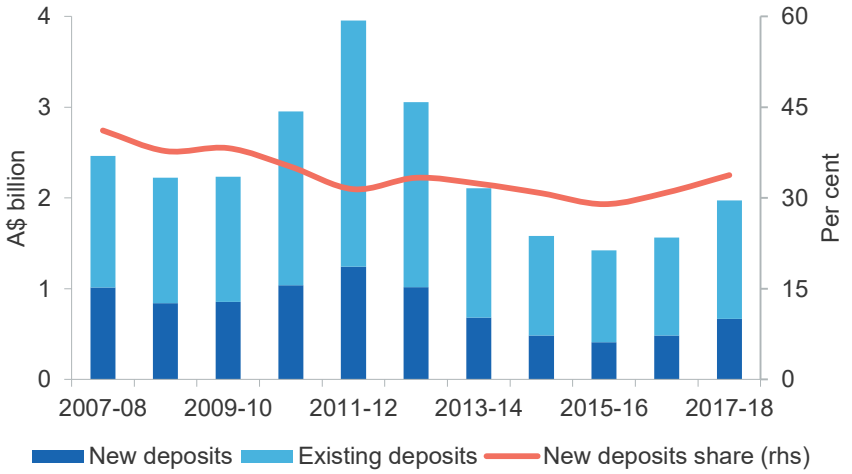
Nickel and cobalt expenditure increased from $81 million to $200 million, a 148 per cent rise. Copper exploration expenditure increased by 42 per cent to reach $193 million. Silver, lead and zinc expenditure increased by 89 per cent to $103 million. Coal exploration increased from a low base set in 2016–17, rising by 29 per cent to $156 million. The increase follows a longer-term decline from the peak of coal exploration expenditure of $834

Figure 16.4: Exploration expenditure



Source: ABS (2018) Mineral and Petroleum Exploration, Australia, 8412.0

Figure 16.5: Mineral exploration by deposit type



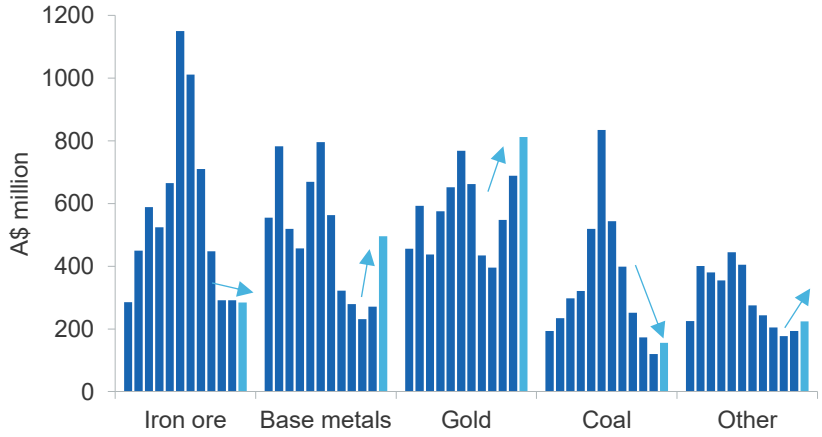
Source: ABS (2018) Mineral and Petroleum Exploration, Australia, 8412.0

million in 2011–12. A sharp recovery in prices is likely to have driven the increase.

Iron ore exploration declined by 2 per cent to $284 million in 2017–18. This represents a low over the past decade, after the peak in 2011–12 of $1.2 billion. Growing global supply and expectations of low prices have headed off any potential rebound in exploration activity.

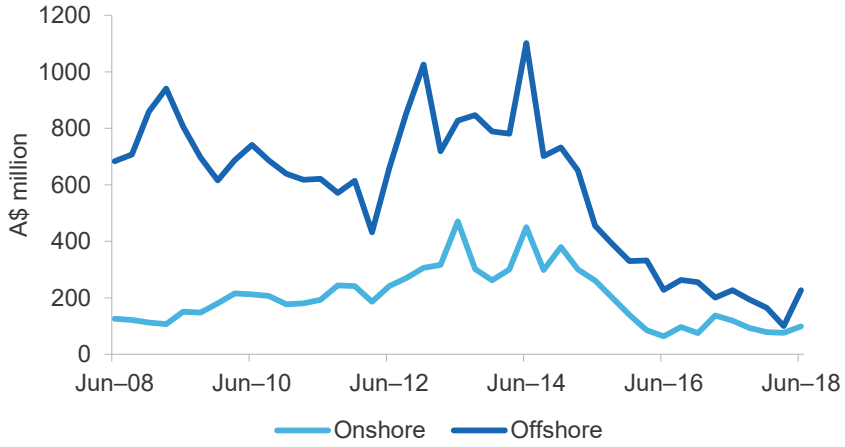
Petroleum expenditure continued to decline, falling from $1.4 billion to $1.0 billion in 2017–18. Both offshore and onshore petroleum expenditure remain around their lowest level in the last decade, however the recent upswing is encouraging (Figure 16.7). Australia's wave of LNG investment saw exploration expenditure reach record levels between 2012 and 2014, but a difficult price environment has weighed heavily on petroleum exploration expenditure since 2014.

Figure 16.6: Exploration expenditure, 2006–07 to 2017–18



Source: ABS (2018) Mineral and Petroleum Exploration, Australia, 8412.0

Figure 16.7: Petroleum exploration expenditure, Quarterly



Source: ABS (2018) Mineral and Petroleum Exploration, Australia, 8412.0

Figure 16.8: Exploration expenditure by group and State 2017–18

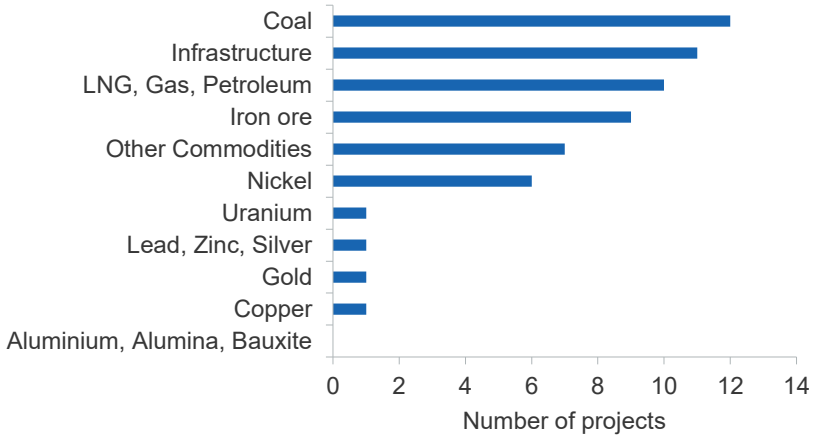
Source: ABS (2018) Mineral and Petroleum Exploration, Australia, 8412.0

16.5 Projects at the publicly announced stage

Newly announced projects for a range of commodities

The value of projects at the publicly announced stage has remained steady, increasing from an estimated midpoint of $61 billion to $73 billion over the 12 months to October 2018. An improving outlook for global commodity demand has facilitated new project announcements across a range of commodities. There are 59 projects at the publicly announced stage, with 17 additions in 2018 worth a potential $12–$22 billion in future investment activity.

Figure 16.9: Number of projects at the publicly announced stage



Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Almost half of the publicly announced projects are in Western Australia, including two new iron ore projects — Ularring and Balmoral South.

With strong market prospects for lithium-ion batteries, there has also been significant interest in lithium production and refining projects. Two new lithium hydroxide refineries (the Wodgina Processing Plant and Mount Holland Refinery) in Western Australia have been announced, and are expected to make financing decisions in 2019.

New coal projects in Queensland have also been added to the listing, and interest in existing projects has also grown. Ongoing strength in metallurgical coal prices has encouraged producers to consider bringing more capacity online, and brought projects of varying sizes into focus, including the Winchester South project, which Whitehaven coal acquired from Rio Tinto earlier in the year.

Two LNG import terminals have been announced over the course of the past year. ExxonMobil's proposed project in Longford, Victoria, could begin importing LNG from 2022. Australian Industrial Energy's proposed project in New South Wales was also announced, and has progressed to the feasibility stage. The project could commence operations as soon as 2020.

16.6 Projects at the feasibility stage

Significant investment potential with projects at feasibility assessment

The value of projects at the feasibility stage — which is the stage where the majority of projects in the development pipeline sit — has been steady at an estimated $170 billion in the 12 months to October 2018. Positive market conditions have facilitated a jump in the number of projects at the feasibility stage. This year, 167 projects are listed at the feasibility stage: an increase of 42 projects on last year. Projects at this stage range in value from $50 million to $17 billion.

New interest in rare earths and critical minerals (some of which are important in battery manufacturing) has facilitated interest in smaller, high value commodity production, which account for a third of the projects listed at this stage. One of the largest is the Sconi Project in Queensland, which will produce cobalt, nickel and scadium, with an estimated capital expenditure of $1.3 billion. Australia's unique resource base is expected to support mining investment and associated processing facilities going forward. Provided market conditions remain supportive, these facilities — which require relatively low investment of an average capital expenditure of less than $350 million — have the potential to progress through the development pipeline at a relatively rapid pace.

The number of coal projects at the feasibility stage has increased over the last year, with 48 projects listed. Of these, 38 are in Queensland. This significant investment potential will be dependent on price expectations, company priorities and government approvals. One significant project is the Olive Downs project in Queensland, which could bring 15 million tonnes of thermal and coking coal production capacity online. This project, with an estimated capital expenditure of $1 billion, is expected to reach an FID in 2019, and potentially start production in 2020.

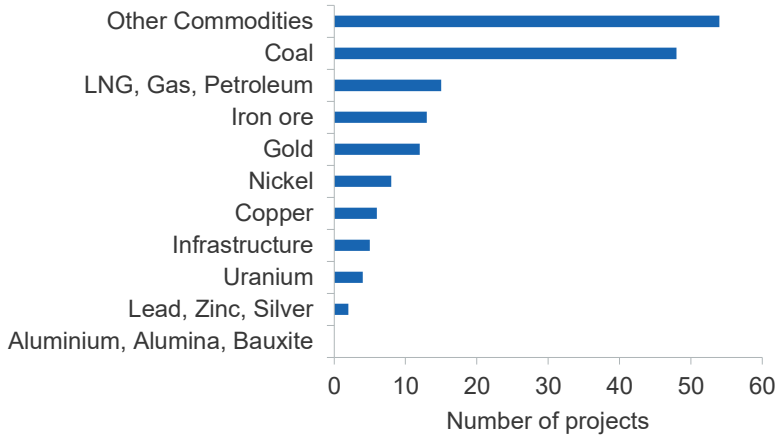
In late November 2018, Adani announced that funding for its scaled-back Carmichael project had been finalised. While this represents a positive FID, the *Major Projects* list captures project developments as of 31 October 2018. As such, the Carmichael mine has been reported at the 'feasibility' stage in this edition, and will progress to the 'Committed' Stage in the 2019 release of *Major Projects.*

An improving outlook for global LNG demand has seen firming prospects for brownfield and backfill projects at existing LNG plants. Technical studies are underway for a second train at Woodside's Pluto project, which is likely to be in the 4–5 million tonne per annum range. The additional train at the Pluto LNG project forms part of Woodside's plans to develop the Scarborough gas resource in the Carnarvon Basin, connecting the offshore resource to the Pluto LNG plant via a 430 kilometre pipeline. An FID is being targeted for 2020, and first LNG is being targeted for 2024.

The Browse project is also being progressed as a backfill option for the North West Shelf with FEED expected to begin in 2019. The Barossa field is the lead candidate for backfill at the Darwin LNG project, where production from the Bayu-Undan field will cease in the early 2020s. The FEED phase of the project is currently underway.

Three prospective LNG import terminals are being assessed for feasibility: Integrated Global Partner's Pelican Point project in South Australia, AGL's Crib Point in Victoria project and AIE's Port Kembla project in New South Wales. All three projects begin operations in the early 2020s, but it remains to be seen how many will ultimately go ahead.

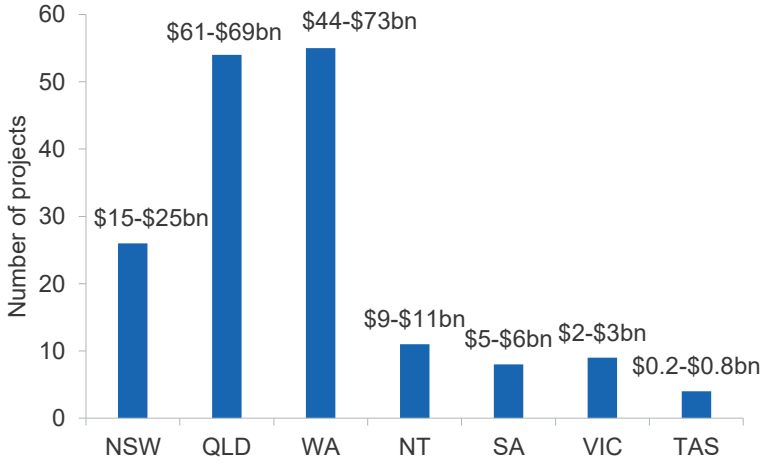
Figure 16.10: Number of projects at the feasibility stage



Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Figure 16.11: Projects at the feasibility stage, by State and Territory



Source: Department of Industry, Innovation and Science (2018)

16.7 Projects at the committed stage

The value of committed projects has fallen away sharply with the completion of several mega projects

The value of projects at the committed stage declined sharply over the twelve months to the end of October 2018, from $122 billion to $30 billion. The past year has seen the substantial completion of the final three projects in Australia's recent wave of LNG investment. These projects had a combined value of roughly $100 billion. They were the Wheatstone project in Western Australia, the Prelude project off the coast of Western Australia, and the Ichthys project in the Northern Territory. The Ichthys project shipped its first LNG cargo in October 2018, and train 2 is expected to come online in the next few months. At the time of writing, the Prelude project was expected to begin operations by the end of 2018.

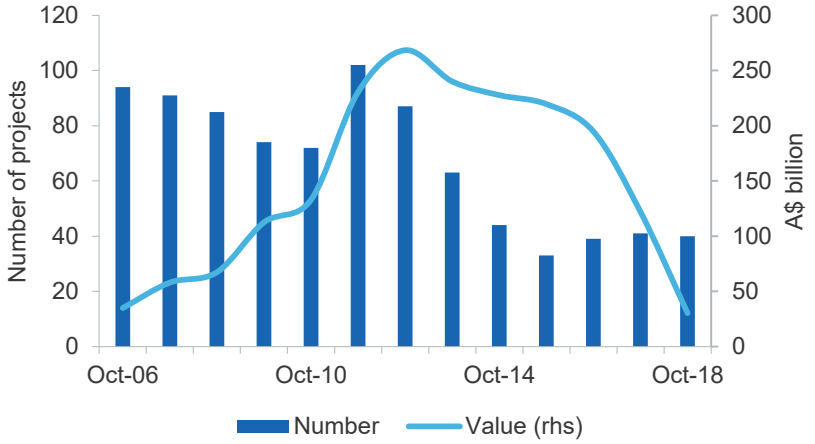
Australia's three largest export commodities — iron ore, coal and LNG — account for almost $22 billion or 72 per cent of investment at the committed stage.

A number of gas, oil, coal, iron ore and lithium projects have taken an FID over the past year, adding around $15 billion to projects at the committed stage. Just over half of the projects to make an FID in the past year were new projects, such as the Eliwana iron ore project in Western Australia developed by Fortescue Metals Group. Other projects in this category were expansions such as the Greater Enfield gas project in Western Australia, being developed as a joint venture by Woodside and Mitsui.

Almost $11 billion of projects reaching an FID in the past year were developing assets in Western Australia, with an additional $3.6 billion of projects reaching the committed stage in Queensland.

For the committed projects for which employment estimates are available, the OCE identified over 13,000 construction jobs and over 5,000 ongoing operating employment opportunities at the committed stage.

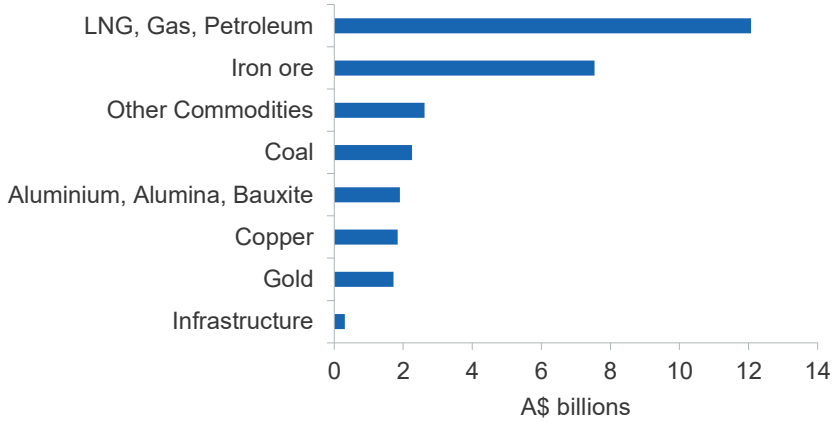
Figure 16.12: Number and Value of committed projects



Note: The Major Projects was formerly a biannual publication released in April and October of each year, but became an annual report in 2016

Source: Department of Industry, Innovation and Science (2018)

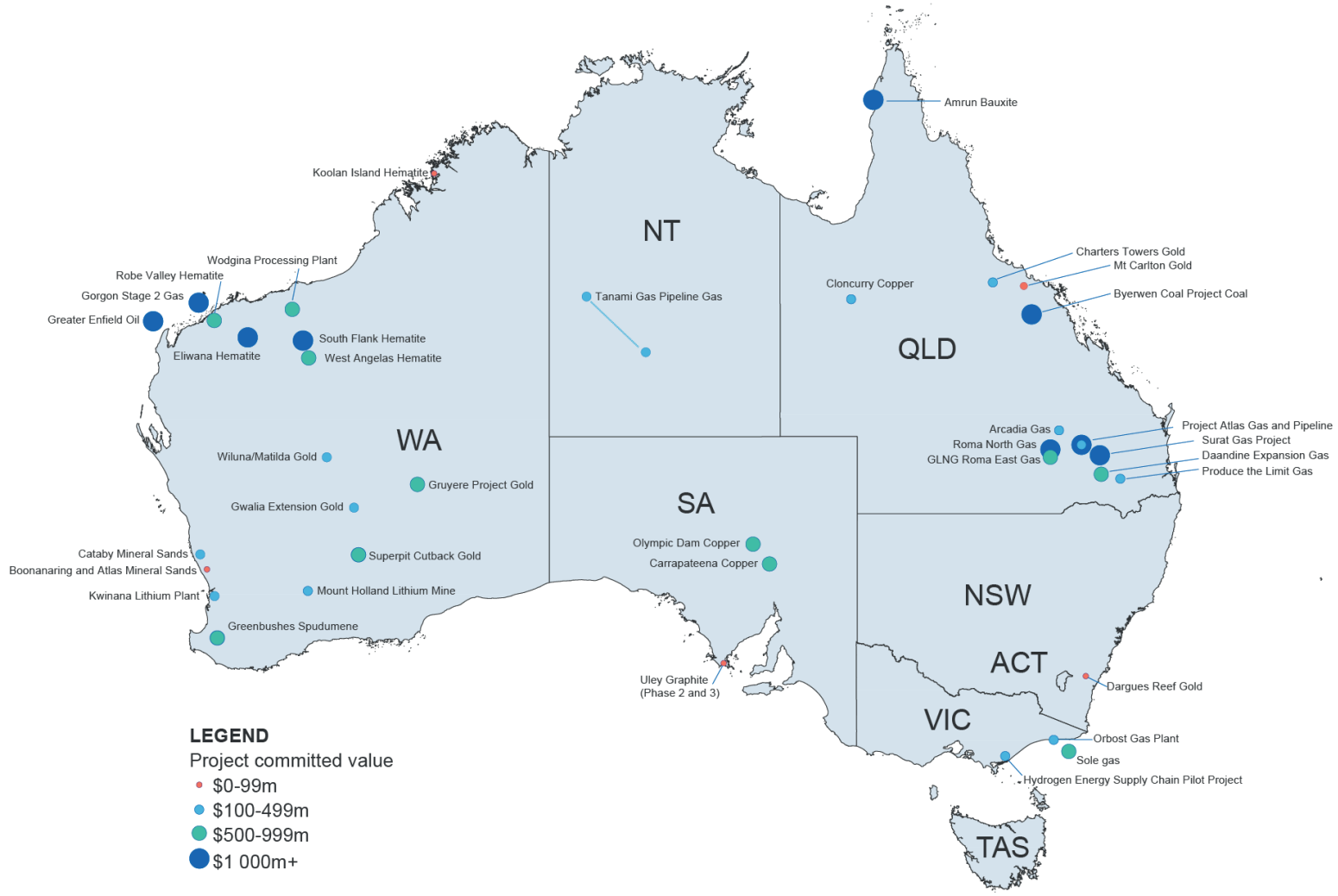
Figure 16.13: Value of committed projects by commodity



Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Image 16.1: Location of projects at the committed stage, as at 31 October 2018



Source: Department of Industry, Innovation and Science (2018) Projects at the committed stage

The value of projects at the completed stage has increased, reflecting the transition of mega LNG projects through the pipeline

The value of projects at the completed stage increased by $22 billion to $106 billion over the 12 months to October 2018, with eighteen projects reaching completion. The increased value of completed projects is largely due to the substantial completion of the last three remaining LNG mega projects — Ichthys, Prelude and Wheatstone — which together represent $100 billion in investment.

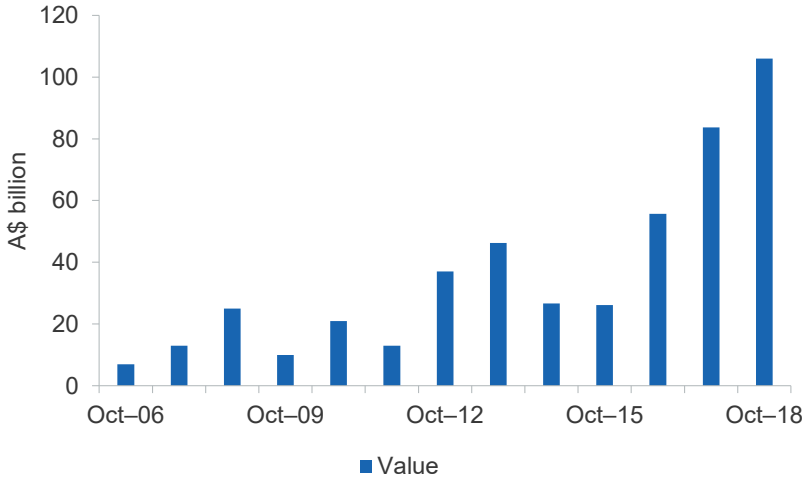
The movement of these three projects to the completed stage was partially offset by the removal of the $60 billion Gorgon LNG project from the Resources and Energy Major Projects list. Together, the six LNG and gas projects completed over the past 12 months represent 98 per cent of total investment reaching the completed stage.

Coal projects remain largely focused on high quality coal. While most coal projects remain in the feasibility stage, Meteor Downs South in Queensland reached completion, and the new Byerwen coal project also in Queensland, achieved first coal in late 2017 and is currently ramping up to full capacity.

Several gold projects reached completion over the past year, including two expansions projects: Newmont's Tanami operations in the Northern Territory and Newcrest's Telfer operation in Western Australia. Along with the new Dalgaranga operations run by Gascoyne Resources and redevelopment of Mt Morgans run by Dacian Gold, both in Western Australia. Together, these four projects have an estimated total capacity of almost 33 tonnes a year.

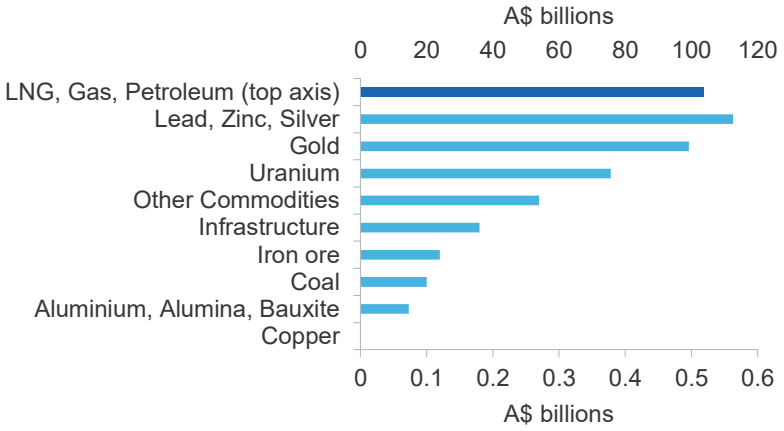
Other completed projects include the expansion of Rio Tinto's West Angelas iron ore project in Western Australia which is expected to replace existing capacity. 2018 also saw the commencement of the new Pilgangoora Lithium project in Western Australia, with an estimated annual capacity of 48 thousand tonnes of lithium carbonate equivalent.

Figure 16.14: Value of completed projects



Source: Department of Industry, Innovation and Science (2018)

Figure 16.15: Value of completed projects by commodity



Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Table 16.4: Summary of projects at the publicly announced stage, as at 31 October 2018

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m
Aluminium, Alumina, Bauxite																
Coal	3	750-1,747+	9	7,750-12,742											12	8,500-14,489+
Copper					1	250-499									1	250-499
Gold							1	0-249							1	0-249
Infrastructure	2	250-748	5	2,250-4,245	3	2,250-3,997	1*	1,500-2,499							11	6,250-11,489
Iron ore					6	5,000-9,744+			3	3,500-6,747					9	8,500-16,491+
Lead, Zinc, Silver	1	0-249													1	0-249
LNG, Gas, Petroleum			2	3,000-4,998	6	14,250-28,246+	1	5,000-5,000+			1	0-249+			10	22,250-38,493+
Nickel					6	3,500-7,494									6	3,500-7,494
Other Commodities	1	0-249			4	1,500-2,996+	1	250-499			1	250-499			7	2,000-4,243+
Uranium			1	500-999											1	500-999
Total	**7**	**1,000-2,993+**	**17**	**13,500-22,984**	**26**	**26,750-52,976+**	**4**	**6,750-8,247+**	**3**	**3,500-6,747**	**2**	**250-748+**			**59**	**51,750-94,695+**

Note: *includes the Northern Gas Pipeline expansion from Tennant Creek in the Northern Territory to Mount Isa in Queensland. Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Table 16.5: Summary of projects at the feasibility stage, as at 31 October 2018

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m
Aluminium, Alumina, Bauxite																
Coal	10	5,265–8,258	38	54,734–61,996+											48	59,999–70,224+
Copper	1	0–249			1	0–249	1	190+	2	333–582+	1	291			6	814–1,561+
Gold	2	848	1	134	7	1,032	1	1,046	1	114					12	3,174
Infrastructure			2	1,500–1,749	1	350			1	600	1	0–249			5	2,450–2,948
Iron ore	1	2,500–4,999			10	12,094–15,889+			2	3,980–4,229+					13	18,574–25,117+
Lead, Zinc, Silver	1	246			1	70									2	316
LNG, Gas, Petroleum	2	2,750–5,249	3	1,300+	5	22,500–46,299+	1	5,000–5,800	1	0–249	3	559–808			15	32,109–59,705+
Nickel	1	100	2	300	5	1,087									8	1,487
Other Commodities	8	3,788–4,535	7	2,452–2,951	22	6,010–7,007	8	3,036–3,535+	1	144	4	1,192	4	263–761	54	16,885–20,125+
Uranium			1	350	3	1,565+									4	1,915+
Total	**26**	**15,497–24,484**	**54**	**60,770–68,750+**	**55**	**44,708–73,548+**	**11**	**9,272–10,571+**	**8**	**5,171–5,918+**	**9**	**2,042–2,540**	**4**	**263–761**	**167**	**137,723–186,572+**

Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Table 16.6: Summary of projects at the committed stage, as at 31 October 2018

	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m
Aluminium, Alumina, Bauxite			1	1,900											1	1,900
Coal			1	1,760							1	496			2	2,256
Copper			1	329					2	1,510					3	1,839
Gold	1	80	2	306	4	1,335									7	1,721
Infrastructure			1	140			1	170							2	310
Iron ore					5	7,543									5	7,543
Lead, Zinc, Silver																
LNG, Gas, Petroleum			7	3,485	2	7,738					2	855			11	12,078
Nickel																
Other Commodities					8	2,566			1	50					9	2,616
Uranium																
Total	**1**	**80**	**13**	**7,920**	**19**	**19,182**	**1**	**170**	**3**	**1,560**	**3**	**1,351**			**40**	**30,263**

Note: Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

Table 16.7: Summary of projects at the completed stage, as at 31 October 2018

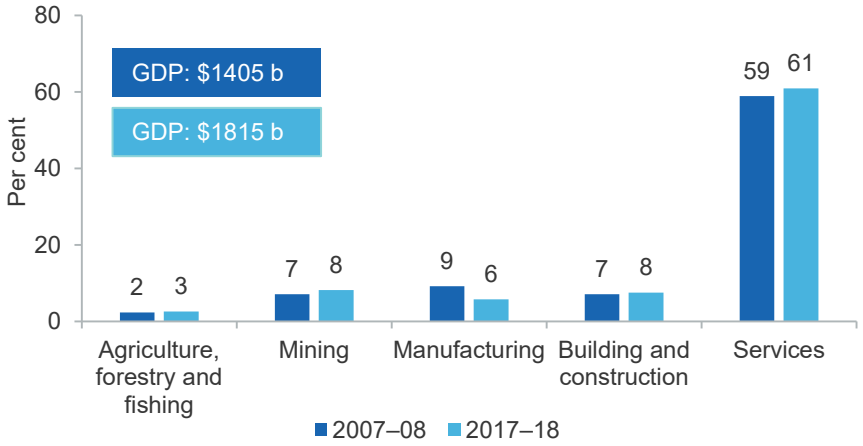
	NSW		Qld		WA		NT		SA		Vic		Tas		Total	
	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m	No. of projects	Value A$m
Aluminium, Alumina, Bauxite			1	73											1	73
Coal			1	100											1	100
Copper																
Gold					3	376	1	120							4	496
Infrastructure							1*	180							1	180
Iron ore					1	120									1	120
Lead, Zinc, Silver									1	563					1	563
LNG, Gas, Petroleum			2	2,000	3	59,223	1	42,566							6	103,789
Nickel																
Other Commodities					2	270									1	378
Uranium					1	378									2	270
Total			**4**	**2,173**	**10**	**60,367**	**3**	**42,866**	**1**	**563**					**18**	**105,969**

Note: *includes the Northern Gas Pipeline from Tennant Creek in the Northern Territory to Mount Isa in Queensland. Infrastructure is limited to resource and energy related infrastructure projects. Other Commodities is limited to resource and energy commodities not elsewhere identified.

Source: Department of Industry, Innovation and Science (2018)

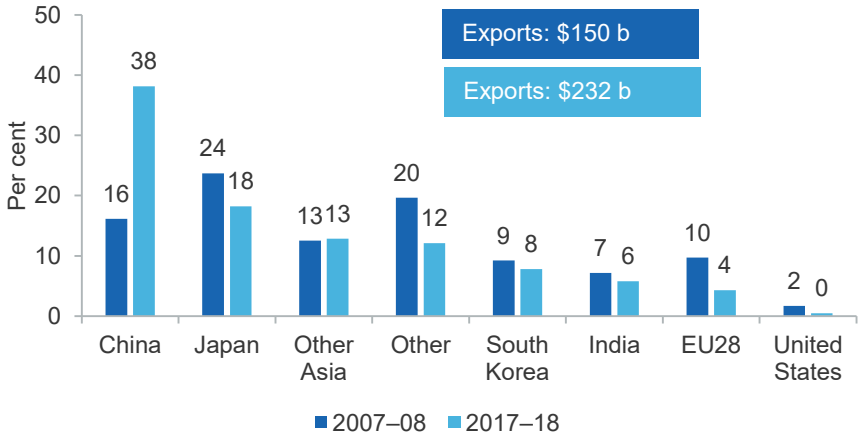
Trade summary charts

Figure 17.1: Contribution to GDP



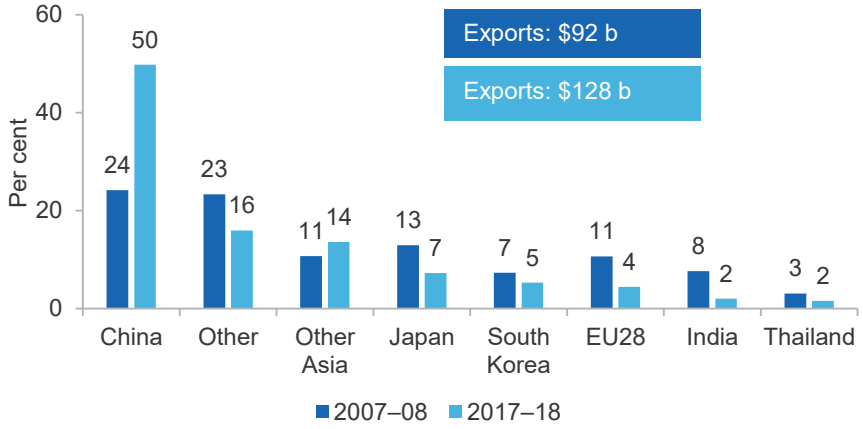
Source: ABS (2018) Australian National Accounts, National Income, Expenditure & Production, 5204.0

Figure 17.2: Principal markets for Australia's resources and energy exports, 2018–19 dollars



Source: ABS (2018) International Trade in Goods and Services, 5368.0

Figure 17.3: Principal markets for Australia's resources exports, 2018–19 dollars

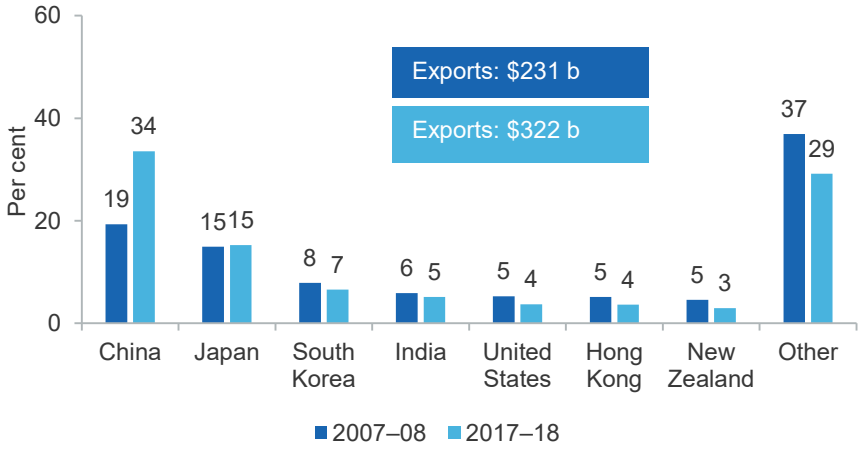


Source: ABS (2018) International Trade in Goods and Services, 5368.0

Figure 17.4: Principal markets for Australia's energy exports, 2018–19 dollars

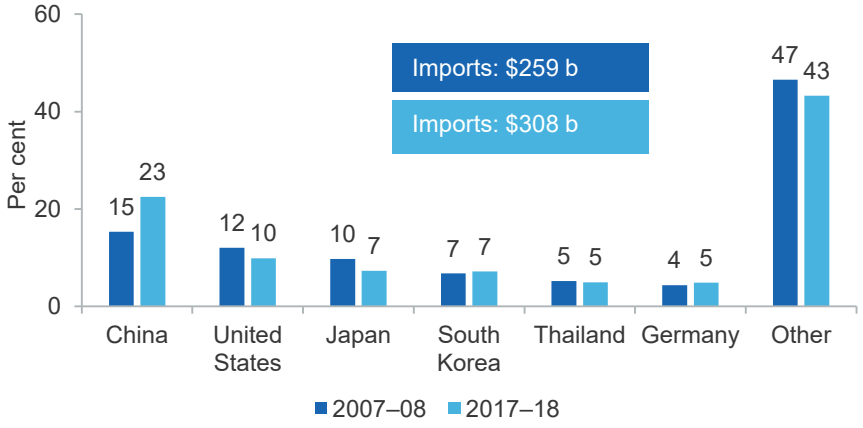
Source: ABS (2018) International Trade in Goods and Services, 5368.0

Figure 17.5: Principal markets for Australia's total exports, 2018–19 dollars



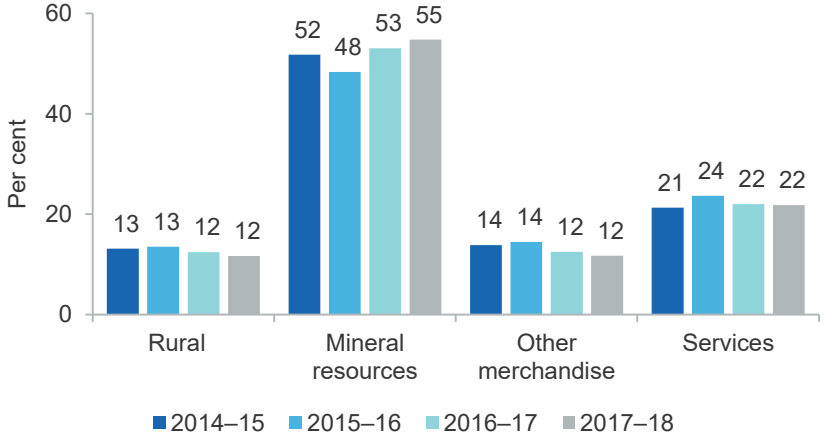
Source: ABS (2018) International Trade in Goods and Services, 5368.0

Figure 17.6: Principal markets for Australia's total imports, 2018–19 dollars



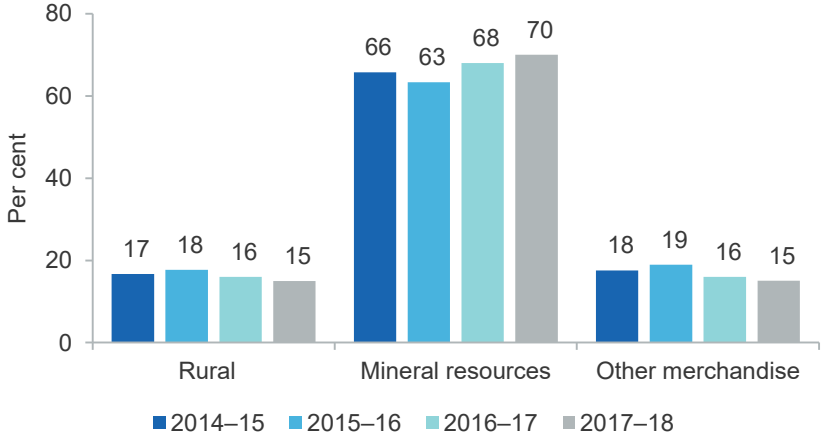
Source: ABS (2018) International Trade in Goods and Services, 5368.0

Figure 17.7: Proportion of goods and services exports by sector



Source: ABS (2018) Balance of Payments and International Investment Position, 5302.0

Figure 17.8: Proportion of merchandise exports by sector



Source: ABS (2018) Balance of Payments and International Investment Position, 5302.0

Table 17.1: Principal markets for Australia's thermal coal exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
Japan	$m	8,388	7,634	7,256	8,587	10,061
China	$m	3,778	2,942	1,837	3,657	4,847
South Korea	$m	3,017	2,870	2,675	2,673	3,040
Taiwan	$m	1,806	1,900	1,671	2,356	2,630
Malaysia	$m	377	628	521	671	764
Thailand	$m	315	293	333	303	379
Total	**$m**	**18,269**	**17,277**	**15,644**	**19,709**	**23,103**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.2: Principal markets for Australia's metallurgical coal exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
India	$m	5,261	5,393	4,891	8,727	9,701
China	$m	6,405	5,133	4,110	7,981	8,569
Japan	$m	6,015	4,961	4,625	7,235	7,431
South Korea	$m	2,688	2,560	2,214	3,847	3,752
Taiwan	$m	1,274	1,226	1,030	1,900	1,978
Netherlands	$m	1,098	895	970	1,967	1,833
Total	**$m**	**25,431**	**23,453**	**20,988**	**36,845**	**38,662**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.3: Principal markets for Australia's crude oil and refinery feedstocks exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
Indonesia	$m	338	36	376	957	1,338
Singapore	$m	2,160	1,955	668	1,056	1,201
Thailand	$m	1,786	1,356	736	587	1,180
South Korea	$m	696	1	476	469	709
China	$m	5	29	748	737	645
Malaysia	$m	321	4	153	445	599
Total	**$m**	**12,155**	**9,307**	**5,774**	**5,710**	**7,122**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.4: Principal markets for Australia's LNG exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
Japan	$m	16,465	15,392	11,169	11,795	14,764
China	$m	697	1,406	3,117	5,948	10,617
South Korea	$m	480	1,022	1,780	2,664	3,757
Singapore	$m	0	152	421	1,491	968
Taiwan	$m	190	43	170	265	708
India	$m	0	0	535	641	533
Total	**$m**	**17,831**	**18,165**	**17,579**	**23,261**	**31,617**

Notes: Department of Industry Innovation and Science estimates by country break-down for all years except 2016–17. Australia's LNG exports by destination except for 2016–17 are estimates based on International Trade Centre data.
Source: ABS (2018) International Trade in Goods and Services, 5368.0; International Trade Centre (2018) International Trade Statistics 2001–2018

Table 17.5: Principal markets for Australia's iron ore exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
China	$m	62,368	45,269	41,124	53,739	51,241
Japan	$m	10,569	7,200	4,966	5,617	5,454
South Korea	$m	6,668	4,351	3,238	4,075	3,684
Taiwan	$m	1,870	1,395	1,083	1,493	1,264
India	$m	45	117	7	5	306
Indonesia	$m	45	30	58	45	45
Total	**$m**	**81,662**	**58,618**	**50,693**	**65,293**	**62,768**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.6: Principal markets for Australia's aluminium exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
Japan	$m	1,219	1,566	739	972	1,406
South Korea	$m	745	826	1,183	772	863
Thailand	$m	332	308	285	320	383
Taiwan	$m	485	525	316	215	335
Indonesia	$m	214	148	100	158	187
China	$m	254	54	99	53	34
Total	**$m**	**3,908**	**4,181**	**3,485**	**3,302**	**4,107**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.7: Principal markets for Australia's copper exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
China	$m	4,307	3,920	3,804	2,813	3,850
Japan	$m	1,776	2,139	1,514	1,414	1,569
Malaysia	$m	668	566	654	896	890
India	$m	1,033	864	544	712	872
South Korea	$m	639	393	520	465	297
Philippines	$m	312	270	233	414	171
Total	**$m**	**9,522**	**9,105**	**8,601**	**7,892**	**8,666**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Table 17.8: Principal markets for Australia's gold exports, 2018–19 dollars

	Unit	2013–14	2014–15	2015–16	2016–17	2017–18
Hong Kong	$m	165	204	2,677	10,022	8,227
United Kingdom	$m	700	627	4,177	4,080	3,344
China	$m	8,841	7,477	6,943	2,418	3,006
Singapore	$m	2,486	3,348	1,268	315	1,184
Thailand	$m	486	965	269	555	1,169
Switzerland	$m	377	16	92	235	799
Total	**$m**	**14,228**	**14,029**	**16,637**	**18,783**	**19,323**

Source: ABS (2018) International Trade in Goods and Services, 5368.0

Appendix

Appendix A
Definitions and classifications

A.1 Exchange rates

In this report, the AUD/USD exchange rate (Australian dollar relative to the US dollars) is based on the median of economic forecasters at the time that the report is prepared. The source is the Bloomberg survey of economic forecasters.

World commodity prices are typically denominated in US dollars, and exchange rate movements can have a significant effect on the actual outcomes of commodity prices and export earnings. A change in the value of the US dollar against other floating international currencies can influence movements in world resources and energy prices. A change in the Australian dollar against the US dollar will impact on export earnings for domestic commodity exporters and producers. There is substantial uncertainty surrounding any exchange rate forecast, with changes to exchange rates influenced by changes in financial market sentiment, sometimes resulting in strong volatility.

A.2 Conversion to real dollars

Nominal values and prices are converted to real dollars using on the Australian and US consumer price indexes (CPI). The Australian and US CPI forecasts are based on the median of economic forecasters at the time that the report was prepared. The source is the Bloomberg survey of economic forecasters.

A.3 Time horizons

It is important to distinguish between different time horizons, as factors affecting production, consumption and prices in the short-term differ from factors affecting these components in the medium to long-term. Forecasts also become increasingly imprecise over longer time horizons, due to increased risk and uncertainty. For these reasons, the OCE uses different terminology to distinguish between short-term forecasts and medium to long-term projections, as outlined in *Table A2*.

Table A1: OCE terminology for time horizons

Outlook period	Years	Terminology
Current period	Current (Incomplete data or subject to revision)	Estimate
Short-term	1 to 2 years	Forecast
Medium-term	3 to 5 years	Projection

Source: Department of Industry, Innovation and Science (2018)

A.4 Commodity classifications

The Office of the Chief Economist (OCE) defines exports for each commodity by a selected set of 8-digit Australian Harmonised Export Commodity Classification (AHECC) codes. Where possible, the choice of AHECC codes is based on alignment with international trade data, to ensure that direct comparisons can be made. For example, groupings for various commodities are aligned with classifications used by the International Energy Agency, World Steel Association, International Nickel Study Group, International Lead and Zinc Study Group, International Copper Study Group and World Bureau of Metal Statistics.

In this report, benchmark prices and Australian production and exports are forecast for 21 commodities, as shown in *Table A3*. In estimating a total for Australia's resources and energy exports, the remaining commodities, defined as 'other resources' and 'other energy', are forecast as a group.

Table A2: Resources and energy commodities groupings and definitions

	Resources (non-energy)	Energy
Definition	Resource commodities are non-energy minerals and semi-manufactured products produced from non-energy minerals	Energy commodities are minerals and petroleum products that are typically used for power generation
Australian Harmonised Export Commodity Classification (AHECC) chapters	25 (part); 26 (part); 28 (part); 31 (part); 73 (part); 74; 75; 76; 78; 79; 80; 81	27 (part)
Commodities for which data is published, forecasts are made and analysed in detail in this report	Aluminium; alumina; bauxite; copper; gold; iron ore; crude steel; nickel; zinc, lithium	Crude oil and petroleum products; LNG; metallurgical coal; thermal coal; uranium

Notes: The AHECC chapter is the first two digits of the trade code. Groupings are made at the 8-digit level.

Source: Department of Industry, Innovation and Science (2018)

Appendix B
Glossary

Term	Description
AISC	All-In Sustaining Cost — an extension of existing cash cost metrics and incorporates costs related to sustaining production.
Benchmark	A standard specification used to price commodities.
Blast furnace and basic oxygen furnace	Used in an integrated steelmaking process that uses iron ore and coal.
CFR	Cost and freight — Seller clears exports, and pays freight.
Coke	Made by heating coal at high temperatures without oxygen, and used to reduce iron ore to molten iron saturated with carbon, called hot metal
CPI	Consumer Price Index — measures quarterly changes in the price of a basket of goods and services which account for a high proportion of expenditure by the CPI population group (i.e. metropolitan households).
Crude steel	Steel in the first solid state after melting, suitable for further processing or for sale.
DES	Delivered Ex Ship — price of LNG including shipping and insurance.
Economic growth	An increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It is measured in nominal or real gross domestic product (GDP).
Electric arc furnace	A furnace that melts steel scrap using the heat generated by a high power electric arc.
ETF	Exchange Traded Fund — an exchange traded fund that allows investors to invest in gold on the exchange.
FOB	Free on board — seller clears export, buyer pays freight.
GAD	Gross air dried basis — For measuring coal quality.
GAR	Gross as received basis — For measuring coal quality.
GDP	Gross Domestic Product — measures the value of economic activity within a country/group.

GFC	Global Financial Crisis — the period of extreme stress in global financial markets and banking systems between mid-2007 and early 2009.
GST	Goods and Services Tax — a value-added tax levied on most goods and services sold for domestic consumption.
HCC	Hard coking coal — The best grade of metallurgical coal used in the steel production process. Australian hard coking coal is regarded as the industry benchmark.
IEA	International Energy Agency
IMF	International Monetary Fund — an international organisation that promotes international financial stability and monetary cooperation.
ISM	US Institute for Supply Management
IP	Industrial Production — measures the output of the industrial sector that comprises mining, manufacturing, utilities and construction.
JCC	Japan Customs-cleared Crude (or Japan Crude Cocktail) — average price of crude oil imported by Japan and a common price index in long-term LNG contracts.
LBMA	London Bullion Market Association
LNG	Liquefied natural gas
LME	London Metal Exchange
LPG	Liquefied petroleum gas
NAR	Net as received basis — For measuring coal quality.
NEV	New energy vehicle — term used for plug-in electric vehicles eligible for public subsidies (battery electric vehicles and plug-in hybrid vehicles)
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of the Petroleum Exporting Countries
OPEC+	Informal reference for OPEC agreements that include an additional 10 countries beyond traditional OPEC members, including Russia and Mexico.
PCE	Personal Consumption Expenditure — a measure of the changes in price of consumer services and goods.

PCI	Pulverised coal injection — PCI coal is used for its heat value and injected directly into blast furnaces as a supplementary fuel, which reduces the amount of coke required.
PMI	Purchasing Managers Index — an indicator of economic health for manufacturing and service sectors.
SHFE	Shanghai Futures Exchange
SSCC	Semi-soft coking coal — A type of metallurgical coal used in the steel production process alongside hard coking coal, but results in a lower coke quality and more impurities.
Tariff	A tax on imports or exports that is used by governments to generate revenue or to protect domestic industries from competition.
TWI	Trade Weighted Index — a measure of the foreign exchange value of the US dollar against a basket of major foreign currencies.
WEO	The International Energy Agency's World Energy Outlook
WTI	West Texas Intermediate crude oil price

Appendix C Contact details

Chapter/s	Author	Email
Overview	David Thurtell	david.thurtell@industry.gov.au
Steel and iron ore	Joseph Moloney	joseph.moloney@industry.gov.au
Metallurgical and thermal coal	Monica Philalay	monica.philalay@industry.gov.au
Gas	Nikolai Drahos	nikolai.drahos@industry.gov.au
Oil	Kate Martin	kate.martin@industry.gov.au
Gold, Macroeconomics	Thuong Nguyen	thuong.nguyen@industry.gov.au
Aluminium, alumina and bauxite, zinc	Andrea Bath	andrea.bath@industry.gov.au
Uranium, Copper, Nickel, Lithium	Mark Gibbons	mark.gibbons@industry.gov.au
Major projects	Joseph Moloney	joseph.moloney@industry.gov.au