Resources and Energy Quarterly
March 2018
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Foreword

Commodity prices rallied two years ago and to the surprise of many forecasters, including ourselves, they are yet to unwind a substantial part of these gains. Higher iron ore and coal prices and rapidly growing LNG export volumes have bolstered Australia’s resources and energy export earnings. In 2017–18, we are forecasting the value of Australia’s resource and energy exports to reach its highest level on record, $230 billion, in both real and nominal terms.

Beyond the short term, our view remains largely unchanged. In the annual update of our five year forecasts, we project export earnings to decline slightly from current levels, before levelling out at about $212 billion to $216 billion from 2019–20 onwards. In total, the next five years will deliver more than $1 trillion in resources and energy export income.

This compares with average annual export earnings of $72 billion in the decade prior to the onset of the resources boom, validating our long-held view that the mining boom would continue to reap dividends long after the price peak in 2011.

Over the next few years, the prices of some of Australia’s large resource and energy exports are expected to decline. Prices for both iron ore and metallurgical coal — Australia’s two largest resource and energy exports — are expected to be weighed down by increasing supply and declining steel production in China. The price of Australian LNG, set by the oil price, is expected to increase modestly, constrained by price-sensitive shale oil production in the United States and sluggish growth in world oil consumption.

Meanwhile, the ramp up in export volumes — driven by the mining investment boom — is expected to have run its course by the turn of the decade. The last of Australia’s LNG projects is scheduled for completion by the end of the year, while growth in iron ore export volumes will slow from 2018–19. The story is similar for other key resource and energy export commodities including coal, gold and several base metals. In this sense, 2020 will mark the end of the remarkable growth phase of the Australian resources and energy sector.

The Resources and Energy Quarterly has recently undergone a review, resulting in changes in this edition and future editions. We are grateful for the time and input received from stakeholders as part of this process.

Mark Cully
Chief Economist
Department of Industry, Innovation and Science

Resources and Energy Quarterly March 2018
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 March edition of the Resources and Energy Quarterly features a ‘medium term’ (five year) outlook for Australia’s major resource and energy commodity exports. The June, September and December quarter editions of the Resources and Energy Quarterly contain a ‘short term’ (two year) outlook. This March quarter edition extends the Office of the Chief Economist’s outlook out to 2022–23.

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 dollar figures in this report are in real 2017–18 dollar terms. All US dollar figures are in real 2018 dollar terms. Inflation and exchange rate assumptions are provided in the Appendix.

Table 1: Resources and Energy Quarterly publication schedule

<table>
<thead>
<tr>
<th>Publication</th>
<th>Expected release date</th>
<th>Outlook period</th>
<th>Special focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2018</td>
<td>9 April 2018</td>
<td>Australian data: 2022–23</td>
<td>Medium term outlook</td>
</tr>
<tr>
<td></td>
<td></td>
<td>World data: 2023</td>
<td></td>
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<tr>
<td>June 2018</td>
<td>2 July 2018</td>
<td>Australian data: 2019–20</td>
<td>Australian east coast gas market</td>
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<tr>
<td></td>
<td></td>
<td>World data: 2020</td>
<td></td>
</tr>
<tr>
<td>September 2018</td>
<td>2 October 2018</td>
<td>Australian data: 2019–20</td>
<td>Resources and energy commodities demand in the ASEAN region</td>
</tr>
<tr>
<td></td>
<td></td>
<td>World data: 2020</td>
<td></td>
</tr>
<tr>
<td>December 2018</td>
<td>7 January 2019</td>
<td>Australian data: 2020–21</td>
<td>Resources and Energy Major Projects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>World data: 2021</td>
<td></td>
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Source: Department of Industry, Innovation and Science (2018)
Overview

Resources and Energy Quarterly March 2018

- 2.6%: Australia's GDP growth in the December quarter of 2017
- 7%: 53% of Australia's GDP in 2016-17
- 68%: Australia's goods and services exports in 2016-17
- 226,500: people employed (as at February 2018)

Australia's resources and energy exports, A$ billions, 2017-18 dollars

- Iron ore: $55b - $39b - $34b - $23b - $17b - $15b
- Met Coal: $34b - $34b - $17b
- Other: $34b - $23b
- LNG: $34b - $23b
- Thermal coal: $34b - $23b
- Base metals: $34b - $23b
- Gold: $34b - $23b

Major markets for Australia's resources and energy exports, 2016-17 ($billion)

- EU28: 11
- India: 11
- South Korea: 16
- Japan: 36
- China: 78
The Australian mining boom: a tale of three phases

1. Price phase
2. Investment phase
3. Production phase

Index

A$ billions (committed projects)

Year
1.1 Summary

- Australia’s resources and energy export earnings are forecast to reach record highs in 2017–18, increasing by $21 billion to $230 billion.
- The drivers of this increase in export earnings are broad-based. LNG is expected to be the largest contributor to the growth in export earnings, followed by metallurgical coal and thermal coal. Iron ore, oil and a number of base metals will also make a significant contribution.
- Commodity prices are projected to decline from 2018-19, with falls in iron ore and metallurgical coal prices having the largest impact on projected real export earnings. Australia’s resources and energy export earnings are projected to level out at $213-216 billion from 2019–20 onwards.
- While commodity prices are expected to drift lower, the outlook is not homogenous. Commodities are at different stages of the commodity price cycle. Price rises are projected for some of Australia’s major resources and energy exports, and price falls for others.
- The production phase of the mining boom has been defined by rapid growth in production and export volumes — a legacy which should last for decades to come. By the turn of this decade, however, the ramp up in Australia’s exports is expected to have largely run its course, marking the end of an extraordinary era for our resources and energy sector.

1.2 Prices

Commodity prices are stabilising

Commodity prices appear to be settling into a more stable pattern after the massive volatility of the past fifteen years. The prices of virtually all resource and energy commodities were on a sharp upward trend during the price phase of the commodity boom, which reached its peak in 2011. By 2015, prices were falling across the board, as waves of new supply entered the market. However, by the end of 2016, these downward price movements seemed to have ceased, with prices lifting for many commodities.

Table 1.1: Annual changes in benchmark commodity prices (per cent)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>2011</th>
<th>2015</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>10.4</td>
<td>-10.9</td>
<td>21.3</td>
</tr>
<tr>
<td>Metallurgical coal</td>
<td>9.7</td>
<td>-22.7</td>
<td>28.8</td>
</tr>
<tr>
<td>Thermal coal</td>
<td>23.1</td>
<td>-17.2</td>
<td>31.7</td>
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<tr>
<td>Gold</td>
<td>27.4</td>
<td>-8.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Iron ore</td>
<td>18.8</td>
<td>-43.4</td>
<td>21.6</td>
</tr>
<tr>
<td>LNG</td>
<td>18</td>
<td>-41.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Oil</td>
<td>39.2</td>
<td>-47.1</td>
<td>21.5</td>
</tr>
<tr>
<td>Copper</td>
<td>17.5</td>
<td>-19.8</td>
<td>26.4</td>
</tr>
<tr>
<td>Lead</td>
<td>11.8</td>
<td>-14.7</td>
<td>22.1</td>
</tr>
<tr>
<td>Zinc</td>
<td>1.5</td>
<td>-10.6</td>
<td>35.4</td>
</tr>
<tr>
<td>Silver</td>
<td>74.2</td>
<td>-17.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Nickel</td>
<td>5.0</td>
<td>-29.9</td>
<td>5.7</td>
</tr>
</tbody>
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Source: LME; LBMA; The Ux Consulting Company; US Department of Energy; Metal Bulletin; Japan Ministry of Economy, Trade and Industry; Bloomberg.

Prices responding to structural and cyclical factors

The past two years have witnessed an unexpected price rebound across most commodities, including iron ore, thermal coal, met coal, LNG, oil, zinc, and nickel.

Some commodity price spikes were a result of cyclical or temporary factors. Steel production in China (and hence the demand for iron ore and metallurgical coal) was boosted by stimulatory government spending and supply-side reforms. Metallurgical coal production was cut back in China and temporarily hampered by weather disruptions, including Cyclone Debbie which blocked coal exports from Queensland. Thermal coal production was affected by Chinese cut backs and South-Asian monsoonal rains which also disrupted thermal coal cargoes out of Indonesia. Metallurgical and thermal coal prices have surged as a result,
though the fundamentals for thermal coal remain tilted towards lower prices, due to a flattening of demand in key markets such as China.

The iron ore price is also expected to moderate, to better reflect the fundamentals of growing low-cost supply from Brazil and moderating demand in China. Likewise, oil prices have increased significantly recently, though the market’s move appears somewhat disconnected to the fundamentals, including rapid growth in supply from the US.

Yet it is increasingly clear that, in some cases, rising commodity prices have been driven by strong market fundamentals. Copper prices, which fell in earlier years, have started rising again as a result of growing global industrial production. Stronger industrial production growth is also exerting upward pressure on prices for zinc and nickel, which both faced increasing supply shortfalls during 2017.

These commodities appear to be entering a new investment cycle, driven by supply shortages and higher prices, and exploration and investment have grown dramatically over the past two quarters.

Some commodity exceptions to lower projected price trends

The outlook for commodity prices is more diverse than it has been for some time. Where previous years have seen strong trends for prices rising or falling across the board, 2018 is likely to see a mix of price outlooks emerging across different commodities. Commodities are shifting towards different stages of their investment cycles, creating a more complex outlook.

On balance, it is expected that prices will trend down to 2018–19 and then stabilise in coming years. However, the picture varies at the commodity level. Thermal coal prices are expected to reverse some of their recent gains, as growing supply from Australia and Russia offset the development of new coal-fired power plants across South Asia. Oil prices are also expected to flatten out, constrained by growing shale oil output and rising OPEC production.

There is a significant diversity of outlooks among the metals. Iron ore prices are projected to ease in the short term, as China reduces steel output. However, prices for other metals including copper, zinc and nickel will face upward pressure over the outlook period as global industrial production continues to rise. Aluminium is expected to see strong price over the next five years, though this is largely driven by lower output from China, which is responding to pollution concerns.

The downward trend in prices that occurred in the 2012–2015 period is expected to resume again in 2018, though with a smaller rate of decline over a shorter time period. Prices are expected to stabilise in the longer term, as the mismatches in supply and demand that have characterised the last 15 years gradually even out, and remain well above levels in the years before 2005.

**Figure 1.2: Resources and energy export prices**

Notes: Prices are a Fisher Price Index, based on Australia’s export values and volumes
1.3 Consumption (resource commodities)

Economic growth and urban population growth drive demand for resource commodities

Economic growth and urban population growth will continue to drive the demand for resources. The IMF is projecting global GDP growth of just under 4 per cent each year out to 2023. Much of this growth will occur in the rapidly industrialising Asia region, creating demand for industrial materials including steel, cement, coal, zinc, nickel, and copper.

Commodity demand is also growing due to healthy growth in global industrial production, which is now rising at around 3.3 per cent per year — well above its long-term trend.

Although global growth in industrial production remains healthy overall, a rising numbers of countries (notably in Africa and the Middle East) are managing to modernise and urbanise without rapid industrialisation. These countries are instead relying on commodity revenue to modernise their economies, and are likely to have lower commodity import needs (and higher commodity exports) than is typical for most developing countries.

China remains the largest growth source for both urbanisation and industrialisation. Yet the rate of population growth in China is set to slow substantially. Between 2015 and 2020, China’s urban population is projected to grow by 19 million persons a year, and in the 5 years following, by 15 million a year. Slowing urban population growth in China will underpin a decline in world urban population growth between 2020 and 2025.

Nevertheless, this will be partially offset by rapidly urbanising populations in other parts of the world. In India, the other ‘population superpower’, urban population is projected to grow by 11 million persons a year. Other regions with notable urban population growth in the medium-term include South East Asia (7 million persons a year), Africa (20 million persons a year) and ‘Other Asia’ (11 million persons a year).

Income growth is also supporting investment in new technology and related consumer items. It is very likely that some countries will skip over much of the traditional large-scale telecommunications and consumer infrastructure in favour of mobile communications and smaller wireless consumer items. It is also likely that emerging countries will, to some extent, reduce traditional centralised power grid construction in favour of distributed renewable energy generation and storage. Both of these trends suggest significant opportunities for commodities such as critical minerals: copper, lithium, nickel, and rare earths.

Figure 1.3: World urban population, annual growth

Notes: Other Asia includes the Middle East, Southern Asia and Central Asia, and excludes China, India and South East Asia.

Slowing construction in China to weigh on demand

China’s construction sector is one of the largest sources of demand for steel (and thus its raw materials, iron ore and metallurgical coal) and base metals. Rapid urbanisation and stimulatory government policies have supported growth in residential construction and infrastructure investment. The effects of these drivers are expected to wane during the outlook period, weighing on commodities consumption.
A slowdown in residential construction due to slowing urban population growth and government policies to cool the property market. Growth in fixed asset investment (FAI) in real estate has already moderated, growing by a subdued 3.3 per cent in 2017. This reflects how government policies can cool the property market — through policies like purchasing restrictions, capped price on new properties and increased down payment requirements.

In 2017, growth in infrastructure FAI accelerated to 18 per cent, as the government relied on infrastructure to drive economic growth. The pipeline of infrastructure projects is expected to thin, as the government increasingly shifts its focus away from investment-driven GDP growth towards consumption.

Environmental policy and supply-side reform in China
After a short pause from more than a decade of surging imports of resource and energy commodities to meet its urbanisation and industrialisation needs, China is once again driving renewed strength in resource commodity imports. The surge is coming as it restructures its resource commodity production and enforces stricter environmental policies. Loss-making coal and metal mining/smelting/refining operations (particularly in aluminium and steel/iron ore) are being cut or winter production curtailed, creating a need for increased imports. Moreover, imports are typically higher grade thermal coal and iron ore, which Australia has high deposits of.

1.4 Consumption (energy commodities)
Overall energy demand to rise
Global energy demand is expected to increase at an average annual rate of around 1 per cent over the outlook period. Emerging economies will make the largest contributions to growth in global energy demand. Industrialisation and urbanisation require increasing energy consumption in buildings, transport, and industry sectors. Energy demand is expected to remain largely unchanged in North America and decline in Europe, with energy efficiency increasing over the outlook period.

The energy mix is changing
Renewables, including hydro and bioenergy, are expected to make the largest contribution to meeting increases in global energy demand over the outlook period, as countries make progress towards their Nationally Determined Contributions (NDCs) made under the Paris Agreement. In some cases, NDCs have been strengthened or unwound by more recent announcements, such as the US Administration’s decision to withdraw from the Paris Agreement.

Gas is expected to record the strongest growth of the fossil fuels, assisted by low prices, growing supply and its role in reducing air pollution and carbon emissions. The industrial sector will be the main driver of demand growth, supported by higher use of gas in the chemical sector and increasing gas use in place of coal in smaller industrial applications. Gas use in power generation — the largest gas consuming sector — is also expected to rise, but demand growth will be constrained due to competition from renewables and coal.

Oil consumption is projected to grow over the next 5 years, supported by healthy economic conditions and driven almost entirely by non-OECD nations, primarily in developing Asia. However, consumption growth is expected to be relatively slow, due to gains in vehicle fuel efficiencies and the ongoing shift in China’s economy away from oil-intensive, heavy manufacturing.

Coal is projected to remain a major component of the global energy mix, but demand growth over the outlook period is limited. Thermal coal consumption is projected to increase in India, South East Asia and other parts of developing Asia increases, but stagnate or decline elsewhere. The outlook for metallurgical coal consumption is similarly subdued. However, the downside risks to the metallurgical coal outlook are less pronounced than for thermal coal (which face competition from other energy sources), given the lack of substitutes for coking coal in most steel making production.
1.5 Production

Short-term capacity is rising

The wave of investment triggered by the commodity price boom still has some way to run in several commodity markets. Production capacity is expected to expand rapidly in global LNG markets in 2018 and 2019, primarily in the United States, Russia and Australia. New low-cost iron ore capacity will come online in Brazil over the same period, as will several large new copper mines in Peru and Kazakhstan.

Other commodity markets have already experienced a period of rapid supply growth, which contributed to downward pressure on prices and production cutbacks, eventually resulting in a price recovery. Oil markets are one example. The shale oil revolution in the US saw oil prices reach as low as US$30 a barrel, leading OPEC and Russia to put in place a production agreement in November 2016 to support prices, which has been extended until the end of 2018.

Coal prices reached very low levels in 2016, and China’s response was to close loss-making domestic operations and to limit the number of days for which profitable coal mines could operate. Coal prices rebounded and the Chinese Government has subsequently loosened supply-side restrictions.

The build-up of excess production capacity in aluminium and alumina markets, particularly in China, led to a huge build-up of stocks, contributing to a rapid decline in aluminium prices in 2015 and early 2016. The Chinese Government’s subsequent efforts to curb excess capacity has reduced global aluminium and alumina production and contributed to the recent price recovery.

Resource deposit quality is declining

Declining resource quality is a key supply-side trend, especially in a number of metals markets, including copper, iron ore and nickel. Declining ore grades lead to higher production costs (and therefore, prices) and increase the capital investment required over project lifetimes.

For example, in Chile and Peru — the world’s largest copper producers — resource grades have declined at a faster rate than the global average, by 2.6 per cent and 3.2 per cent a year since 2005. This trend is expected to continue, as most projects under development are to utilise low grade ores. Australia’s mined copper has a relatively high ore grade.

Technology to change operations and unlock new resources

Future production dynamics will depend on producers’ abilities to increase operational efficiencies and utilise new technologies. Australia has been a focus of mining innovation and at the forefront of technological change, particularly in the areas of automation and value-chain integration. Producers in Australia have made significant investment in research and development (R&D); in 2015–16 mining business expenditure on R&D was around $1.9 billion.

Over the outlook period, continued investment in the mining equipment, technology and services (METS) sector will play a crucial role in advancing industry development in a rapidly changing world. Future growth will come from increased use of data and analytics, advanced extraction techniques and the commercialisation of specialist technologies, including automation. The emergence of the US shale oil and Canadian tar sands industry demonstrated how quickly disruptive technology can permeate markets. New laterite technologies used in nickel processing, including rotary kiln-electric furnace (RKEF) processing, have significantly improved nickel recovery rates, producing more product for sale.

The LNG industry may increasingly turn to Floating Liquefied Natural Gas (FLNG) technology to develop smaller offshore gas resources.
1.6 Australia

Australia’s export earnings continue to recover

After two years of decline, the value of Australia’s resources and energy exports increased sharply in 2016–17, climbing by over $40 billion to $208 billion. The increase was driven by the recovery in commodity prices, particularly iron ore and metallurgical coal, combined with the continued build in export volumes, most notably in LNG.

Export earnings to reach record highs in 2017–18

Australia’s resources and energy export earnings are forecast to reach $230 billion in 2017–18 — the highest level on record, driven primarily by a rise in the value of Australia’s energy commodity exports (Figure 1.4).

Figure 1.4: Australia’s resource and energy export earnings

![Chart showing Australia’s resource and energy export earnings from 2012-13 to 2022-23]

LNG is expected to make the largest contribution to growth in overall export earnings in 2017–18, driven by both higher export volumes and higher prices.

Thermal and metallurgical coal will also make major contributions to growth in export earnings. Coal prices have rallied over the past few quarters, with Chinese output and capacity cuts and weather events in Australia and the US restricting metallurgical coal production, and thermal coal prices kept high by strong demand and Chinese production cutbacks.

Also propelling the value of Australia’s resources and energy exports higher in 2017–18 will be iron ore’s continued price strength (coupled with growing export volumes). The recovery in oil prices, the ramp up in condensate exports from new LNG projects, as well as a mini-rally in base metals prices will also increase export values.

Export earnings to fall but remain at high levels

The value of Australia’s resource and energy exports is projected to decline in 2018–19 and 2019–20, falling back to $216 billion. The main driver is expected to be a decline in the iron price, as new low-cost supply enters the market and demand growth moderates — a result of declining steel production in China. The forecast fall in both metallurgical and thermal coal prices from recent highs will also weigh on export earnings.

Demand growth is expected to slow for coal, and low-cost supply will return to metallurgical coal markets after numerous disruptions.

Price declines in iron ore and coal will be partly offset by growing LNG exports. The remaining three Australian LNG projects under construction are scheduled to be completed by the end of 2018, potentially making Australia the largest LNG exporter in the world in 2019.

Export earnings to plateau after 2019–20

From 2019–20, the real value of Australia’s resource and energy export earnings is projected to stabilise. Iron ore prices are projected to bottom out at US$49 a tonne (FOB Australia) in 2020, and modestly increase to US$53 a tonne in 2023 as supply growth slows. Further gains in oil prices (which drive LNG prices) are expected to be contained by price-responsive shale oil production in the US and sluggish consumption growth.
Growth in export volumes is also projected to plateau from 2019–20, (Figure 1.5). Projects commissioned during the investment phase of the mining boom are expected to reach full output around this time and few new projects will start operations. The remaining LNG projects under construction are scheduled to be completed by end 2018, and only one brownfield expansion is currently expected in the next five years.

The ramp up in iron ore export volumes will likely slow after 2018–19, with efficiency improvements and the commissioning of smaller projects just offsetting mine closures. Growth in coal exports is expected to be contained by modest gains in global consumption, although Australian miners will benefit from their position as suppliers of a high quality product.

**Figure 1.5: Growth in Australia’s resources and energy export values, contributions from prices and volumes**

![Graph showing growth in Australia's resources and energy export values, contributions from prices and volumes](image)


Similarly, Australia’s exports of a number of base metals — copper, bauxite and zinc — are expected to increase over the next few years, but then remain broadly unchanged in the early 2020s. Gold exports are expected to decline in the 2020s as a number of mines reach life end.

The production phase of the mining boom has been defined by rapid growth in output and export volumes — the legacy of which will last for decades. However, with growth in export volumes expected to taper off by the end of this decade, 2019 might be considered the last year of the production phase of Australia’s largest ever mining boom.

**Mining continues to support economic growth**

Australia’s Gross Domestic Product (GDP) grew by 0.4 per cent in the December quarter of 2017, with the mining industry accounting for 2.6 per cent of GDP growth. Mining industry value added grew by 1.0 per cent year-on-year, driven by growing resources and energy export volumes.

Mining has recently been an important contributor to economic growth, directly accounting for 12 per cent of Australia’s GDP growth in the last five years. However, as growth in export volumes associated with the production phase of the mining boom tapers off after 2019, mining’s contribution to GDP growth is projected to moderate (Figure 1.6).

**Figure 1.6: Australia’s nominal GDP and resources and energy export earnings, year-on-year-change**

![Graph showing Australia's nominal GDP and resources and energy export earnings, year-on-year-change](image)

Mining industry investment expected to weaken

Investment in Australia’s mining industry declined by 8.4 per cent year-on-year in the December quarter of 2017. Despite their recent gains, commodity prices remain well below levels that spurred high levels of investment in the period from 2009 to 2012. Mining companies are likely to exercise more caution and focus on paying down debts. This is reflected in businesses’ expectations for mining capital expenditure (Figure 1.7), which suggests further declines in nominal investment of 4.2 per cent in 2017–18 and a sharper 30 per cent in 2018–19.

The expected decline in mining industry investment is consistent with the findings in the special chapter on Resources and Energy Major Projects in the December 2017 Resources and Energy Quarterly. The chapter shows that the value of projects under development will fall from almost $120 billion in 2017 to around $10 billion in 2018.

**Figure 1.7: Private investment in mining**

![Bar chart showing private investment in mining](chart)

Notes: Expected capex is based on responses to an ABS survey of businesses. In current prices.
Source: ABS (2018) Private New Capital Expenditure and Expected Expenditure, 5625.0

Oil and gas investment remained the driver of declining mining investment in the December quarter, falling by 23 per cent year-on-year. This was partially offset by a 29 per cent increase in coal mining investment, and a 52 per cent increase in investment in metal ore mining. The rapid decline in oil and gas investment reflects the gradual wind up of construction activity at Australia’s recent wave of LNG ‘mega-projects’. Further falls in oil and gas investment in Australia are forecast with the three remaining LNG projects under construction scheduled for completion in 2018.

**Exploration expenditure**

Australia’s mineral and petroleum exploration expenditure totalled $703 million in the December quarter of 2018, remaining steady year-on-year. Petroleum exploration expenditure continued its decline, decreasing by a further 27 per cent year-on-year to $243 million, the lowest quarterly expenditure since 2004. The decline in petroleum exploration expenditure was offset by strong growth in minerals exploration, which continued its rebound with five consecutive quarters of year-on-year growth. Minerals exploration expenditure rose by 23 per cent year-on-year to $460 million.

**Figure 1.8: Exploration expenditure, quarterly**

![Line chart showing exploration expenditure](chart)

Exploration expenditure increased across all the mineral commodities, with the exception of iron ore, supported by higher commodity prices and an improved outlook for most commodities. There were notable increases in exploration expenditure for nickel, cobalt, silver, lead and zinc, with expenditure for both groups more than doubling from the previous year. Gold exploration expenditure grew by 15 per cent to $209 million, the highest quarterly expenditure in more than two decades.

Mixed trends for mining employment

The mining sector employed 226,500 people in February 2018, up by 2.7 per cent quarter-on-quarter and by 1.6 per cent year-on-year. Mining employment grew by 32 per cent year-on-year in coal mining, by 70 per cent in oil and gas extraction and by 48 per cent in non-metallic mineral mining and quarrying. This growth was partially offset by a 14 per cent decline in employment in metal ore mining and by 24 per cent in exploration and other mining support services. Employment in the mining sector is expected to remain broadly stable over the outlook period, in line with production.

Figure 1.9: Australia’s mining sector employment

1.7 Revisions to the outlook

After five years of decline, commodity prices rallied in 2016 and have since maintained these gains through to the start of 2018. Consequently, the outlook for Australia’s resource and energy export earnings in 2017–18 has been revised up by around $10 billion from the March 2017 Resources and Energy Quarterly. The upwards revisions to the short-term outlook largely reflect the continued resilience in the iron ore price and unexpected price surges in metallurgical and thermal coal. The projections for Australia’s resources and energy export earnings from 2019–20 onwards are largely unchanged from the projections made in the past two years, reflecting an unaltered view on the direction of prices and export volumes. Prices for Australia’s major resource and energy commodity exports are projected to decline, and the rapid growth in export volumes — driven by the mining investment boom — will have run its course by the turn of the decade.

Figure 1.10: Revisions to the outlook

Notes: Three quarter moving average. Undefined mining employment has been proportionally allocated across the other mining sectors.

Source: Department of Industry, Innovation and Science (2018)
Figure 1.11: Australia’s major resources and energy commodity exports

Notes: In 2017–18 dollars; Per cent change is CAGR (compound annual growth rate) from 2016–17 to the specified year; f Forecast; z Projection.

### Table 1.1: Outlook for Australia’s resources and energy commodities

<table>
<thead>
<tr>
<th></th>
<th></th>
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<td>225,046</td>
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<td>109,706</td>
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<td>106,126</td>
<td>108,808</td>
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<td>122,212</td>
<td>125,537</td>
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<td>- real b</td>
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<td>125,858</td>
<td>117,859</td>
<td>114,713</td>
<td>113,901</td>
<td>114,189</td>
<td>113,893</td>
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</tr>
</tbody>
</table>

Notes: b In current financial year Australian dollars; f forecast; z projection; r CAGR is compound annual growth rate in percentage terms from 2017–18 to 2022–23

### Table 1.2: Australia’s major resources and energy commodity exports

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
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<td>2.1</td>
<td>7,721</td>
<td>11,934</td>
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<td>Gold</td>
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<td>308</td>
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<td>Iron ore</td>
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<td>895</td>
<td>1.5</td>
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<td>54,629</td>
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<td>Nickel</td>
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<td>2,726</td>
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<td>Zinc</td>
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<td>1,626</td>
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<td>3,010</td>
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<td>LNG</td>
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<td>Metallurgical coal</td>
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<td>Thermal coal</td>
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<td>17,070</td>
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<td>Oil</td>
<td>kbd</td>
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<td>311</td>
<td>5.9</td>
<td>5,586</td>
<td>9,333</td>
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<tr>
<td>Uranium</td>
<td>t</td>
<td>7,081</td>
<td>6,400</td>
<td>–1.7</td>
<td>608</td>
<td>540</td>
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Notes: f forecast; z Projection; r CAGR is compound annual growth rate in percentage terms from 2017–18 to 2022–23
Table 1.3: Spot prices, nominal quarterly average

<table>
<thead>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Alumina fob Australia</td>
<td>US$/t</td>
<td>328</td>
<td>449</td>
<td>380</td>
<td>350</td>
<td>354</td>
<td>357</td>
<td>359</td>
<td>355</td>
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<tr>
<td>Aluminium LME cash</td>
<td>US$/t</td>
<td>2,012</td>
<td>2,102</td>
<td>2,195</td>
<td>2,020</td>
<td>2,040</td>
<td>2,060</td>
<td>2,122</td>
<td>2,016</td>
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<tr>
<td>Copper LME cash</td>
<td>US$/t</td>
<td>6,347</td>
<td>6,808</td>
<td>6,987</td>
<td>6,765</td>
<td>6,427</td>
<td>5,820</td>
<td>6,287</td>
<td>6,773</td>
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<tr>
<td>Gold LBMA PM</td>
<td>US$/t</td>
<td>1,278</td>
<td>1,274</td>
<td>1,319</td>
<td>1,352</td>
<td>1,367</td>
<td>1,361</td>
<td>1,349</td>
<td>1,391</td>
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<tr>
<td>Iron ore fob Australia a</td>
<td>US$/t</td>
<td>65</td>
<td>56</td>
<td>68</td>
<td>64</td>
<td>60</td>
<td>55</td>
<td>51</td>
<td>51</td>
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<tr>
<td>Nickel LME cash</td>
<td>US$/t</td>
<td>10,528</td>
<td>11,584</td>
<td>12,100</td>
<td>12,200</td>
<td>11,900</td>
<td>11,850</td>
<td>11,800</td>
<td>11,800</td>
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<tr>
<td>Zinc LME cash</td>
<td>US$/t</td>
<td>2,963</td>
<td>3,236</td>
<td>3,300</td>
<td>3,300</td>
<td>3,300</td>
<td>3,200</td>
<td>3,100</td>
<td>2,900</td>
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<tr>
<td>LNG fob b</td>
<td>US$/MMBtu</td>
<td>7.0</td>
<td>7.0</td>
<td>8.0</td>
<td>9.0</td>
<td>8.6</td>
<td>8.3</td>
<td>8.4</td>
<td>8.4</td>
</tr>
<tr>
<td>Metallurgical coal c</td>
<td>US$/t</td>
<td>190</td>
<td>206</td>
<td>235</td>
<td>205</td>
<td>188</td>
<td>173</td>
<td>157</td>
<td>157</td>
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<tr>
<td>Thermal coal fob Newcastle 6000 kc</td>
<td>US$/t</td>
<td>93</td>
<td>94</td>
<td>103</td>
<td>98</td>
<td>95</td>
<td>91</td>
<td>88</td>
<td>85</td>
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<tr>
<td>Crude oil (WTI)</td>
<td>US$/bbl</td>
<td>52</td>
<td>60</td>
<td>67</td>
<td>64</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
</tr>
<tr>
<td>Crude oil (Brent)</td>
<td>US$/bbl</td>
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<td>54</td>
<td>63</td>
<td>60</td>
<td>57</td>
<td>58</td>
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<tr>
<td>Crude oil (Japan Customs Cleared)</td>
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<td>58</td>
<td>67</td>
<td>64</td>
<td>61</td>
<td>62</td>
<td>63</td>
</tr>
<tr>
<td>Uranium d</td>
<td>US$/t</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>24</td>
<td>26</td>
<td>28</td>
<td>28</td>
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</table>

Notes: fob free-on-board; kc calorific content; a At 62 per cent iron content estimated netback from Western Australia to Qingdao China; b Australia’s export unit values; c Premium hard coking coal fob East Coast Australia; d Average of weekly restricted spot price published by The Ux Consulting Company; f forecast; s estimate.

Table 1.4: Australia’s export values, nominal quarterly

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Sep-17</th>
<th>Dec-17</th>
<th>Mar-18 s</th>
<th>Jun-18 f</th>
<th>Sep-18 f</th>
<th>Dec-18 f</th>
<th>Mar-19 f</th>
<th>Jun-19 f</th>
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<tbody>
<tr>
<td>Iron ore</td>
<td>$m</td>
<td>15,899</td>
<td>14,842</td>
<td>17,360</td>
<td>17,232</td>
<td>16,043</td>
<td>14,657</td>
<td>12,901</td>
<td>13,551</td>
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<tr>
<td>Gold</td>
<td>$m</td>
<td>4,069</td>
<td>4,387</td>
<td>4,407</td>
<td>4,482</td>
<td>4,488</td>
<td>4,476</td>
<td>4,620</td>
<td>4,854</td>
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<td>Copper</td>
<td>$m</td>
<td>1,746</td>
<td>2,181</td>
<td>2,420</td>
<td>2,358</td>
<td>2,382</td>
<td>2,060</td>
<td>2,266</td>
<td>2,441</td>
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<td>Alumina</td>
<td>$m</td>
<td>1,618</td>
<td>2,212</td>
<td>2,155</td>
<td>2,078</td>
<td>1,871</td>
<td>1,927</td>
<td>1,967</td>
<td>2,014</td>
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<td>Aluminium</td>
<td>$m</td>
<td>913</td>
<td>960</td>
<td>941</td>
<td>881</td>
<td>950</td>
<td>1,010</td>
<td>935</td>
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<td>Zinc</td>
<td>$m</td>
<td>807</td>
<td>1,130</td>
<td>887</td>
<td>825</td>
<td>924</td>
<td>970</td>
<td>1,081</td>
<td>944</td>
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<td>Bauxite</td>
<td>$m</td>
<td>276</td>
<td>305</td>
<td>291</td>
<td>320</td>
<td>336</td>
<td>303</td>
<td>296</td>
<td>326</td>
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<td>Nickel</td>
<td>$m</td>
<td>74</td>
<td>61</td>
<td>94</td>
<td>101</td>
<td>97</td>
<td>95</td>
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<td>$m</td>
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<td>4,794</td>
<td>5,120</td>
<td>4,237</td>
<td>4,613</td>
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<tr>
<td>Total resources</td>
<td>$m</td>
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<td>30,518</td>
<td>32,743</td>
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<td>31,885</td>
<td>30,617</td>
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<td>29,730</td>
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<td>Metallurgical coal</td>
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<td>11,924</td>
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<td>9,776</td>
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<td>Thermal coal</td>
<td>$m</td>
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<td>5,716</td>
<td>5,840</td>
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<td>6,011</td>
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<td>LNG</td>
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<td>6,961</td>
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<td>9,697</td>
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<td>Crude oil</td>
<td>$m</td>
<td>1,505</td>
<td>1,497</td>
<td>1,799</td>
<td>1,930</td>
<td>1,901</td>
<td>2,406</td>
<td>2,253</td>
<td>2,200</td>
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<td>Uranium</td>
<td>$m</td>
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<td>177</td>
<td>146</td>
<td>160</td>
<td>160</td>
<td>161</td>
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<tr>
<td>Other energy</td>
<td>$m</td>
<td>689</td>
<td>741</td>
<td>870</td>
<td>899</td>
<td>967</td>
<td>1,025</td>
<td>1,042</td>
<td>1,071</td>
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<tr>
<td>Total energy</td>
<td>$m</td>
<td>22,980</td>
<td>23,646</td>
<td>28,588</td>
<td>28,521</td>
<td>28,512</td>
<td>28,346</td>
<td>26,810</td>
<td>26,038</td>
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<tr>
<td>Total resources and energy</td>
<td>$m</td>
<td>52,817</td>
<td>54,163</td>
<td>61,331</td>
<td>61,282</td>
<td>60,397</td>
<td>58,963</td>
<td>55,207</td>
<td>55,768</td>
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</table>

Notes: f forecast; s estimate

Macroeconomic outlook

Resources and Energy Quarterly March 2018

- = Share of global GDP

- = Economic growth 2018

- A firming global economic recovery. The world to grow 3.6% in 2017

Drivers — low inflation and interest rates, improved manufacturing conditions, increased trade volumes

Risks — potential for a lower Chinese growth path, uncertainty for US economy
2.1 Summary

- Economic growth around the world has picked up, with the US and ASEAN playing a greater role in bolstering the global economy.
- Global inflation remains contained overall, with cheaper commodities helping to curb price growth.
- Although conditions remain strong on balance, rising instability in parts of the world, risks of global trade conflicts, and the need to curb long-running stimulus across the OECD present a complex set of risks.

2.2 Global economic outlook

Growth across the global economy continues to improve, with the profile of growth becoming more balanced over time and less dependent on China. The IMF recently upgraded its forecasts of global GDP growth by 0.2 percentage points to 3.9 per cent for 2018 and 2019, reflecting a stronger US outlook and the passing of further stimulus in the form of sizeable tax cuts. While China continues to play a crucial role as an engine of growth, higher spending and output in other regions is creating a broader growth picture. A new wave of emerging Asian countries is playing an increasingly important role in driving global output and consumption.

Global industrial production — a key driver of commodity demand — continues to grow in many countries including the US, Japan, and the European Union. However, growth in industrial production appears to be slowing in parts of Asia and Africa.

Urbanisation is continuing at the rapid rate, with the UN projecting all of the expected 1.1 billion population growth in the world out to 2030 will occur in cities. This urbanisation would normally be associated with a rapid rise in industrialisation. However, while urbanisation and industrialisation remain highly correlated in East Asia, the connection has become less clear in South Asia (notably India), Africa, and the Middle East, where many nations are now urbanising and growing rapidly without rapid
industrialisation. The long commodity boom of recent years has provided a surge of income to these nations, allowing urbanisation to occur without the normal rate of industrial growth.

Lower industrialisation in parts of the world is likely to slightly constrain demand for cement, coal, steel, and associated materials over the outlook period. However, technological change and a need for less polluting energy sources are driving growth in other areas including tech minerals, copper, and rare earths.

Higher commodity production is helping to check global inflation, which remains low (at 3.3 per cent) despite a long run of strong conditions across most countries. Rising supply and lower commodity prices have fed through into lower costs for consumer and manufactured goods. This has helped economies to grow without price breakouts, and is likely to keep constraining global inflation for the next five years and beyond.

**Figure 2.14: Commodity prices and the USD**

![Commodity prices and the USD graph](image)

Notes: The broad index is a weighted average of the foreign exchange value of the U.S. dollar against the currencies of major U.S. trading partners.


### 2.3 China

Fiscal and monetary stimulus and export growth propelled the Chinese economy to grow by just under 7 per cent in 2017. This growth will likely ease marginally in 2018 — to around 6.5 per cent — as the campaign to tackle debt funded and low-quality state investment enters a second year. As part of this campaign, the Government is reducing access to cheap money and tightening finance requirements in areas connected with property speculation. These measures may somewhat reduce the rapid pace of Chinese infrastructure rollouts, while increasing their quality.

A crackdown on industrial pollution may also curb industrial production in 2018. Consumer inflation remains low, and current policy settings create little pressure to lift interest rates from the current level of 4.35 per cent.

The new emphasis on curbing pollution, taming financial risks and closing the income gap will likely produce a slight slowdown in overall growth, with mild flow-on effects to global commodity demand. China’s economy is forecast to average around 6.2 per cent growth over the next five years.

**Figure 2.15: Indicators of Chinese construction activity, year-on-year change**

![Indicators of Chinese construction activity graph](image)

2.4 United States

The US economy is healthy on most measures, growing by 2.6 per cent (annualised) in the December quarter. Exports and wages are rising, and unemployment has dropped to 4.1 per cent after 87 months of jobs growth.

In response, the US Federal Reserve has begun raising interest rates from their previous emergency levels. This task is complicated, however, by the previous injection of US$3 trillion in stimulus into the financial system. Equity prices on Wall Street now average 25 times earnings, against a historical average of 15-16 times. Stock market growth has been contingent, in part, on cheap debt, and expectations of interest rate rises recently prompted a sharp fall in US equities. Further such falls risk destabilising the US economy.

This risk is lifted by high consumer debt, which may be vulnerable to even small rate rises. Recent tax cuts have added further stimulus, increasing pressure on interest rates. The US economy is forecast to grow by 1.9 per cent annually out to 2023, but significant risks will need to be managed.

![Figure 2.16: Growth in US GDP, year-on-year](source: Bloomberg Economic and Statistical Research (2018))

2.5 Other major markets

Japan’s economy grew by 0.5 per cent (annualised) in the December quarter. This was the 8th straight quarter of growth, the longest run of growth since the late 1980s. Growth slowed from 2.2 per cent in the prior quarter, partly due to rising imports, which point to strong domestic demand. Japanese industrial production rose by a healthy 4.2 per cent over the year. Growth is forecast to be moderate over the outlook period (averaging 0.6 per cent per year), but a higher result is possible if strong industrial production and domestic demand create a "virtuous cycle" of rising demand and investment.

The Euro area economy grew by 0.6 per cent in the final quarter of 2017, supported by accelerating growth in France, Belgium and Lithuania. Industrial production grew 3.2 per cent through the year to November 2017 — a stronger-than-expected result, capping a relatively solid year for the Euro area economy. The Euro area faces deep demographic challenges, and is expected to average growth of 1.6 per cent per year over the outlook period. However, economic reforms in France and other countries could improve prospects by supporting higher productivity.

Economic growth in the ASEAN-5 economies (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) is estimated to have topped 5 per cent in 2017, supported by strong industrial production and exports. ASEAN nations remain on a heavily industrialised growth path, and stronger outcomes in these countries are likely to feed through into global commodity markets. ASEAN countries are expected to maintain average growth of 5.3 per cent each year over the outlook period.

South Korea’s economy disappointed in the December quarter of 2017, unexpectedly contracting by 0.2 per cent. This followed a strong September quarter growth rate of 1.5 per cent. Tighter conditions for car and ship manufacturing fed through both to exports — which fell by 5.4 per cent — and industrial production, which fell by 0.5 per cent. It is widely expected that these difficulties will not persist, with the South Korean economy expected to recover in the early part of 2018, and maintain growth of around 3 per cent each year through the outlook period.
India’s economic growth is estimated to have slowed to 6.7 per cent in 2017. However, growth is expected to pick up to average 7.9 per cent over the outlook period, reaching 8.2 per cent by 2023 as the country urbanises and economic reforms take effect. However, complex challenges remain, including fiscal consolidation, removal of infrastructure bottlenecks, and a need to foster private investment across a huge and diverse economy.

Growth is generally on a strengthening path across most other regions, supported by strong investment and industrial activity in the OECD. However, new risks are also emerging. Recent moves by the US Government to place tariffs on commodity imports create a heightened risk of a trade war. Venezuela remains close to economic collapse. Conditions in Libya and Iran remain volatile. Saudi Arabia’s war against Yemen has become a regional crisis, with potential to destabilise other parts of the global economy. North Korea remains in a stand-off over nuclear weapons. And recent stock market turns in the US demonstrate the risks countries face in unwinding massive stimulus.

Thus, while global conditions are strengthening, events over the past quarter signal that global risks may be lifting as well, most notably on the trade front.

Source: IMF World Economic Outlook January 2018

Source: Bloomberg Economic and Statistical Research (2018)
### Table 2.5: Key world macroeconomic assumptions

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Notes: a Assumption; b Change from previous period; 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
Steel

Resources and Energy Quarterly March 2018

To produce 1,000 kg of crude steel in a blast furnace, 1,400 kg of iron ore needed. 800 kg of metallurgical coal needed.

Steel consumption per capita (kilograms per person), 2016:
- United States 318
- European Union 339
- China 506
- Japan 529
- Indonesia 58
- Africa 34
- Australia 269

Major steel producers, 2017:
- China 49%
- European Union 10%
- Rest of the world 16%
- Japan 6%
- India 6%
- United States 5%
- South Korea 4%
- Russia 4%

Steel use by sector:
- 50% Construction
- 16% Mechanical machinery
- 13% Automotive
- 5% Other transport
- 4% Electrical equipment
- 2% Domestic appliances
3.1 Summary
- World steel production has been lifted by strong economic growth, an ongoing pickup in industrial production, and robust production in China.
- China’s steel production and consumption is projected to gradually decline over the outlook period, reflecting a slow-down in construction activity, stricter environmental policies and supply-side reforms.
- India and other emerging economies are expected to increasingly drive growth in world steel consumption and production.
- The US tariff on steel imports and the threat of escalating protectionist policies presents a risk to the outlook for major steel exporting countries.

3.2 World consumption and production

China’s steel production boosted by high prices and strong demand
China’s steel producers were buoyed by high prices and margins in 2017. Higher prices reflected capacity cuts, the closure of illegal induction furnaces, and stockpiling on concerns over supply shortages (stemming from production restrictions over winter).

Despite these supply constraints, Chinese steel output grew by 5.7 per cent to reach a record 832 million tonnes in 2017, representing 49 per cent of world steel production. The growth reflects higher rates of capacity utilisation — in response to high margins — and the replacement of previously unreported production (at illegal induction furnaces) with new production (captured by official statistics). Higher output was absorbed by strong domestic demand, due to robust industrial production growth and stimulatory government spending and policies.

Capacity reductions are expected to continue, with another 30 million tonnes of capacity to be cut in 2018. Increasingly stringent policies to address air pollution are also expected, such as the extension of production restrictions in the Hebei province, and a repeat of production restrictions over the winter period — when air pollution is particularly intense. These factors are not expected to translate to substantial declines in total annual production in 2018, which is forecast to be broadly steady, due to higher capacity utilisation outside of the winter months.
China’s steel consumption is also forecast to hold steady in 2018. Both industrial output and fixed asset investment growth accelerated in the first two months of the year, by 7.2 per cent and 7.9 per cent respectively. However, the pace of growth in China’s land and home sales, and in newly started residential buildings, slowed over the same period. The impact of government efforts to cool the property market — including purchasing restrictions, caps on prices on new properties, and increased down payment requirements — saw property prices moderate in 2017. The property market is expected to remain subdued in 2018, weighing on steel consumption.

China’s steel production projected to gradually decline

Over the medium term, steel production is projected to flatten and gradually decline at an annual average rate of 0.5 per cent, to reach 805 million tonnes in 2023. This would reduce China’s share of global steel production from 49 per cent in 2017 to 45 per cent in 2023.

The decline in steel production is expected to be driven by moderating consumption, and a continuation and consolidation of current government policies. These policies include stricter environmental regulations, supply-side reforms, a shift in focus from ‘quantity to quality’, and reducing debt.

China’s steel consumption is forecast to decline at an annual average rate of 0.5 per cent to reach 742 million tonnes in 2023, largely driven by an expected slowdown in urban residential construction and infrastructure investment. Residential construction is expected to be weighed down by a projected slowdown in urban population growth and the effects of ongoing government policies to limit speculative investment in the property market. The pipeline of infrastructure projects is expected to thin, as the government shifts its focus away from investment-driven growth.

Growing demand from other sectors — appliances, automobiles and machinery — and a modest increase in steel exports is expected to partially offset the decline in construction activity.

Steel exports decreased by 31 per cent in 2017 to 76 million tonnes, their lowest level in four years. Declining exports have been driven by higher prices — making China’s steel products less competitive on export markets, and to a lesser extent, the growing suite of trade barriers around the world. Nevertheless, exports are expected to pick up towards the end of the outlook period, supported by new trade routes opened up by the One Belt One Road Initiative and to meet growing demand from emerging economies, particularly in South East Asia.

The projection for China’s steel consumption implies a levelling in China’s steel intensity — the volume of steel consumed per person — and results in China following a different trajectory to Japan or South Korea (see Figure 1.3). Unlike these countries, which consume large amounts of steel in industries like automobiles and shipbuilding, China’s development path is not expected to follow the same scale of steel-intensive export growth.

There is substantial uncertainty regarding the projections for China’s steel sector. Government policy will continue to drive the outlook for steel, as authorities continue to adjust policies to manage a smooth transition while restructuring and reforming the economy.

Figure 3.2: China’s steel consumption, production and exports

India set to become the second largest steel producer in 2018

India’s steel production grew by 6.2 per cent in 2017, to 101 million tonnes, driven by the ongoing expansion of steel-making capacity. Domestic consumption — which grew by an estimated 5.2 per cent — has lagged production, in part due to the implementation of economic policies and reforms, such as demonetisation and the implementation of the GST. India’s steel exports have surged as a result of subdued demand.

India’s steel intensity was an estimated 73 kilograms per capita in 2017, well below China’s 555 kilograms per capita, suggesting substantial potential for growth. Steel consumption is projected to grow at an annual average rate of 6.3 per cent to reach 140 million tonnes in 2023, implying a steel intensity of 97 kilograms per capita.

India’s steel consumption will be underpinned by rapid urban population growth, substantial government investment in infrastructure, housing and urban development and the expansion of the manufacturing sector. The projection also reflects the expected impacts of structural reforms and other government policies, such as bank recapitalisation (an injection of capital into India’s state-owned banks). These policies should improve prospects for economic growth and support the ability of state-owned banks to fund real estate, infrastructure and other steel-intensive projects.

Steel production is projected to grow at an annual average rate of 6.8 per cent over the outlook period. India is forecast to overtake Japan to become the world’s second largest steel producer in 2018, with production reaching 108 million tonnes. By 2023, India’s steel production is projected to reach 150 million tonnes, representing 8.5 per cent of world production.

The projections for steel production are lower than what is inferred in India’s National Steel Policy 2017, which has targets for crude steel production to reach 255 million tonnes by 2030–31, implying an annual average growth rate of 7.4 per cent. Despite positive progress on political and economic reforms, the expansion of the steel sector faces hurdles from ongoing regulatory challenges and difficulty in accessing raw materials, land and finance. The September 2017 Resources and Energy Quarterly further explores prospects for commodities consumption in India.

Japan and South Korea’s steel output to decline after short run strength

Japan’s crude steel production remained steady at 105 million tonnes in 2017. Despite strong industrial production growth, the steel sector was affected by scheduled maintenance and technical glitches. Steel production is forecast to grow modestly in the short-term, supported by a rebound in capital expenditure, export growth in the automobile and manufacturing sectors, and demand from Olympics-related projects. Beyond 2020, crude steel production is projected to decline at an annual average rate of 0.8 per cent, due to a slowdown in the residential construction and automobile sectors.

South Korea’s steel production grew by 3.7 per cent in 2017, supported by high prices, and is expected to remain stable in the short-term. Growth will be supported by robust domestic consumption, rising exports and a recovery in the shipbuilding industry — on the back of improvements in the number of new orders of ships. Over the medium term, steel production is projected to decline at an average annual rate of 0.5 per cent, weighed down by an expected slowdown in industrial production growth.
Steel output in United States to be boosted by tariffs on imports

Steel production in the United States grew by 4.0 per cent to 82 million tonnes in 2017, and is forecast to grow by a further 5.4 per cent and 4.3 per cent in 2018 and 2019, respectively, supported by the proposed 25 per cent tariff on imported steel.

The proposed tariff on steel imports to the United States and the threat of escalating protectionist policies around the world, presents a risk to the outlook for major steel exporting countries — discussed further in Box 3.1.

Emerging economies to increasingly drive steel demand growth

Steel production in the world excluding China grew by 4.9 per cent in 2017, the strongest rate in 6 years. This reflects growing momentum in global economic and industrial production, and a recovery in prices and profitability on the back of a sharp decline in steel exports from China.

Steel production in the world ex-China is projected to grow at a modest annual average rate of 2.1 per cent a year to 2023, driven by a positive outlook for global economic growth and ongoing urbanisation and infrastructure investment in emerging economies.

The ASEAN region offers one of the brightest prospects for growth in steel demand. Growth will be driven by rising construction activity and infrastructure investment in Vietnam, Malaysia, Thailand, Indonesia and the Philippines, and the potential development of the automotive industry in Thailand and Cambodia. Per capita steel consumption is notably low in Indonesia and the Philippines (59 and 108 kilograms per capita in 2016, respectively), reflecting substantial potential for consumption growth.

The region is currently a net importer of steel, with imports accounting for around 80 per cent of total apparent consumption. The region is projected be a growing source of steel import demand from China, Japan and South Korea. Blast furnace capacity is also expected to grow in Vietnam and Indonesia, supporting demand for iron ore and metallurgical coal.

Box 3.1: Impact of United States steel tariff on Australia’s commodity exports

In March 2018, the Trump Administration signed a Proclamation which imposed a 25 per cent tariff on steel imports into the United States. The intent of the tariff is to increase capacity utilisation in the US steel industry to 80 per cent, up from current levels of 73 per cent. On preliminary estimates, this implies an additional 9 million tonnes of production, representing 0.5 per cent of world steel production.

There is substantial uncertainty regarding the implementation of the tariff, and consequently, its potential impact on Australia’s commodity exports. The US is Australia’s largest market for steel exports, but is not a significant export market for Australia’s iron ore or metallurgical coal.

The impact of the tariff on iron ore and metallurgical coal markets depends on the extent to which the additional steel production in the US displaces production elsewhere in the world, particularly in Australia’s key iron ore and metallurgical coal export markets. If the rest of the world absorbs the excess steel production, the effect on iron ore and metallurgical coal markets should be relatively minimal.

If the additional production in the US results in lower steel production elsewhere in the world, this could weigh on total world iron ore and metallurgical coal demand. Approximately 67 per cent of steel produced in the US is via the electric arc furnace (EAF) process, compared with 26 per cent for the world average. The EAF process uses less iron ore and metallurgical coal than the basic oxygen furnace (BOF) process.¹

The potential for escalation in protectionist measures around the world represents another broader risk. Such outcomes could disrupt international trade and slow global economic growth in ways that are difficult to predict.

Notes: ¹ For every tonne of crude steel produced, the EAF process uses about 0.016 tonnes of coal and varying amounts of direct reduced iron, depending on how much scrap is used. In contrast, every tonne of crude steel produced via the BOF process uses about 1.4 tonnes of iron ore and 0.8 tonnes of coal.
Table 3.1: World steel consumption and production

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Notes: r Compound annual growth rate for the period from 2018 to 2023; s Estimate; f Forecast; z Projection.
Source: World Steel Association (2018); Department of Industry, Innovation and Science (2018)
Iron Ore
Resources and Energy Quarterly March 2018

Australia is the largest exporter of iron ore in the world. 818 million tonnes exported in 2016–17. That's enough to build 9,700 Sydney Harbour bridges. 29% of the largest iron ore reserves in the world. $63 billion exported in 2016–17.

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 2016
- 53% Australia
- 24% Brazil
- 4% South Africa
- 3% Ukraine
- 3% Canada
- 13% Rest of the world

North Australia (NT), Queensland (QLD), New South Wales (NSW), South Australia (SA), Victoria (VIC), Tasmania (TAS), Western Australia (WA)

Australia’s iron ore key export destinations, 2016–17
- 83% China
- 8% Japan
- 6% South Korea
- 2% Taiwan
- 1% Rest of the world

Global share of iron ore imports in 2016
- 67% China
- 10% European Union
- 8% Japan
- 5% South Korea
- 10% Rest of the world
4.1 Summary

- Australia's iron ore export earnings grew by 16 per cent to $63 billion in 2017, driven by high prices and growth in export volumes (which increased by 2.5 per cent to 828 million tonnes).
- Australia’s real iron ore export earnings are projected to decrease to $55 billion by 2022–23, as a result of a projected decline in prices.
- The real iron ore price is projected to decline to US$53 a tonne (FOB Australia) in 2023, as a result of falling steel production in China and a well-supplied seaborne market.
- The key uncertainty underpinning the outlook for the iron ore price is the pace and magnitude of the decline in China’s steel production, which in turn, largely depends on government policy.

4.2 Prices

Iron ore price forecast to be supported in the short-term

The iron ore price (FOB Australia) averaged US$68 a tonne in the March quarter of 2018. Price resilience earlier in the quarter gave way to a steady decline in the iron ore price in March, reflecting rising steel inventories, rising iron ore port stocks and concerns about weak demand in China. Nevertheless, positive industrial production and fixed asset investment data released in March indicates that demand will likely remain robust in the near term, and a seasonal rebound in construction activity in China’s spring months is expected to provide some price support.

China’s steel sector will continue to be characterised by ongoing capacity reductions and policies to address air pollution (see the Steel chapter). These factors are expected to provide some support to steel prices, and consequently, the iron ore price, which tracks steel prices very closely. However, weaker steel production also means weaker demand for iron ore. The two conflicting influences will likely result in some price volatility.

The iron ore price is forecast to gradually decline to average US$55 a tonne (FOB Australia) in the December quarter of 2018, reflecting ongoing growth in exports from Brazil (as Vale’s S11D project continues to ramp up).

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, not the benchmark CFR (cost and freight) North China iron ore price.

Figure 4.2: Steel and iron ore prices, month-on-month change

Notes: Steel price is based on index of steel prices in China, Iron ore price is FOB Australia
Iron ore price projected to weaken before a modest recovery

The iron ore price is projected to decline further to US$49 a tonne (FOB Australia, in real 2018 dollars) in 2020, as a result of moderating demand and growing supply, before a modest recovery to US$53 a tonne in 2023 as supply growth softens. The projection is underpinned by the assumption that first, the price will trend towards the break-even level required by producers of the last tonnages needed to meet demand, and second, that a small (5 per cent) proportion of producers (largely in China) will be loss-making. Despite the forecast decline in price, the vast majority of Australian producers are expected to remain highly profitable, reflected in the margin curve below, due to high quality and low-cost production.

The seaborne market is forecast to be well-supplied over the outlook period with low-cost-production from Brazil and Australia. Iron ore import demand is expected to be weighed down by declining steel production in China. The main drivers of declining steel production are slowing construction activity and infrastructure investment, and increasingly stringent environmental regulations.

The discount for lower quality ores averaged 37 per cent in the March quarter of 2018, compared with 16 per cent in 2016. Higher quality iron ore improves the efficiency of steel mills, and the persistently high discount has been driven by both structural (government policy) and cyclical (high steel prices) factors. The divergence is expected to narrow as steel prices decline; however, it is unlikely to revert back to historical levels, with strong signals from the Chinese government of an increasing emphasis on efficiency and air quality.

4.3 World trade

China’s iron ore imports projected to gradually decline

China’s iron ore imports grew by 4.5 per cent to a record 1,075 million tonnes in 2017, propelled by strong growth in steel production. Australia’s iron ore exports accounted for 62 per cent of China’s iron ore imports, while Brazil accounted for 16 per cent. Despite winter production cuts, China’s imports grew by 5.2 per cent year-on-year in the first two months of the year, due to restocking demand in the lead up to Chinese New Year.

Figure 4.3: Projected iron ore margins by mine in 2023, based on projected price of US$53 a tonne (FOB Australia, in real 2018 dollars)

Notes: Margins are based on a projected iron ore price of US$53 a tonne (FOB Australia, in real 2018 dollars); Production is in dry metric tonnes.

Source: AME Group (2018)
China’s iron ore imports are projected to decline at an average annual rate of 4.0 per cent over the outlook period, to reach 1.04 billion tonnes in 2023. The outlook for China’s iron ore import demand is driven by a projected decline in steel production (see the Steel chapter).

The effect of declining steel production on iron ore imports is expected to be partially offset by a projected decline in domestic iron ore production. China’s iron ore reserves are largely low grade, with an average iron content of around 30 per cent. There is considerable uncertainty regarding China’s iron ore production, with the authorities playing a large role in driving closures. More stringent environmental policies are expected to weigh on domestic iron ore production, which will drive an increasing preference for higher quality iron ore. Authorities revoked about a third of iron ore mining licenses in 2017, in line with the government’s stricter environmental policy. Conversely, some uneconomic mines may continue to operate, particularly those that are vertically integrated with steel mills or located inland with lower transport costs to nearby steel mills.

**Figure 4.4: China’s iron ore imports and production**

Growing scrap use — due to growing environmental pressure — is also expected to dampen the demand for iron ore, with every tonne of scrap steel displacing around 1.4 tonnes of iron ore. The recent winter production cuts have encouraged steel mills to use more scrap to offset the loss in pig iron (an intermediate product) production. Authorities have also been supportive of the construction of electric arc furnaces (EAFs), which uses scrap, rather than iron ore, as the main raw material input.

However, the increase in scrap use is expected to be gradual and be more of a risk towards the end of the outlook period. Steel used in construction has an average lifecycle of 40 years, so growth in scrap output will be slow. The high cost of electricity and constraints in adding new capacity will also limit the pace of growth in EAFs. In 2017, EAFs only accounted for an estimated 8 per cent of steel production in China, and large scale investments are expected over a longer (10 to 15 year) time horizon.

**India projected to become a net importer of iron ore**

The recent growth in India’s iron ore production is forecast to slow in 2018. The slowdown is underpinned by the cancellation of mining permits in Goa due to renewal issues (representing 20 million tonnes of predominantly low-grade iron ore, mostly exported to China) and the suspension of seven mines in Odisha for non-payment of illegal mining fines (representing another 20 million tonnes, mostly supplying the domestic steel industry). While production at other mines is expected to increase in 2018, imports of iron ore are expected to rise from a low base to meet domestic demand.

India’s iron ore production is projected to recover after 2018, underpinned by rapidly growing demand from the domestic steel industry. While India has the potential to be self-sufficient in iron ore, there are ongoing challenges in the development of new mines. These include difficulties in accessing land and capital, insufficient infrastructure to transport ore, complex regulations, community objections, and ongoing uncertainty in government policy. While government policy is expected to become more supportive to promote self-sufficiency, growth in consumption is projected to outpace production, resulting in modest import growth.

Notes: China’s iron ore production is quality adjusted.
Strong export growth forecast in the short-term, primarily from Brazil

The seaborne iron ore market is forecast to be well-supplied in the short-term, with world iron ore exports forecast to grow by 4.6 per cent and 1.2 per cent in 2018 and 2019, respectively.

Much of the export growth will be underpinned by the ramp up of Vale’s S11D project at the Carajás complex, which will bring Vale’s capacity to 400 million tonnes by 2019. Anglo American’s Minas-Rio expansion is also expected to reach full capacity of 26.5 million tonnes by 2020. Vale indicated that the Samarco mine — which has been closed since the tailings dam burst in November 2015 — could return to production by 2019 if environmental licenses can be obtained. Production is expected to gradually ramp up to a third of total capacity, resulting in an additional 9.5 million tonnes of output by 2020.

Australia is also expected to contribute to export growth, although to a lesser extent. This reflects ongoing productivity improvements across Rio Tinto and BHP’s operations, and the ramp up of new capacity.

Seaborne exports projected to be dominated by Australia and Brazil

World iron ore export growth is projected to slow to an annual average rate of 0.3 per cent from 2020 to 2023, reflecting the end of large-scale additions to capacity. Both Australia and Brazil are expected to solidify their share of global iron ore exports at the end of this period, displacing high-cost production elsewhere. Australia is projected to increase its market share from 53 per cent in 2017 to 54 per cent in 2023, and Brazil from 25 per cent in 2017 to 26 per cent in 2023.

The iron ore market is expected to continue to be dominated by the ‘Big 4’ producers, with Rio Tinto, BHP, Vale and Fortescue Metals Group (FMG) projected to account for around 72 per cent of the seaborne market. The first three companies are expected to increase production to reach their long-term targets in the first half of the outlook period. There are several large projects in Australia currently undergoing feasibility studies — Rio Tinto’s Koodaiderie, BHP’s South Flank, and FMG’s Solomon Expansion and Eliwana. These projects are intended to sustain quality, replace depleting mines, and contribute to the medium-term targets, rather than be a major source of growth.

<table>
<thead>
<tr>
<th>Table 4.1: ‘Big four’ iron ore producers’ targets (million tonnes)</th>
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</thead>
<tbody>
<tr>
<td>Company</td>
</tr>
<tr>
<td>Vale</td>
</tr>
<tr>
<td>Rio Tinto</td>
</tr>
<tr>
<td>BHP</td>
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<td>FMG</td>
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</table>

Notes: On a 100 per cent basis; Vale is expected to reach nominal capacity of 450 million tonnes in 2020; BHP production guidance is for 2017–18; FMG guidance is for 2017–18. Source: Company reports and presentations

4.4 Australia

Iron ore exploration expenditure decreased in the December 2017 quarter

Australia’s iron ore exploration expenditure totalled $291 million in 2017, an increase of 0.9 per cent from the previous year. Exploration expenditure was $69 million in the December 2017 quarter, a decline of 18 per cent quarter-on-quarter and 6.5 per cent year-on-year. Iron ore exploration expenditure is likely to have largely bottomed out, with ongoing investment increasingly needed to replace depleting reserves.

Australia’s iron ore export volumes continue to grow

Australia’s iron ore export volumes grew by 1.8 per cent to reach a record 218 million tonnes in the December 2017 quarter. Growth was a result of productivity improvements and the commissioning of the Silvergrass iron ore mine at Rio Tinto’s operations, as well as increased plant availability and improved rail performance at BHP’s operations.

Despite record export and production volumes, lower prices saw export earnings decrease to $15 billion in the December quarter 2017, down 7.4 per cent quarter-on-quarter and 11 per cent year-on-year.
Australia’s iron ore export earnings to be weighed down by lower prices

Australia’s iron ore export values are forecast to grow by 2.3 per cent in 2017–18 to $65 billion, driven by strong growth in export volumes (of 5.6 per cent) to 861 million tonnes. Roy Hill faced some technical difficulties in the December 2017 and March 2018 quarters, but is expected to return to its nameplate capacity of 55 million tonnes later in 2018.

Real export values are forecast to decline sharply in 2018–19 and 2019–20 and then modestly recover to reach $55 billion in 2022–23, as a result of the forecast decline and subsequent rebound in the iron ore price.

Australia’s export volumes growth is projected to slow after 2018–19, marking the end of major expansions and additions. The projections for Australia’s iron ore production assume:

- productivity improvements and replacement mines at Rio Tinto and BHP’s operations to reach their long-term production targets
- the commissioning and ramp up of some smaller projects, including Mount Gibson Iron’s Koolan Island, and
- the closure of some mines due to depletion, and the announced cessation of production at Cliff’s Koolyanobbing mine.

There are also several larger iron ore projects currently undergoing feasibility studies, which have not been included in the projections. The potential additional production represents an upside risk to the projections, but whether the projects commence operations depends on a range of factors, including market conditions and access to port and rail infrastructure.

Revisions to export earnings

The forecasts for Australia’s iron ore export earnings in 2017–18 and 2018–19 have been revised up by $5.0 billion and $6.2 billion, respectively. The revision reflects an upwards adjustment to the iron ore price in 2018. The iron ore price has held higher than expected in early 2018, and some short-term support is expected from ongoing resilience in steel prices and production in China.
Table 4.2: World trade in iron ore

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<tr>
<th></th>
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<td>2018 f</td>
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<tr>
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<td>Japan</td>
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<td>131</td>
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<td>China</td>
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<td>South Korea</td>
<td>72</td>
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<td>India</td>
<td>5</td>
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<td>384</td>
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<td>India</td>
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<td>Ukraine</td>
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Notes: r Compound annual growth rate for the period from 2017 to 2023; s Estimate; f Forecast; z Projection.
Source: World Steel Association (2017); International Trade Centre (2018); Department of Industry, Innovation and Science (2018)
Table 4.3: Iron ore outlook

<table>
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<th>World</th>
<th>Unit</th>
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<th>2019 f</th>
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<td>Mt</td>
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<td>61.8</td>
<td>51.1</td>
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<td>54.1</td>
<td>56.2</td>
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<td>50.0</td>
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<tr>
<td>– Steel hs</td>
<td>Mt</td>
<td>5.35</td>
<td>5.40</td>
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<td>5.40</td>
<td>5.40</td>
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<td>916.5</td>
<td>927.8</td>
<td>933.6</td>
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<tr>
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<tr>
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<td>A$m</td>
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<td>753</td>
<td>701</td>
<td>701</td>
<td>701</td>
<td>701</td>
<td>701</td>
<td>-3.6</td>
</tr>
<tr>
<td>– real value hi</td>
<td>A$m</td>
<td>892</td>
<td>753</td>
<td>685</td>
<td>669</td>
<td>653</td>
<td>638</td>
<td>622</td>
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<tr>
<td>Iron ore</td>
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<tr>
<td>– nominal value</td>
<td>A$m</td>
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<td>65,333</td>
<td>57,151</td>
<td>54,386</td>
<td>56,332</td>
<td>59,297</td>
<td>61,549</td>
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<tr>
<td>– real value i</td>
<td>A$m</td>
<td>63,876</td>
<td>65,333</td>
<td>55,839</td>
<td>51,917</td>
<td>52,502</td>
<td>53,936</td>
<td>54,629</td>
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Notes: b fob Australian basis; c Spot price, 62 per cent iron content basis; d In 2018 US dollars; 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 2017–18 Australian dollars; r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23; f Forecast; s Estimate; z Projection.

Metallurgical coal
Resources and Energy Quarterly March 2018

98% of world metallurgical coal production is in Australia

17% of world metallurgical coal production is in Australia

177 million tonnes exported in 2016–17

Australia is the largest exporter of metallurgical coal in the world

Australia’s metallurgical coal key export destinations, 2016–17

Global share of metallurgical coal exports, 2016

60% Australia
12% Other
10% USA
8% Canada
6% Mongolia
4% Russia

Global share of metallurgical coal imports, 2016

18% Japan
17% China
17% India
12% South Korea
12% European Union
4% Taiwan
2% Rest of the world
5.1 Summary

- Metallurgical coal prices have stayed at relatively high levels in recent months, as disruptions to Australian export supply continue to leave the seaborne market short. Prices are likely to remain well above the US$100 a tonne mark, and hence above the lows of 2015–16.
- The prospects for metallurgical coal demand over the medium term are firm. Strong growth in emerging Asia will drive strong growth in steel production and hence metallurgical coal demand.
- Supply growth will generally keep up with demand, though the ongoing rationalisation of the Chinese coal industry poses a risk to world supply.
- Export earnings are forecast to be almost $40 billion in 2017–18, before declining. Earnings should maintain $29 billion over the forecast period.

5.2 Prices

Prices have stayed high, as ongoing supply issues added to firm demand

The Australian Prime Hard Coking Coal (HCC) FOB spot price remains around US$220 a tonne, as strong Asian demand, bad weather in the United States early in 2018 and ongoing supply problems in eastern Australia all keep the seaborne market tight.

The price of metallurgical coal is expected to fall over the first half of the forecast period, as supply expands to better match growing demand. The price is expected to bottom out at the US$140 a tonne mark halfway through the forecast period before rebounding. The favourable outlook relative to thermal coal reflects metallurgical coal’s lack of substitutes in the majority of existing steel-making production, and efforts around the world to reduce reliance on thermal coal as a power/energy source.

Metallurgical coal will not be immune from environmental problems: air pollution problems in large Asian cities will likely result in pressure to use high grade iron ore, allowing lower coal use.

With Australia likely to remain the dominant force in the global seaborne metallurgical coal market, weather events in north eastern Australia will continue to have the potential to impact adversely on global seaborne supply and thus drive periodic price spikes.

Figure 5.1: Metallurgical Coal Prices - Australian Prime Hard vs US Low Vol, FOB

Source: IHS Markit (2018)

Figure 5.2: Benchmark contract price for Australian Hard Coking Coal

Source: IHS Markit (2018); Department of Industry, Innovation and Science (2018)
5.3 World trade

A feature of 2017 was the uniform strengthening in industrial activity in the world’s major economies. The acceleration in global steel output associated with this economic pickup drove a strong rise in metallurgical coal usage. The rise in demand came just at a time when supply declined, mainly as a result of stagnant Chinese output and transportation problems affecting Australian exports. Metallurgical coal demand in ex-China developing Asia should continue to post healthy gains over the forecast period. Relatively strong growth and the ongoing urbanisation of these nations will boost steel usage (and thus metallurgical coal demand), largely offsetting minor drops in steel usage in North East Asia.

World demand and imports

Developments in China remain a significant market force

Strong Chinese demand and domestic production cuts helped drive market tightness in 2017. The closure of a significant number of (illegal) steel induction furnaces — which do not use metallurgical coal as an input — were a factor adding to Chinese metallurgical coal demand in 2017. As induction furnaces closed, blast furnaces — which do use metallurgical coal — increased production. Imports rose by 10 million tonnes on 2016 levels to hit 69 million tonnes, the 2nd highest level of imports on record.

In 2018, Chinese production of metallurgical coal will continue to be constrained by the impact of both ongoing mine safety inspections across Shanxi province and coal transport restrictions in northern China. These factors should clear over the remainder of the outlook period, reducing the need for metallurgical coal imports. Over the rest of the five year outlook period, the impact on Chinese import demand of a modest decline in Chinese steel output will be (largely) offset by the ongoing consolidation of China’s coal industry whereby small/unsafe mines will be closed.

Trade sanctions announced by the US Administration so far this year on steel, solar panels, washing machines, and aluminium, are unlikely to have a significant impact on China: the US last year imported only around US$6 billion worth of these products from China.

Mongolian metallurgical coal exports to China totalled 26.3 million tonnes in 2017, an increase of 11 per cent on 2016. The Mongolian Government’s recently imposed limits to road usage by coal trucks to solve congestion problems has had a deep impact on exports to China in early 2018, and this issue is expected to take a year or more to ease. Longer term, the prospects are for only a modest rise in output: Mongolia is a captive supplier to Chinese buyers, and consequently receives low prices for its output, hurting investment in new coal projects.

India’s imports of metallurgical coal will continue to rise

In 2017, India’s metallurgical coal imports were unchanged from 2016. Weighing on imports was strong resistance by Indian steel mills to the sharp price gains of seaborne metallurgical coal after March. Metallurgical coal inventories were run down, as the mills waited for Australian supply to normalise. Mills turned to North America as an alternative supply source. With India’s steel production set to rise strongly over the forecast period, and a lack of meaningful metallurgical coal deposits, India’s metallurgical coal imports are set to continue to grow. India will likely become the world’s largest importer of metallurgical coal by 2020; imports are forecast to rise at annual rate of almost 9 per cent in the period to 2023.

Figure 5.3: Major metallurgical coal importers – 2017 and 2023

Notes: z projection
Japanese demand declining

Despite a 2.8 per cent decline in metallurgical coal imports in 2017, Japan retained its position as the world’s second largest metallurgical coal importer. The prospects are for a gradual decline in Japanese imports in the second half of the forecast period, as steel production drifts lower.

ASEAN demand forecast to strengthen

ASEAN itself will only import/consume comparatively modest amounts of metallurgical coal. Its main consumption of metallurgical coal will be indirect, through steel imports from the large Asian steel making nations. Along with India, strong ASEAN steel demand will help offset the impact on global metallurgical coal consumption of a minor decline in domestic usage of steel in China, Japan and South Korea.

World production and exports

Global metallurgical coal production is forecast to remain steady over the medium term, at just over 1 billion tonnes. Cutbacks in Chinese production will be offset by rising output in Australia and Russia. Exports will decline in the short term, as swing suppliers such as the US react to lower prices¹.

The decline in Chinese production appears likely to have ended

After two years of significant declines, Chinese metallurgical coal production has levelled out in recent quarters. China has been closing down small, loss-making State-owned mines and cracking down on unsafe mining operations. A push to lower air pollution has seen Chinese steel mills move towards using high grade iron ore that requires lower metallurgical coal usage.

United States’ production to hold much of its recent gains

United States’ metallurgical coal exports remained relatively strong as the calendar year turned. American exports were buoyed by high prices and a firm push by countries such as India to diversify their sources of supply.

Going forward, American exports will ease as seaborne metallurgical coal prices subside; large new investment in new mines and expansions is unlikely, given the temporary nature of the price spike of the past year. The US Administration’s moves to protect domestic steel makers, the healthy corporate climate and easier mine permitting will assist domestic metallurgical coal consumption and production. Corsa Coal aims to double 2017 output of 1.8 million tonnes by 2019 via several new mines. Annual output at RAMACO’s Elk Creek operations will rise to 3.8 million tonnes by 2020 from 0.6 million tonnes in 2017.

Russian exports are likely to rise steadily

Russian metallurgical coal exports are likely to gain over the forecast period. However, the country’s reserves of metallurgical coal are not nearly as extensive as its reserves of thermal coal, and Russia’s ability to take large slabs of market share is thus limited.

Figure 5.4: Major metallurgical coal exporters, annual

¹ Indonesian metallurgical coal exports are a source of some uncertainty. Item 27011210 Indonesian statistical website details volumes of ‘bituminous coal – coking coal’.

Source: IEA (2017); Department of Industry, Science and Innovation (2018)
Table 5.1: World metallurgical coal trade

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<th></th>
<th>2017 s</th>
<th>2018 f</th>
<th>2019 f</th>
<th>2020 z</th>
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<th>2023 z</th>
<th>CAGR r</th>
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<tr>
<td>Total world trade</td>
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<td>315</td>
<td>321</td>
<td>324</td>
<td>327</td>
<td>331</td>
<td>334</td>
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Notes: s Estimate; f Forecast; z Projection
Source: IEA (2017); Department of Industry, Innovation and Science (2018)

5.4 Australia

Australian exports to improve steadily after 2018

Rail and port maintenance issues pose a major risk to metallurgical coal exports in 2018, a repeat of 2017 — when bad weather and (mainly weather-related) damage and problems with transport infrastructure also hampered exports. Temporary closures for maintenance at a number of berths at Gladstone and Dalrymple Bay in April and May will add to the impact of similar berth closures at Hay Point and Abbott Point in March. Of major concern, the Aurizon Network — the below-rail operator of the Central Queensland Coal Network — has advised that 20 million tonnes of capacity could be lost across the system, as it aligns maintenance operations with the Queensland Competition Authority’s Draft Access Undertaking (UT5). This undertaking curbs annual maintenance charges that Aurizon can bill the system. Miners in Queensland could be expected to build stockpiles to make sure that they are ready to transport coal when or if the rail transport system returns to previous capacity levels.

By 2022–23, exports should reach 210 million tonnes. The gains will come on the back of firm prices, as Australian producers attempt to keep up with rising demand in India and ASEAN. Both have few metallurgical coal resources of their own.
Australian production to rise steadily

Australian metallurgical coal production declined by around 10 million tonnes in 2017, hit by bad weather, industrial action and operational changes. The average strip ratio rose in trend terms (see Box 1).

Assuming no large weather-related outages, production is expected to rebound in 2018, helped by strong prices. However, significant problems with transport and export infrastructure in Queensland could see production disappoint compared to levels that might have otherwise been achieved. NSW producers are not immune from problems: South32 expects mine problems to cause production at its Illawarra complex to decline to 4.5 million tonnes, down 36 per cent on 2016–17.

Box 5.1: Queensland strip ratio

The average strip ratio at Queensland (metallurgical and thermal) open cut coal mines rose in 2017, as the strong rise in prices in 2016–17 justified exploiting areas of mining tenements that required increased overburden removal. Strip ratios have been steadily rising over the past decade, as metallurgical coal production comprises a larger and larger portion of total coal production in the State. Declining prices over the next couple of years could be expected to cause strip ratios fall back modestly.

Figure 5.5 Queensland strip ratio*, quarterly

Australian production is then expected to break through the 200 million tonne level and keep on climbing through the rest of the forecast period. By 2022–23, production should reach 215 million tonnes, representing annual growth of 2.0 per cent from 2016–17.

Australia’s export earnings to stay in a $29–34 billion range

Australian metallurgical coal export earnings are expected to hit a record of almost $40 billion in 2017–18. The price impact of tighter global supply — due to both the anaemic recovery in Chinese production (after the Beijing-enforced cutbacks of mid 2016) and severe transport outages in Australia — will outweigh the impact on earnings of lower export volumes.

Export earnings are forecast to decline in the two years after 2017–18, as the impact of declining prices more than outweighs rising export volumes. Export earnings are nevertheless expected to hold above the $29 billion mark. Rising export volumes and price gains in the 2020 should result in an export earnings rebound, hitting $34 billion in real terms in 2022–23.

Figure 5.6: Australia’s metallurgical coal production and exports – fiscal year basis

Notes: *Overburden removed (cubic metres) divided by raw coal output of open-cut mines
Source: Queensland Department of Natural Resources and Mines (2018)
## Table 5.2: Metallurgical coal outlook

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Notes: b Fob Australian basis; c Contract price assessment for high-quality hard coking coal; d In 2018 calendar year US dollars; f Forecast; g Hard coking coal fob Australia east coast; z Projection
Thermal coal
Resources and Energy Quarterly March 2018

Australia is the 2nd largest thermal coal exporter in the world.

202 million tonnes exported in 2016–17

Australia accounted for 5% of world thermal coal production in 2016.

81% of Australia’s thermal coal production is exported.

Key importers of Australian thermal coal (million tonnes), 2016–17

- Japan: 41%
- China: 21%
- South Korea: 14%
- Taiwan: 13%
- Malaysia: 3%
- India: 2%
- Other: 6%

Exports
Imports

Australia 20%
Russia 14%
Columbia 7%
Rest of world 12%
United States 2%
Indonesia 37%
South Africa 8%

Other 36%
6.1 Summary

- Thermal coal prices have edged up further in recent months, as supply concerns and strong demand keep buyers keen to snap up cargoes.
- Going forward, strong growth in demand in Emerging Asia will largely offset softer demand in the OECD. Western nations appear likely to continue to push to phase down their thermal coal use in favour of renewables and gas, the latter both for heating and power generation.
- Supply growth will be dominated by Australia, Russia and the United States, but investors will only reluctantly fund new capacity.
- Australian export earnings are expected to hit a record $22.9 billion dollars in 2017–18 before declining to $17.1 billion in 2022–23.

6.2 Prices

Prices have pushed higher, as strong demand dominates the market

The Newcastle benchmark price has edged above US$100 a tonne in recent weeks, as strong seasonal demand combines with supply problems. Indonesian producers of higher quality coal have been struggling to put together cargoes because of monsoonal rains.

Figure 6.1: Thermal coal prices

![Thermal coal prices graph]

Source: IHS Markit (2018)

The Japanese Fiscal Year (JFY) benchmark price for 2018 (April 2018 to March 2019) will likely settle at US$100 a tonne but drift down steadily over the next few years, as demand steadily deteriorates relative to supply. In the medium to long term, the lack of large new developments in major exporting nations will tend to sustain prices above the US$60 a tonne mark. The JFY 2023 contract price is projected to fall to US$75 (JFY 2018 dollars) a tonne, as gains in exports/production in nations such as Australia and Russia steadily overwhelm modest gains in world demand. Non-OECD Asia will drive growth in world demand, with the OECD consuming less as governments push away from coal. The real Newcastle FOB spot price is projected to be US$71 a tonne by 2023.

6.3 World demand and trade

A feature of 2017 was a sharp rise in thermal coal imports outside of the main five Asian importing countries (China, India, Japan, Taiwan and South Korea). Higher imports to Europe from both Russia and the United States drove most of the gains, and led to less competitive pressure on Australian and Indonesian miners trying to make sales into Asia.

Figure 6.2: Benchmark contract price for Australian thermal coal

![Benchmark contract price graph]

Source: Department of Industry, Innovation and Science (2018)
World imports
Imports of thermal coal are likely to weaken over the forecast period, as China and the major industrialised nations seek to reduce carbon emissions intensity in order to meet climate change commitments and pollution targets. Based on the usage of China—a nation with the same population as India—Figure 6.3 suggests that Indian coal usage has the potential to rise sharply over the next twenty years. However, it does not automatically follow that higher imports will be needed. India has aspirations to be self-sufficient in coal, but also wants coal to account for a much lower proportion of total electricity generation than in China currently. Apart from Indonesia, other developing Asian nations do not have the coal reserves needed to generate their own rising power needs.

China cutting coal usage
After a gain of 15 per cent in 2016, Chinese thermal coal imports fell by 4.4 per cent in 2017. The 2017 decline owed much to the easing in domestic production restrictions throughout the year. It appears likely that imports will stay strong in 2018, as government fiat constrains domestic production. (Beijing is to carry out a ‘special action’ on illegal coal mines that fail to meet safety measures or operational standards will be required to close and rectify violations.)

Chinese coal usage is expected to grow modestly over the forecast period. A faster than expected switch away from coal to gas and renewables in the power sector represents the main uncertainty: air pollution remains a significant problem in China, particularly in the north of the country. China plans to further reduce coal’s share in energy consumption from 60.4 per cent last year. It will do this by adding renewable power capacity, cutting oversupply in the thermal power industry (especially high-cost and loss-making operations) and improving coal efficiency in power generation.

With rising domestic output, Chinese thermal coal imports are expected to decline from 188 million tonnes in 2017 to 152 million tonnes in 2023.

India is deregulating coal production
Developments in India over the next year or so will have a crucial influence on Indian coal imports during the latter half of the forecast period.

Figure 6.3: Coal-based power generation in China and India, 2016

![Figure 6.3: Coal-based power generation in China and India, 2016](source: IEA (2017))

Figure 6.4: Coal-based power generation in some Asian nations

![Figure 6.4: Coal-based power generation in some Asian nations](source: IEA (2017))
India’s Modi Government has recently announced that it will allow the public auction of coal mines for commercial purposes, ending nearly forty years of monopoly held by Coal India (CIL).

Until now, private companies in India have only been allowed to mine coal to fuel captive power operations; the state-owned sector conducted all commercial mining of coal. The state-owned sector has repeatedly underperformed relative to the targets set by the Government.

If the private sector responds to the abolition of CIL’s monopoly, stronger growth in coal output is possible, especially in the latter half of the forecast period. However, some of that stronger output growth may just fill a gap left by slower growth in South African and Indonesian coal exports. South Africa is suffering from a withdrawal of investment by multi-national companies. Indonesia is likely to try to make determined efforts to cap the amount of coal that leaves the country over the next few years.

Ultimately, it is likely that a significant rise in Indian coal production hinges on reform to the power sector in India. Profitability and capacity utilisation in the power generation sector is low, due to government price controls. The low level of profitability flows on to the profitability of domestic coal production.

Japan to import marginally less thermal coal
Japanese imports of thermal coal will decline modestly over the forecast period. Against a backdrop of sluggish power demand (as the population declines), with the nuclear power sector likely to continue to make only a minor contribution to the country’s power generation needs, gas and the rapid deployment of renewables will more than obviate the need for more thermal coal imports.

South Korean imports expected to decline slightly
South Korea has resumed the temporary suspension of operations at five coal-fired units which are more than 30 years old. The closures affect 2.3 GW of generating capacity, run from March to June 2018, and will impact around 2.5 million tonnes of sub-bituminous coal imports.

South Korean coal consumption is expected to stagnate over the forecast period, as the government attempts to reduce coal’s share in the power mix. Over 5 GW of new coal capacity have just been commissioned and another 4 GW are under construction.

With coal consumption set to stall, imports are unlikely to grow. However, with air pollution becoming an increasing problem in the larger South Korean cities, there could be a move to higher grade coal.

ASEAN demand to become more important
South East Asian nations will become more important sources of demand, particularly towards the end of the forecast period. Nations such as Thailand, Vietnam, the Philippines and Malaysia are forecast to import increasing amounts of thermal coal to satisfy growing power generation needs. Pakistan will also consume more coal, as its (large) population’s energy needs grow.
6.4 World production and exports

Indonesia’s efforts to place further price controls on coal may backfire

Indonesia’s President Widodo recently signed a regulation authorising Indonesia’s Energy and Mineral Resources Minister to set the price (HBA2 index) of coal for the domestic market (Indonesia consumes just under one-fifth of the 460 million tonnes per annum of coal it produces and exports the rest). Indonesia is already set to hold local electricity and fuel prices at current levels for two years. Combined with a domestic reservation scheme3, the danger is that coal miners will be discouraged from producing (and exploring for) coal if their margins are held artificially low (in order to effectively subsidise electricity prices). The Indonesian Government could also raise its export tax to discourage coal exports; this would be aimed at slowing the depletion of the country’s coal resources.

United States production unlikely to flood seaborne markets

United States production is expected to drift lower over the forecast period. Weaker prices in the short term, sluggish power demand growth and robust renewable expansion will limit coal demand, notwithstanding friendlier policies towards coal implemented by the US Administration. A further switch in power generation towards gas poses downside risks.

Russian exports are set to continue their recent strength

A feature of 2017 was the solid gains in Russian thermal coal exports, particularly to western Europe. The sharp depreciation in the Russian Ruble in 2013–14 helped raise the competitiveness of Russian coal miners, and as a result Russian thermal coal exports have risen at an average annual rate of 6.5 per cent since 2013.

Notes: Includes thermal coal and lignite production

2 The Harga Batubara Acuan (HBA) is a monthly average price, based 25 per cent on the Platts Kalimantan 5,900 kcal/kg GAR assessment; 25 per cent on the Argus-Indonesia Coal Index 1 (6,500 kcal/kg GAR); 25 per cent on the Newcastle Export Index and 25 per cent on the globalCOAL Newcastle (6,000 kcal/kg NAR) index.

3 To secure domestic supplies, the Indonesian Ministry of Energy and Mineral Resources can order domestic coal producers to reserve a specific amount of their production for domestic consumption (the Domestic Market Obligation, or DMO). In 2018, the DMO has been set at 25 per cent of the 485 million tonnes production target. The government aims for more domestic consumption of coal, as it wants coal to supply around 30 percent of the country’s energy mix by 2025.
6.5 Australia

Thermal coal production expected to rise modestly

Production declined marginally in 2017. A number of factors explained the declines, including bad weather, industrial problems (mainly affecting Queensland output) and mine production sequencing changes at major mines in the NSW Hunter Valley. The average strip ratio rose (see Box 1).

Production is expected to rise marginally over the forecast period, from 250.0 million tonnes in 2017 to 255.2 million tonnes in 2022–23. The modest rise will come despite declining prices.

The reason for the modest rise in Australian output is the flat outlook for thermal coal usage in the nations that currently consume the vast majority of Australia’s thermal coal exports. Australian exporters are likely to increase their share of a stagnant market, as countries such as China and South Korea consume higher amounts of high energy/low to medium ash coal to reduce air pollution and meet international climate commitments.

Gains in Australia’s share of world seaborne trade rest on obtaining more of the (likely faster growing) Indian and ASEAN markets — the former currently being dominated by relatively low grade Indonesian and South African coal. The forecasts assume that Australia has some success in this endeavour: the higher quality of Australian coal will be needed to prevent the further build-up of air pollution, which is now a chronic problem in some of the larger Indian cities.

Adani has not yet reached a final investment decision (FID) on the Carmichael mine in Queensland’s Galilee Basin. Public announcements by the company suggest that funding for both the mine and the rail operations (needed to take output from the mine to port) has not yet been secured. The potential additional production from Carmichael would add substantially to total Australian production in the latter half of the forecast period, but whether the project commences operations depends on a range of factors, including market conditions and access to rail infrastructure.

Box 6.1: Strip ratios in the NSW open-cut coal sector

As with the Queensland coal mining sector, 2017 saw a rise in the average strip ratio in NSW — where most coal that is mined is of the thermal variety. Here too, high thermal and metallurgical coal prices justified the extraction of coal that required increased overburden removal. By mining the areas of a tenement that have high levels of overburden, this may allow new low strip areas to be accessed and/or existing low strip areas to be preserved for when prices fall.

Over the past decade, the strip ratio in NSW has been on a very slight downward trend. The strip ratio could be expected to fall back if prices follow the (declining) path forecast over the outlook period.

Figure 6.7: NSW strip ratio*, quarterly

Notes: *Overburden removed (cubic metres) divided by raw coal output of open-cut mines
Source: Coal Services (2018); Department of Industry, Innovation and Science (2018)
Australia’s thermal coal export earnings to decline after 2017-18

Australian export earnings are set to hit a record $22.8 billion dollars in 2017-18, as strong prices combine with increased export volumes. China’s production cuts go a long way in explaining the fortuitous gains in Australian thermal coal export earnings over the past two years.

Going forward, the impact of easing thermal coal prices is expected to more than offset the impact on export earnings of minor growth in export volumes. Earnings are expected to bottom out at around $16.2 billion in 2020–21 and 2021–22, before rebounding to $17.1 billion in 2022–23.

If the Carmichael mine proceeds, it is highly likely that the vast majority — if not all — of the output will be exported. Moreover, it is unlikely that the output of the Adani mine will offset output from established Australian coalfields: Carmichael would mostly displace sales of lower grade Indonesian and South African coal into the important Indian market, where current Australian sales are comparatively poor.

Coal exploration

Australia’s coal exploration expenditure remains relatively modest, with $39.0 million invested in the December quarter.

Over 2017 as a whole, exploration expenditure totalled $124.0 million. This represents little change from 2016, but remains well below the peak level of $757 million recorded in 2011.

The downtrend in coal exploration over the past 7 years has been driven by falling coal prices and oversupply in low-grade coal markets. However, there are prospects for recovery, should the recent price lifts be sustained.

Most coal exploration now underway is taking place in Queensland, with exploration in other States having fallen away in recent years. This trend likely reflects the comparatively favourable outlook for metallurgical coal compared to thermal coal.

Figure 6.9: Australia’s coal exploration expenditure, quarterly

Table 6.1: Thermal coal outlook

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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; e In 2018 calendar year US dollars; s Estimate; f Forecast; z Projection

Sources: ABS (2017) International Trade, cat.no 5465.0; IHS Inc (2017); IEA (2017) Coal Information 2018; Coal Services Pty Ltd; Queensland Department of Natural Resources and Mines (2018); Department of Industry, Innovation and Science (2018); Company Reports
Gas
Resources and Energy Quarterly March 2018

- LNG is natural gas cooled to -162°C
- 2nd largest LNG exporter in the world
- 52 million tonnes of LNG exported in 2016–17
- 41% rise from 2015–16 export volumes
- 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 key export destinations, 2016–17
- 48% Japan
- 29% China
- 11% South Korea
- 7% Singapore
- 3% India
- 3% Rest of the world

Global share of LNG exports in 2016
- 30% Qatar
- 16% Australia
- 10% Malaysia
- 7% Nigeria
- 6% Indonesia
- 32% Rest of the world

Global share of LNG imports in 2016
- 34% Japan
- 13% South Korea
- 9% China
- 7% India
- 5% Taiwan
- 31% Rest of the world
7.1 Summary

- The real value of Australia’s LNG exports is forecast to increase from $23 billion in 2016–17 to $39 billion in 2022–23, driven by higher export volumes and, to a lesser extent, higher prices. LNG is forecast to overtake metallurgical coal as Australia’s second largest resource and energy export in 2018–19.
- The completion of the final three Australian LNG projects under construction will underpin strong growth in export volumes and bring total export capacity to 88 million tonnes.
- LNG contract prices — at which most Australian LNG is sold — are projected to increase gradually in line with oil prices.
- Australian LNG projects are likely to face increasing competition. Global LNG markets look set to move into a period of overcapacity, starting in the second half of 2018 and lasting through to 2020. However, slippages in project completions have the potential to delay overcapacity.

7.2 Prices

Asian LNG prices recovered in 2017

Gas prices and gas pricing mechanisms vary from region to region. Prices for LNG delivered into North Asia increased in 2017, driven by a gradual recovery in oil prices. Oil-linked pricing has been the dominant pricing mechanism in Asia since Japan began importing LNG in the late 1960s as a substitute for oil in power generation. The average price of LNG (Delivered Ex Ship) imported by Japan — the world’s largest LNG buyer — was $9.80 a gigajoule in 2017 (US$8.0 per MMbtu), up from $8.70 a gigajoule in 2016 (US$6.80 per MMbtu).

Asian LNG spot prices also recovered in 2017. Prices (Delivered Ex Ship) averaged $9.00 a gigajoule (US$7.20 per MMbtu), up from $7.40 a gigajoule in 2016 (US$5.80 per MMbtu). Prices rose sharply towards the end of the year (Figure 7.1), driven by strong winter buying by major importers in Asia (particularly China), but have subsequently declined to around $10.50 in March 2018 (US$8.60 per MMbtu).

LNG contract prices to increase, but LNG spot prices to fall

Oil-linked LNG contract prices in North Asia are projected to rise gradually over the outlook period. The real Japan Customs-cleared Crude (GCC) oil price, to which Asian LNG contract prices are often linked, is projected to increase from US$55 a barrel in 2017 to US$60 a barrel in 2023.

LNG spot prices in Asia are expected to decline in the short term. Asian LNG spot prices (Delivered Ex Ship, real 2018 dollar terms) are forecast to fall to an average $6.60 a gigajoule in 2019 (US$5.60 per MMbtu), as additions to global supply capacity outstrip growth in LNG demand over the next few years. LNG spot prices are then projected to gradually recover from 2020 as supply growth slows, reaching an average $9.40 a gigajoule in 2023 (US$7.90 per MMbtu).

Figure 7.1: Gas and LNG prices, monthly

Notes: Henry Hub is the US domestic gas reference price. National Balancing Point is the most liquid gas trading hub in Europe.
Source: Argus (2018); Bloomberg (2018)

With the United States emerging as a major source of new supply, US LNG exports are expected to add to downward pressure on Asian LNG spot prices over the next few years. The cost of delivering US LNG to Asia will be determined by the price for which US LNG exporters can purchase
domestic gas for export, plus the cost of liquefaction and transportation to Asia. If current Henry Hub prices persist, and if tolling fees (fixed charges paid by LNG buyers that cover the capital costs of US LNG plants) are treated as a sunk cost, this could potentially be as little as US$5.00 per MMbtu ($6.30 a gigajoule). However, the capacity of the Panama Canal (the fastest route from the US’ east coast terminals to Asia) to accommodate growing LNG shipments could potentially limit growth in US exports to the region.

Box 7.1: Price developments in the eastern gas market

The majority of gas in Australia’s eastern market — which excludes the Northern Territory — is traded on bilateral contracts. Prices on recently executed contracts for gas supply in 2018 in Australia’s eastern gas market are around current netbacks from oil-linked LNG contract prices; that is, around LNG contract prices less the costs of liquefying and transporting gas from Australia to international customers.

According to the ACCC December 2017 Gas Inquiry, the average wholesale gas price for supply in 2018 on a new gas supply agreement is A$8.45/GJ in Queensland and A$9.01/GJ in the southern part of the eastern gas market. In early 2018, LNG netbacks from oil-linked contract prices were in the $8-9 a gigajoule range at Wallumbilla, Queensland.

Domestic wholesale spot prices have only increased modestly as Asian LNG spot prices have spiked, as Figure 7.2 shows. The December 2017 Resources and Energy Quarterly identified a number of reasons for this, including rigidities in organising sales of spot LNG, a lack of liquidity in domestic spot markets, and other influences on domestic spot prices.

Expectations of future international LNG prices are expected to shape domestic contract price negotiations as buyers look to recontract for new supply. Domestic gas prices in Australia’s eastern gas market may become increasingly integrated with global LNG prices if an LNG import terminal is established in the southern part of the market. AGL is considering an LNG import terminal in Victoria, starting operations in 2020 or 2021, while Australian Industry Energy (AIE) is considering one in New South Wales.

7.3 World trade

World LNG imports are projected to increase from 250 million tonnes in 2016 to 378 million tonnes in 2023. Emerging Asia — led by China — and Europe are expected to drive demand growth. Prospects for growth in the imports of Japan and South Korea are more limited.

Despite robust growth in demand, the expansion in global LNG supply capacity is expected to outpace LNG demand over the next few years. Overcapacity in global LNG markets is expected to set in sometime in 2018 and last through to 2020 (Figure 1.3). The expansion in global liquefaction capacity will be concentrated in the United States, Australia and Russia.
From early next decade, however, the market is expected to begin rebalancing, as growth in global liquefaction capacity slows in the second half of the outlook period. There are few new LNG projects in the investment pipeline, and LNG projects typically have lead times of five years or more between final investment decisions (FIDs) and completion.

**Figure 7.3: Global liquefaction capacity and LNG demand**

![Graph showing global liquefaction capacity and LNG demand](image)

Notes: global liquefaction capacity is nameplate capacity.  
Source: Nexant (2017); Department of Industry, Innovation and Science (2018)

### 7.4 World imports

**Nuclear restarts to weigh on Japan’s LNG imports**

The LNG imports of Japan, the world’s largest buyer, are projected to fall from 86 million tonnes in 2017 to 76 million tonnes in 2023. Gas consumption in both the residential and industrial sectors is expected to remain relatively stable over the outlook period. At the same time, LNG is expected to face increasing competition in the power generation sector, which accounts for around two-thirds of Japan’s gas consumption.

The Fukushima nuclear disaster in 2011 resulted in the closure of Japan’s fleet of nuclear reactors. At the time of writing, five of Japan’s fleet of 42 nuclear reactors, with a combined capacity of 4.4 gigawatts, had recommenced operations. Four more reactors (combined capacity 4.7 gigawatts) had received final approval to restart. A further 21 reactors have applications in front of the Nuclear Regulation Authority for restart — the administrative body charged with ensuring the safety of nuclear plants.

The timing and scale of nuclear restarts remains a key uncertainty affecting the outlook for gas consumption in Japan. To date, the pace of nuclear restarts has been slow, with nuclear energy continuing to face public opposition. There remain significant risks of delays and slippages in nuclear restarts.

Gas is also expected to face increasing competition in power generation from renewable energy sources. Between 2010 and 2016, renewable generation in Japan increased from 10 terrawatt hours to 50 terrawatt hours, with most of the increase led by solar and wind power.

**Figure 7.4: LNG import forecasts**

![Graph showing LNG import forecasts](image)

Notes: 2017 is an estimate.  
Source: Nexant (2017); Department of Industry, Innovation and Science (2018)
Modest growth projected for South Korea’s imports

South Korea’s LNG imports are projected to increase slightly over the outlook period, rising from 36 million tonnes in 2017 to 38 million tonnes in 2023. Gas consumption in the residential and industrial sectors is expected to remain relatively flat. However, there is potential for growth in gas use in power generation, which accounts for around half of South Korea’s gas consumption.

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. Gas-fired generation capacity will increase by around a third, while no new coal or nuclear plants (other than those under development) will be approved.

Over the outlook period (to 2023), several recent announcements by the South Korean government should support the use of LNG in power generation. From 2018, South Korea will suspend operations at eight old coal-fired power stations between March and June each year in order to reduce air pollution. These eight coal-fired power stations, plus a further two, will be permanently closed by mid-2022. The Government also intends to close the aged Wolsong 1 nuclear reactor, with reports this could occur as early as 2018.

If coal-fired and nuclear generation capacity is reduced, increased LNG imports may be required. While the medium term outlook is for a modest increase in South Korea’s imports, South Korea’s LNG imports are forecast to decline slightly in 2018. South Korea experienced unexpected nuclear outages over 2017, and the return to operation of nuclear reactors over 2018 is expected to weigh on LNG imports in the short term.

China will make the single largest contribution to growth in LNG demand

China’s LNG imports increased rapidly in 2017, driven by government policies designed to address air pollution by encouraging gas use in place of coal. The Chinese government is aiming to increase the share of gas in the energy mix from 5.3 percent in 2015 to 8.3-10 per cent in 2020. Chinese gas consumption is projected to reach the lower end of this target in 2020, before climbing to 357 billion cubic metres in 2023.

LNG is expected to play an important role in servicing rising gas demand. China’s LNG imports are forecast to increase from 37 million tonnes (50 billion cubic metres) in 2017 to 57 million tonnes in 2020, before declining to 50 million tonnes (68 billion cubic metres) in 2023.

Figure 7.5: China’s gas consumption by source, 2016–2023

A key factor affecting China’s LNG demand will be the extent of competition from domestic gas production and gas imported through pipelines. China’s pipeline imports are expected to remain relatively stable over the first half of the outlook period. From the early 2020s, however, LNG will likely face stiffer competition from pipeline imports. China is expected to begin importing gas from Russia via the Power of Siberia pipeline around this time, starting at 5 billion cubic metres in the first year of operation and reaching 38 billion cubic metres in the sixth year.

China’s domestic production is expected to grow steadily over the outlook period. China is reportedly targeting natural gas production of 220 billion cubic metres in 2020, up from 137 billion cubic metres in 2016, including an increase in shale gas production from 4.5 billion cubic metres in 2015 to 30 billion cubic metres in 2020. China’s gas production is not expected to reach this target during the outlook period.
Other emerging Asian economies to also drive demand growth

Other economies in emerging Asia are expected to make a large contribution to growth in global LNG imports, including India, Pakistan, Bangladesh, Indonesia, Thailand and Singapore. Growth will be underpinned by low LNG spot and short-term contract prices and the availability of floating storage and regasification unit (FSRU) technology. FSRU technology can be installed relatively cheaply and quickly compared to a conventional onshore import terminal, opening up the option for countries to import small volumes of LNG.

India’s LNG imports are projected to grow substantially, climbing from 18 million tonnes in 2017 to 37 million tonnes in 2023. The Indian Government is aiming to increase the share of gas in the energy mix from 6.5 per cent at present to 15 per cent as soon as 2022, according to recent statements. India’s domestic production is not expected to keep pace with the country’s future gas needs, and LNG is expected to play an important role in meeting rising demand. India currently has four LNG import facilities, and the Indian Government has announced plans to build 11 new import terminals on India’s east coast over the next seven years. The extent of India’s LNG requirements will partly depend on progress on the Iran-Pakistan-India and Turkmenistan-Afghanistan-Pakistan-India pipelines.

Europe’s LNG imports are set to increase

Despite a relatively subdued demand outlook for gas consumption, European LNG imports are projected to increase to 68 million tonnes in 2023, up from an estimated 41 million tonnes in 2017. Europe’s pipeline imports are expected to remain relatively stable over the outlook period, while European gas production is projected to fall (particularly in the Netherlands), creating room for LNG imports to grow.

While Europe is not a large market for Australian LNG, the outlook for European gas demand is still important for Australian producers. If LNG demand in Europe does not grow as strongly as projected, Qatari and US LNG may be displaced, potentially bringing increased competition to the Asia-Pacific.

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. Around half of all new capacity will come from the United States. By the end of 2019, all six LNG projects in the United States are expected to have commenced operations, bringing the combined nameplate capacity of US LNG projects to 67 million tonnes.

Major new capacity additions are also expected in Australia (discussed below) and Russia. LNG capacity is Russia is expected to expand over the next few years as the Yamal LNG project (nameplate capacity of 16.5 million tonnes) comes online. The Yamal project shipped the first cargo from the first of its three LNG trains in 2018.

Figure 7.6: Global LNG supply capacity

Qatar’s LNG exports are projected to remain largely unchanged

Qatar is the world’s largest LNG exporter. Since 2011, Qatar’s exports have ranged from 72-77 million tonnes per annum, and they are projected to remain in this range over the outlook period.
Qatar’s plans to increase LNG production capacity by 30 per cent to 100 million tonnes are not expected to have a significant impact on its LNG exports over the next five years. The expansion, announced in mid-2017, is expected to take 5-7 years to complete. Growth in LNG exports will be supported by new gas production from Qatar’s North Field. Qatar lifted its self-imposed moratorium on new gas development at its North Field in April 2017.

7.6 Australia

LNG export earnings to increase, largely driven by higher export volumes

Australia’s LNG export earnings are forecast to increase from $23 billion in 2016–17 to $39 billion in 2022–23 (2017–18 dollar terms). As Figure 7.7 shows, rising export values will be driven by higher export volumes (especially over the short term) and, to a lesser extent, higher prices.

Australia’s LNG export volumes are forecast to reach 79 million tonnes in 2022–23, up from 52 million tonnes in 2016–17. Higher export volumes will be driven by the completion of the three remaining LNG projects under construction — Wheatstone, Ichthys and Prelude. The completion of these three projects will bring the combined nameplate capacity of Australia’s LNG projects to 88 million tonnes.

Chevron’s Wheatstone project is likely to be the first of the three projects completed. Train 1 at Wheatstone has already begun production while train 2 is due to come online in the June quarter 2018. Shell has indicated that the Prelude Floating LNG project will be completed between May and August 2018. First gas production at Inpex’s two train Ichthys project is expected to start in April or May 2018.

Additional export capacity could be added later in the outlook period. Woodside concluded feasibility studies last year for a capacity expansion at the Pluto project of between 0.7 and 3.3 million tonnes per annum. The first expansion option — debottlenecking — would add just under one million tonnes of capacity. The second — an off-the-shelf train that would plug-in to the existing infrastructure — would add 1 to 1.5 million tonnes.

A larger expansion would see gas from the Scarborough gas field piped through the Pluto LNG plant.

**Figure 7.7: Annual growth in Australia’s real LNG export values, contributions from prices and export volumes**

Higher Australian LNG prices to play a part in lifting export earnings

The price of Australian LNG (FOB) is projected to edge up from $8.30 a gigajoule in 2016–17 to average $9.30 a gigajoule in 2022–23 (Figure 7.8). Higher export prices will be driven by rising oil-linked contract prices. Most Australian LNG is sold into Asia on contracts linked to the price of Japanese Customs-cleared Crude (JCC) oil by a time lag of around three months. However, low LNG spot prices will play some role in constraining the average export price realised over the next few years, as Australian exporters increase their share of sales at spot prices.
The price competitiveness of Australian producers is another factor affecting the outlook for Australia’s LNG exports. A large cost for LNG plants is feed gas. The three LNG export terminals on the east coast — which are largely fed by CSG from Queensland’s Surat and Bowen Basins — are thought to have relatively high costs for feed gas (in the vicinity of $5-6 a gigajoule or US$4-5 per MMbtu). Unlike LNG ventures using gas from conventional reservoirs, LNG operators on the east coast need to drill hundreds of new wells each year to maintain CSG production, with costs of over a million dollars per well.

On current projections, Australia will overtake Qatar as the world’s largest LNG exporter in 2019, when Australian LNG exports reach 75 million tonnes. However, given the narrow difference between the projected exports of the two nations, Australia overtaking Qatar at this time is not certain.
### Table 7.1: Gas outlook

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<td>8.4</td>
<td>8.5</td>
<td>8.8</td>
<td>8.9</td>
<td>8.9</td>
<td>5.4</td>
</tr>
<tr>
<td>– real value e</td>
<td>US$/MMBtu</td>
<td>6.6</td>
<td>7.8</td>
<td>8.2</td>
<td>8.2</td>
<td>8.2</td>
<td>8.0</td>
<td>7.9</td>
<td>3.0</td>
</tr>
</tbody>
</table>

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 production 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 2017–18 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; Department of Industry, Innovation and Science (2018); Company reports; Nexant World Gas Model (2017)
Around 70% of crude and condensate production comes from the Carnarvon basin in WA.

Australia’s production of crude and condensate peaked in 2000, at 41,300 ML.

Around 17% of refinery feedstock is domestically produced. On average 83% is imported.

**Top five countries for Australia’s crude oil and refined product imports, 2016–17 (billion litres)**

1. **Malaysia** 10.237
2. **South Korea** 9.310
3. **Singapore** 8.994
4. **Japan** 4.974
5. **UAE** 3.421

Note: excludes natural gas imports

**Historic price snap shot:**
Brent crude oil in the last five years (US$ per barrel)

- **Highest price:** $117, 6/09/2013
- **2018 average:** $66
- **Lowest price:** $26, 19/01/2016
8.1 Summary

- Australia’s crude oil and condensate exports are forecast to increase from $5.6 billion in 2016–17 to $9.3 billion in 2022–23 in real terms, driven by higher export volumes and higher oil prices.
- Over the outlook period, declining crude oil output will be offset by higher condensate output, related to the new LNG projects coming online.
- World oil prices are projected to increase modestly over the outlook period. Higher US production and lower consumption growth is expected to limit price increases.

8.2 Prices

Oil prices reach three year highs

In January, the Brent spot price reached US$70 a barrel, its highest level since 2014, before moving lower towards the end of the quarter. Oil prices have been on the rise over the past two years, after bottoming out at US$30 a barrel in early 2015. Price gains have been driven by the OPEC Production Agreement, expanding consumption and geopolitical tensions. In 2017, Brent crude averaged US$54 a barrel, 22 per cent higher than 2016, and West Texas Intermediate (WTI) averaged US$51 a barrel, 17 per cent higher than 2016.

Over the outlook period, oil prices are forecast to increase, at a constrained pace. Lower production from OPEC and the other agreement partners — including Russia — is expected to keep world production growth constrained in the short term, despite increasing US production. With a more balanced world market, prices will also be buoyed by healthy economic conditions in growing consumer markets.

Towards the end of the outlook period, it is expected OPEC production will return to the market and increases in US production will subside. Higher capital costs and low exploration may weigh on future capacity investments. World oil prices are expected to increase, as consumption expands, however at a lower rate, due to available world supply. In 2023, average prices are projected to be US$60 a barrel for Brent and US$56 a barrel for WTI (in 2018 dollar terms).
8.3 World oil consumption

In 2017, world oil consumption expanded by 1.6 per cent, reaching 97.8 million barrels a day. Consumption growth continued to be concentrated in non-OECD markets, particularly in China and India, which showed growth of 5.1 per cent and 2.6 per cent respectively. Generally improved economic conditions in other countries facilitated healthy consumption growth in 2017.

Changing consumption patterns and moderating consumption growth

Over the outlook period, world consumption is expected to increase in line with the positive outlook for world economic conditions and growing consumer markets. In 2023, world consumption is projected to be 104.7 million barrels a day, increasing at an average annual rate of 1.1 per cent. By 2023, China and India are expected to consume an additional 1.2 and 1.1 million barrels a day of oil products, respectively.

While world consumption is set to increase, the rate of consumption growth will be slower than over the past few years. China is expected to continue to account for around 13 per cent of world consumption, as its consumption grows at around 2.6 per cent year. For all major consumption markets, including China, changing consumer preferences and government policies to decarbonise transport are expected to weigh on consumption growth over the outlook period.

In China, measures have been taken to restrict car ownership and promote lower vehicle usage, coupled with government support for electric vehicles and the electrification of bus and light truck fleets. In 2017, 2.7 per cent of all new cars sold in China were electric vehicles, and electric vehicles now make up around 0.7 per cent of China’s car population.

The most significant growth area of oil consumption is expected to be in petrochemical feedstocks, which account for around 20 per cent of total consumption. World consumption of LPG, ethane and naptha is forecast to increase by 2.3 per cent a year to 2030.
8.4 World oil production

Flat global production contributed to a rebalancing in 2017

In 2017, world oil production was 97.4 million barrels a day, unchanged from 2016 levels. Constrained OPEC production offset increases in US and Canadian production. The 2017 Production Agreement between OPEC members and Russia aimed to reduce excess supply in the world market, by reducing combined production by 1.8 million barrels a day. The agreement was initially introduced for six months, before being extended to the end of 2017. Actual total production was cut by more than the agreed level, primarily driven by Saudi Arabia and Venezuela; compliance reached 129 per cent at the end of the year.

Short-term production outlook: US to reach record high production levels

World production is forecast to reach 99.5 million barrels a day in 2018, 2.1 per cent higher than in 2017. The OPEC Production Agreement has been extended until the end of 2018. Record forecast production from the US and new production from Brazil, Canada, Mexico and Norway is expected to outweigh any production restraint exhibited by OPEC.

After strong drilling activity in 2017, sharp increases in US production are expected over the next two years, resulting in record export volumes. Operating economics have improved with industry learning and knowledge. Shale wells have high production rates, although lower operating lifetimes than conventional oil fields.

Low-cost production from the Permian is expected to raise US production to 14.7 million barrels a day in 2018, 11.5 per cent higher than 2017. Under current forecasts, the US is expected to become the highest producer in the world in 2018, exceeding Saudi Arabia’s production of around 12.3 million barrels a day and Russia’s 11.3 million barrels a day.
OPEC production outlook — continuing to coordinate

In 2017, combined OPEC production was 39.2 million barrels a day, 0.9 per cent lower than the previous year. With strong compliance to the agreement and positive oil market movements in 2017, it is expected that production will be little changed in 2018. Volatile production from a number of OPEC producers poses risks to the outlook. Venezuela’s oil production decreased significantly in 2017 to reach 30-year lows. Difficult economic conditions and operational constraints with labour and refinery inputs make significant production recovery unlikely. Output from Nigeria and Libya, who are excluded from the OPEC agreement, have not reached production targets due to militant attacks on oil infrastructure.

Production may return to OPEC-led market dynamics

Towards the end of the outlook period, it is expected that OPEC and agreement partners will seek to maintain balance in world markets; a coordinated transition away from the OPEC Production Agreement or an ongoing arrangement is likely to be established. US shale productivity is expected to decrease, as ‘sweet spots’ are exploited. World production is projected to increase at an average rate of 1.7 per cent a year to 2023, reaching 106.7 million barrels a day.

8.5 Australia

Positive export outlook

The real value of Australia’s petroleum exports is projected to increase over the outlook period; in 2022–23, crude oil and condensate export earnings are projected to reach $9.3 billion, up from $5.6 billion in 2016–17.

Export earnings growth is expected to be primarily driven by higher export volumes, which are forecast to reach record levels over the outlook period. Higher condensate exports, co-produced at the new LNG facilities, are expected to contribute to export volumes growing by an average 10.8 per cent a year over the outlook period. In 2022–23, export volumes are projected to reach 311 thousand barrels a day, up from 221 thousand barrels a day in 2016–17.

![Figure 8.7: Australia’s export volumes and values](image-url)


Declining crude oil production balanced by higher condensate production

Australia’s petroleum production is expected to increase over the outlook period, as declining oil field production is outweighed by increased condensate production. Total production is projected to increase from 283 thousand barrels a day in 2016–17, to 372 thousand barrels a day in 2022–23. Within this, crude oil production is projected to decrease at an average annual rate of 4.7 per cent over the outlook period, reaching a projected production rate of 109 thousand barrels a day in 2022–23. The Greater Enfield facility, with an operating capacity of 40 thousand barrels a day, is scheduled to come online mid-2019, extending the life of Woodside’s Enfield project.

Significant increases in condensate production in the first few years of the outlook period are expected, as the Wheatstone, Icthys and Prelude LNG projects come into full operation. Inpex’s Icthys project in the Bonaparte basin is expected to become the biggest producing petroleum field in Australia with peak capacity of 100 thousand barrels a day of condensate.
Continued declines in exploration expenditure and quiet project horizon

Oil and gas exploration expenditure decreased at an annual rate of 26.9 per cent in the December 2017 quarter, to $245 million. Low average oil prices and a difficult operating environment have contributed to the reduction in exploration activity. Future investment is focused on brownfields expansion and backfilling declining production fields.

**Figure 8.8: Australia’s petroleum production**


**Box 8.1: Australia’s petroleum refineries**

There are four major petroleum refineries in Australia, with an average age of 65 years. Australia’s refineries have been extensively upgraded since start-up, in order to modernise production and meet higher fuel standards. However, Australia’s refineries are relatively small by world standards, with the largest having a capacity of 8,650 million litres per year, compared to the four largest Asian refineries, which each produce between 30,000 and 70,000 million litres per year.

Unleaded petrol and diesel form the largest portion of Australia’s refinery output, at 79 per cent of total production. Jet fuel and LPG, as well as specialty products like bitumen and chemical feedstocks, are also produced domestically.

Australia’s refineries typically produce around 40-45 per cent of the refined products that are consumed in Australia, with the remainder primarily imported from South Korea, Singapore and Japan and Malaysia.

**Table 8.1: Australia’s refinery capacity**

<table>
<thead>
<tr>
<th>Refinery, company</th>
<th>Location</th>
<th>Start-up</th>
<th>Capacity ML/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwinana, BP</td>
<td>Kwinana, WA</td>
<td>1955</td>
<td>8650</td>
</tr>
<tr>
<td>Geelong, Viva Energy</td>
<td>Geelong, VIC</td>
<td>1954</td>
<td>7470</td>
</tr>
<tr>
<td>Lytton, Caltex</td>
<td>Brisbane, QLD</td>
<td>1949</td>
<td>6500</td>
</tr>
<tr>
<td>Altona, Mobil</td>
<td>Altona, VIC</td>
<td>1949</td>
<td>5222</td>
</tr>
</tbody>
</table>

Source: Company websites, Australian Institute of Petroleum (2018)

Refinery production has recently increased, as refinery investment, debottlenecking programs and technical overhauls were undertaken at all major facilities over the last four years. To optimise production and improve capacity at a petroleum refinery, ‘turnaround maintenance’ is undertaken around every 4-6 years. Refineries have also invested in production facilities to cater to growing consumer markets, and to increase storage capacity and supply chain flexibility.

Australia’s refinery output increased at an annual rate of 5.8 per cent in the December quarter, to 463 thousand barrels a day. Australia’s refinery production is expected to continue at current rates over the outlook period, taking into account scheduled maintenance.

Towards the end of the outlook period, refinery production is projected to average 420 thousand barrels a day.

World refinery capacity is expected to expand over the outlook period, by 7.7 million barrels a day in 2023, an annual growth rate of 1.5 per cent. Expanding refinery capacity is expected to outpace the growth in refined product consumption over the medium term.

**Australia’s refining activity**

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### Table 8.2: Oil outlook

<table>
<thead>
<tr>
<th>World</th>
<th>Unit</th>
<th>2017 s</th>
<th>2018 f</th>
<th>2019 f</th>
<th>2020 z</th>
<th>2021 z</th>
<th>2022 z</th>
<th>2023 z</th>
<th>CAGR r</th>
</tr>
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<tbody>
<tr>
<td>Production a</td>
<td>mb/d</td>
<td>97.4</td>
<td>99.5</td>
<td>101.7</td>
<td>103.8</td>
<td>105.0</td>
<td>106.0</td>
<td>106.7</td>
<td>1.8</td>
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<tr>
<td>Consumption a</td>
<td>mb/d</td>
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<td>99.2</td>
<td>100.5</td>
<td>101.5</td>
<td>102.6</td>
<td>103.7</td>
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<td>WTI crude oil price</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal</td>
<td>US$/bbl</td>
<td>50.5</td>
<td>59.2</td>
<td>59.4</td>
<td>61.6</td>
<td>61.7</td>
<td>61.2</td>
<td>61.9</td>
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<tr>
<td>Real b</td>
<td>US$/bbl</td>
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<td>59.2</td>
<td>58.1</td>
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<td>58.2</td>
<td>56.6</td>
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<td>1.7</td>
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<tr>
<td>Brent crude oil price</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal</td>
<td>US$/bbl</td>
<td>54.0</td>
<td>63.4</td>
<td>63.7</td>
<td>65.9</td>
<td>66.0</td>
<td>65.5</td>
<td>66.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Real b</td>
<td>US$/bbl</td>
<td>55.3</td>
<td>63.4</td>
<td>62.3</td>
<td>63.3</td>
<td>62.2</td>
<td>60.6</td>
<td>60.1</td>
<td>1.7</td>
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<td>Crude and condensate</td>
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<tr>
<td>Production a</td>
<td>kb/d</td>
<td>283</td>
<td>296</td>
<td>364</td>
<td>413</td>
<td>406</td>
<td>385</td>
<td>372</td>
<td>4.7</td>
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<tr>
<td>Export volume a</td>
<td>kb/d</td>
<td>221</td>
<td>229</td>
<td>301</td>
<td>345</td>
<td>339</td>
<td>321</td>
<td>311</td>
<td>6.3</td>
</tr>
<tr>
<td>Nominal value</td>
<td>A$m</td>
<td>5,476</td>
<td>6,731</td>
<td>8,759</td>
<td>10,332</td>
<td>10,383</td>
<td>9,769</td>
<td>10,515</td>
<td>9.3</td>
</tr>
<tr>
<td>Real value g</td>
<td>A$m</td>
<td>5,586</td>
<td>6,731</td>
<td>8,558</td>
<td>9,863</td>
<td>9,677</td>
<td>8,886</td>
<td>9,333</td>
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<tr>
<td>Imports a</td>
<td>kb/d</td>
<td>351</td>
<td>377</td>
<td>368</td>
<td>363</td>
<td>358</td>
<td>342</td>
<td>350</td>
<td>-1.5</td>
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<tr>
<td>LPG production ac</td>
<td>kb/d</td>
<td>52</td>
<td>54</td>
<td>109</td>
<td>102</td>
<td>71</td>
<td>67</td>
<td>65</td>
<td>3.8</td>
</tr>
<tr>
<td>Refined products</td>
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<td></td>
<td></td>
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<tr>
<td>Refinery production a</td>
<td>kb/d</td>
<td>429</td>
<td>447</td>
<td>440</td>
<td>440</td>
<td>434</td>
<td>415</td>
<td>420</td>
<td>-1.2</td>
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<tr>
<td>Export volume ad</td>
<td>kb/d</td>
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<td>13</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>-7.2</td>
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<tr>
<td>Import volume a</td>
<td>kb/d</td>
<td>616</td>
<td>652</td>
<td>721</td>
<td>734</td>
<td>732</td>
<td>757</td>
<td>756</td>
<td>3.0</td>
</tr>
<tr>
<td>Consumption</td>
<td>A$m</td>
<td>1,004</td>
<td>1,047</td>
<td>1,070</td>
<td>1,086</td>
<td>1,103</td>
<td>1,119</td>
<td>1,125</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Notes: Number of days in a year is assumed to be exactly 365; b In 2018 calendar year dollars; c Primary products sold as LPG; d Excludes LPG; e Domestic sales of marketable products; f Forecast; g In 2017–18 financial year Australian dollars; z Projection. A barrel of oil equals 158.987 litres.

Uranium
Resources and Energy Quarterly March 2018

Australia holds 31% of the world’s proven uranium reserves.

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

Uranium makes up 11% of global electricity generation.

There are 245 civil research reactors operating across 56 countries.

There are 447 nuclear power reactors across 31 countries, with 60 more being built.

Major Australian uranium deposits (tonnes):
- <2,967
- 2,968–6,762
- 9,763–17,571
- 17,572–59,338
- >59,339

Uranium required in 2017 (tonnes):
- USA: 17,847
- France: 9,216
- Russia: 7,767
- China: 7,757
- South Korea: 4,816
- Japan: 2,517
9.1 Summary

- Uranium spot prices remain historically low, but are expected to rise slowly over the outlook period, lifting from $US25 a pound at the start of 2018 to just over $US38 a pound by 2023. This reflects supply cutbacks in Kazakhstan and Canada, and new reactor builds across Asia.

- Australian production is expected to trend down marginally over the next three years, as output from the Ranger mine edges down ahead of the cessation of production in 2021. However, production at the Mulga Rock mine is projected to begin in 2022, leading to some recovery in production by 2023.

- Australia’s uranium export earnings are forecast to decline slightly over the outlook period, with a rising spot price partly offsetting lower production.

9.2 Prices

Prices have stabilised, and are forecast to gradually increase


Although prices have turned slightly, they remain historically low and well below production costs for most mines. Price pressures on producers will also increase, as legacy contracts expire over the next 4-5 years, placing downward pressure on contract prices and narrowing the gap between contract and spot prices.

Low prices may force some high-cost producers out, potentially curbing supply over the outlook period. However, supply cuts will not necessarily lead to significant price growth: previous such cuts over 2017 produced only short-lived and temporary price lifts, due to demand volatility and the quantity of stored-up uranium accumulated since the Fukushima nuclear reactor accident.

There is thus little pressure for new supply to enter the market, although some extra output is expected to emerge from low-cost operations in Kazakhstan and Namibia.

Demand is expected to have more effect on price movements over the outlook period, with 50,000 megawatts (MW) of nuclear reactor capacity currently under construction across Asia. The completion of new reactors is expected to slowly increase uranium requirements, putting prices on a rising arc over the next five years. However, this price lift will be delayed and drawn out by the existence of substantial secondary markets and inventories, as well as demand volatility linked with intense competition from gas and renewables.

Spot prices are forecast to rise to around $US25 over the next six months, then make further gains over subsequent years, reaching around $US38 a pound by 2023 — a high enough level to encourage new exploration and additional primary supply to enter the market. Contract prices are expected to lift at a slower pace, broadly tracking the spot market but subject to additional drag, due to the expiry of legacy contracts.

Figure 9.1: Uranium prices, monthly

9.3 Consumption

Growth in nuclear power continues, but with heavy concentration in Asia. Uranium use is projected to grow solidly over the next five years, rising from 80,900 tonnes in 2017 to just over 97,000 tonnes by 2023. This is expected to be driven by a large wave of reactor constructions, many of which will have concluded by 2023. China is expected to complete almost 30 new reactors over this period, while significant construction programs are also underway in Turkey, India, and Russia.

The US, which failed to bring new reactors online for decades, has recently completed several, and is now expected to bring its large Vogtle 3 and 4 reactors online by 2023. A Bipartisan Budget Act passed by Congress has extended incentives for nuclear projects, providing tax breaks similar to those on offer for renewables. This will improve prospects for the Vogtle reactors as well as NuScale’s small modular reactor project.

Japan has reconnected five of the 42 operable reactors disconnected after Fukushima. A further four reactors (Kyushu EPC’s Genkai units 3 and 4, and Kansai EPC’s Ohi units 3 and 4) have received approval from Japan’s Nuclear Regulation Authority to restart, with reconnection expected by mid-2018. Another 21 reactors have applications in front of Japan’s Nuclear Regulation Authority for restart.

Germany is expected to shut down its 1284 MW Gundremmingen-B reactor by the end of 2018 in line with its Energiewende policy, which has seen nuclear power progressively replaced with coal and renewables. A further 7 reactors are mooted to close in Germany over the next 5 years, although the likely impact on carbon emissions and grid reliability may create pressure to delay. France has indefinitely postponed its own plans to reduce nuclear power from 75 per cent to 50 per cent of electricity use, opting instead to phase-out coal power by the early 2020s.

Longer term prospects for nuclear power depend in part on the rate at which reactors built during the 1970s are decommissioned. Technology will play an important role in enabling future nuclear power, with much depending on the progress of mass-producible Generation IV reactors.
9.4 Production

Mine output is falling, but huge inventories will fill the emerging supply gap

Low prices drove a series of production cutbacks in 2017, which will sharply cut global mine production — from 69,000 tonnes in 2017 to an expected 59,800 tonnes in 2018. Significant cutbacks are already in effect at Cameco’s majority-owned McArthur River/Key Lake project in Canada, and New AREVA’s SOMAIR project in Niger. Some cutbacks in Kazakhstan made over the past 12 months will also likely persist into 2021, with still more cuts in prospect should prices stay low.

Production is expected to bottom out in 2018, before rising slowly, to just over 78,000 tonnes by 2021. Two countries — Kazakhstan and Namibia — are expected to provide the bulk of this production growth. Kazakhstan has a range of mines due to ramp up production late in the outlook period. And Namibia’s newly developed Husab mine — which will become one of the largest mines in the world — is also expected to pursue higher production, though technical issues may delay the ramp-up into the early 2020s.

Growth in mined uranium will likely be offset in part by lower sales from US Government stocks. US Government sales are expected to be cut back in the early 2020s, leading to a temporary dip in overall supply. Total uranium supply (including mine production and secondary stocks) is likely to grow to 91,700 tonnes by 2023.

Mined supply is expected to remain below demand for each of the next five years, creating a persistent draw on inventories and secondary markets. However, with more than 1.5 billion pounds of inventories accumulated after Fukushima, uranium prices are likely to respond only slowly.

This provides little incentive for new supply in the near future. However, should prices reach around $US35 a pound, a range of alternative suppliers will become profitable, and new suppliers may emerge outside of Kazakhstan and Namibia. This is forecast to happen just beyond the outlook period.
9.5 Australia

Australia’s uranium exploration expenditure remains low

Australia’s uranium exploration expenditure fell from $6.6 million to a new low of $2.9 million in the December quarter. Exploration was $19.8 million over 2017 as a whole — far below the peak of $190 million in 2011. The result reflects a combination of historically low prices as well as a recent ban on new mines in Western Australia.

Production is expected to remain largely steady over next five years

Production edged down from 7,295 tonnes in 2016–17 to an expected 6,421 tonnes in 2017–18. The fall is largely due to a pause in production at Olympic Dam, where mine upgrades have recently concluded. Production at the mine has now returned to its pre-upgrade level, and is expected to rise gradually over time.

Two major developments are expected to affect the outlook for future supply. ERA’s Ranger mine is scheduled to cease mining operations by 2020–21. ERA has sought to keep options open for the eventual development of its 3 Deeps uranium resource, which would extend the life of the project. However, major shareholder Rio Tinto opposes the development, making it unlikely. A cessation of mining operations at the Ranger mine will reduce uranium production considerably from 2021.

Partly offsetting this, prospects have improved for the Vimy Resources’ Mulga Rock project. A definitive feasibility study demonstrated that the Mulga Rock project has “robust financials” and a “simple, low cost” mining process, with a low operating cost of $US25.11 per pound.

Prices are expected to be above this by 2021, and annual production at the mine is likely to reach 1,300 tonnes. The company is now seeking project finance and is due to make a final decision by late 2018.

The cessation of production at Ranger is expected to lead to a decline in overall Australian production to 6,000 tonnes in 2021–22. However, a recovery to around 6,400 tonnes is projected in the subsequent year, as production commences at Mulga Rock.
Other potential mines include the Kintyre, Wiluna, and Yeelirrie mines in Western Australia, all of which were granted environmental approval prior to the state ban on new mine approvals. However, it is not expected that any of these mines will open within the next five years. The Yeelirrie project was approved against the advice of the West Australian Environmental Protection Authority, and remains under legal challenge from the Conservation Council of Western Australia and members of the Tjiwarl Native Title group.

Conditions for exporters remain difficult, but some improvement is expected over the outlook period.

Export values are expected to lift slightly, to reach $620 million in real terms in 2017–18. A resumption of higher production at Olympic Dam will largely drive the improvement, offsetting the impact of ongoing weakness in prices and the likely expiration of some legacy contracts.

Export values are expected to remain roughly stable in 2018–19, with some benefit from higher spot prices offset by a potential decline in production at ERA’s Ranger mine. Spot prices are expected to continue to rise, bringing export revenue up in 2019–20, before a decline in overall revenue over the subsequent to years, as the Ranger mine moves towards closure in 2021.

A rebound in export revenues — to around $610 million — is expected towards the end of the outlook period, as production starts up at Mulga Rock.

Although overall export revenues are likely to edge down in coming years, improvements in prices should lead to steady improvement in the outlook for individual exporters, who currently face tough conditions.

There is also potential for exporters to benefit from faster-than-expected reconnections of plants in Japan, or a more rapid spread of nuclear technology (including the emerging Generation IV reactors, which have passive safety features and potential for mass-production in manufacturing plants) across Asia. Further production cuts in Kazakhstan and elsewhere may also create new opportunities for exporters to expand their share of a rapidly changing market.

Figure 9.8: Australia’s uranium exports

![Graph showing Australia's uranium exports from 2007-08 to 2022-23.]
### Table 9.1: Uranium outlook

<table>
<thead>
<tr>
<th>World</th>
<th>Unit</th>
<th>2017</th>
<th>2018 f</th>
<th>2019 f</th>
<th>2020 z</th>
<th>2021 z</th>
<th>2022 z</th>
<th>2023 z</th>
<th>CAGR r</th>
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<td>kt</td>
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**Australia**

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<tr>
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Notes: b Includes Niger, Namibia, South Africa, Malawi and Zambia; c In 2018 US dollars; d in 2017–18 Australian dollars; f forecast; z Projection; r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23.

Gold
Resources and Energy Quarterly March 2018

288 tonnes of gold produced by Australia in 2016–17

8.9% of world mine gold supplied by Australia in 2016–17

Major Australian gold deposits (t)
- <20
- 21–70
- 71–185
- 186–473
- 474–1,027
- >1,028
   - Deposit
   - Operating mine

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

Key jewellery consumer markets (tonnes)
- Turkey
- Iran
- UAE
- United States
- China
- India

Global uses of gold
- 47% Jewellery
- 24% Gold coins and bars
- 12% Gold backed Exchange Traded Funds
- 8.7% Central Bank Reserves
- 7.1% Electronics and Industrial
- 0.4% Dental and medical
10.1 Market summary

- Gold prices are projected to rise gradually over the next five years, as gold’s status as a safe haven asset fuels investor demand over the short term and world mine supply declines from 2020.
- Having averaged US$1,257 an ounce in 2017, the gold price is expected to increase by 4.8 per cent annually to reach an average of US$1,350 an ounce in 2019. Gold prices are forecast to decline in 2020, driven by lower investor demand, and then rise consecutively each year to average near US$1,300 an ounce in 2023.
- The value of Australia’s gold exports is forecast to peak in 2019–20 at near $19 billion, driven by higher prices and export volumes. Export values are projected to decline to $15 billion (in 2017–18 dollar terms) by 2022–23.
- Australian producers benefited from a historically high Australian dollar gold price in 2017. Australian dollar gold prices are expected to remain steady over the outlook period, as higher world prices offset unfavourable moves in the exchange rate.

10.2 Prices

Gold prices remained steady in 2017

The London Bullion Market Association (LBMA) gold price averaged US$1,257 an ounce in 2017, virtually unchanged from 2016. The gold price was steady as the headwind from higher interest rates was countered by persistent safe haven demand. In 2017, the US Federal Reserve increased interest rates three times and commenced reducing its balance sheet by selling US Treasuries and mortgage-backed securities. Both actions supported higher US Treasury bond yields (a common investment alternative to gold), which in turn kept pressure on gold prices. However, several events — including geo-political concerns over North Korea’s Nuclear Missile programme and political developments in the US — were supportive of gold as a safe haven asset.

Gold prices increased to average US$1,330 a troy ounce in the March quarter 2018, partly driven by a sharp selloff in US equities in February. However, the recent rise in 10 year US Treasury bond yields to near 3 per cent prevented any dramatic rise in gold — which does not offer investors any interest.

**Figure 10.1: Gold prices and key US economic variables**

Gold prices are forecast to rise in the short term due to higher investor demand for gold as a safe haven asset. Gold prices rose alongside rising US Treasury bond yields over the first quarter of 2018 departing from their usual inverse relationship, as Figure 10.2 shows. The simultaneous rise in gold prices and bond yields (which usually have an inverse relationship) is indicative of current financial risks that will likely encourage investors to purchase gold over the short term.
Any prolonged decline or unusual volatility in equities will likely support gold prices as a safe haven asset. While traditionally, rising bond yields pressure gold prices lower, this relationship is less clear than in the past, creating an upside for gold.

The US dollar is an important driver of gold prices, as Figure 10.3 shows. When the US dollar declines, gold (which is denominated in US dollars) becomes cheaper for non-US residents to purchase, leading to higher gold prices. Over most of 2017, the US dollar declined against several major currencies including the Euro and Japanese yen, supporting gold prices.

Gold prices are expected to benefit from a weaker US dollar relative to other major currencies over the short term. The US economy is at a relatively more mature stage in its business cycle compared to the EU. As such, there is more room for interest rates to rise in Europe compared to the US — adding downward pressure on the US dollar.

A key upside risk for gold prices in the short term is an economic slowdown in the US. A slowing economy in the US would likely prevent any further interest rate rises, which would further weaken the US dollar removing a key headwind to higher gold prices.

Higher prices over the medium term

Over the outlook period, gold prices are projected to rise to around US$1,300 (2018 dollars) in 2023. Gold prices will be supported by steady investor demand, increasing jewellery consumption and declining mine supply after 2020.

Real gold prices will likely be supported by a rising supply of bonds, driven by historically high debt levels in key economies. The increasing supply of bonds over much of the past 20 years, driven by rising US debt issuance has outpaced the supply of gold. As such, the value of gold has increased relative to US Treasury bonds, and this trend is expected to continue over the outlook. US debt is expected to rise over the outlook period strengthening the price premium of gold relative to bonds.
Over the medium term, nominal gold prices are expected to be supported by steady inflation in key markets — China, India, Europe and the US. Around 60 per cent of gold demand is consumed by jewellery and in industrial fabrication. As consumer prices rise, so too does the cost of jewellery and industrial inputs and this is largely why nominal gold prices tend to rise with inflation over time.

**There is potential for volatility in gold prices**

While gold prices are projected to rise slightly over the medium term, a range of factors could trigger temporary rallies in prices. These include prolonged price declines in financial markets, unexpected geo-political events, and poor economic data emanating from the US, China or Europe.

Risks to the downside include a rising US dollar and higher Treasury bond yields led by rising interest rates due to a stronger US economy.

**10.3 Consumption**

Global gold consumption is forecast to rise by 1.8 per cent annually over the forecast period, reaching over 4,380 tonnes in 2023. Higher gold consumption will be driven by rising jewellery purchases and greater use of gold in industrial fabrication. Investment demand is expected to pick up over the short term, but remain largely unchanged after 2020.

**Jewellery consumption rises in 2017**

Gold jewellery consumption increased by 4.0 per cent in 2017 — led by improved sales in India. In 2017, several auspicious festivals boosted Indian gold sales, which more than offset the dampening impact of the demonetisation of large currency notes and the introduction of a Goods and Services Tax (GST) in July — which hurt gold sales.

Gold jewellery sales rose in China in 2017, ending 4 years of consecutive decline. Chinese consumers continue to demand more fashionable designed jewellery while demand for pure gold pieces has been subdued.

**Figure 10.5: Outlook for gold consumption by sector**

Jewellery consumption expected to rise in the short to medium term
Gold jewellery consumption is projected to rise over the next five years, driven by rising incomes in India and China — the world’s two major jewellery markets. Higher incomes in these key markets will support higher discretionary spending on gold over the outlook period. In China, the shift towards more fashionable (non-pure gold) pieces and expansion into e-commerce should boost sales among young consumers and in 3rd and 4th tier cities.

Indian consumers are particularly sensitive to price, as well as other factors that adversely impact on affordability, such as falling rural incomes, which contributed to declining gold sales in 2016.

Industrial consumption is expected to rise over the outlook
Gold used in electronics rose by 2.9 per cent in 2017 — the second consecutive year of growth. Going forward higher industrial consumption will be underpinned by growth in demand for gold bonding wire used in memory chips, particularly for producing smartphones. Increased industrial consumption will also be driven by the use of gold in the production of sensor technology and LED lighting in the automotive industry. Gold consumption in industrial applications is forecast to increase by 1.0 per cent annually over the outlook period, from 329 tonnes in 2017 to 353 tonnes in 2023.

ETF holdings to rise in the short term and hold steady in the long term
Investors increased Exchange Traded Funds (ETF) holdings by 200 tonnes in 2017, representing a decline of 63 per cent year-on-year, due to an exceptional 2016 which included Brexit and unexpected developments in US politics.

Over the forecast period investment in gold — including gold bars, coins and bullion-backed Exchange Traded Funds (ETF) — is forecast to increase by 0.4 per cent annually, from 1,232 tonnes in 2017 to 1,263 tonnes in 2023. Most of the rise is expected to occur in the short term, with total investment projected to plateau from 2020 onwards.

Central bank purchases expected to taper over the outlook
Central bank buying decreased by 4.7 per cent year-on-year in 2017. The majority of central bank purchases over the past several years have been facilitated through rising local mine production. Two of the world’s largest producers — China and Russia — have retained much of their recent mined gold production in state reserves over the past several years, and neither are expected to sell any of their gold reserves over the outlook.

In 2017 — the world’s largest central bank purchases were made by Russia, Turkey and Kazakhstan — all of whom had rising domestic mine supply. Central bank purchases are forecast to taper off over the outlook period, declining to 200 tonnes in 2023. The largest purchases over the outlook are expected to come from Russia, where rising mine supply is expected to peak in 2019. Russian official purchases are expected to taper off from 2020, reducing total central bank demand.

10.4 Production
Total world gold supply is forecast to reach a peak of 4,630 tonnes in 2019, and then steadily decline to 4,460 tonnes in 2023. In the short term, increasing total gold supply will be propelled by higher mine production, with scrap production forecast to be steady over the outlook period. From 2020, world gold supply is forecast to decline, due to a lack of new gold mining projects in the investment pipeline.

World mine production was steady in 2017, rising just 0.2 per cent to 3,270 tonnes. Output benefited from new mines, which more than offset declines at established mines and lower production in China, which fell by 40 tonnes year-on-year in 2017. China — the world’s largest gold producer — closed several mines in 2017 for breaching environmental standards.

China’s efforts to reduce the discharge of cyanide tailings from gold mining operations will weigh on production over the short term. Production in the United States and Canada increased by 21 and 13 tonnes in 2017, respectively, with both nations benefiting from new mine supply.
Mine production expected to rise in the short term

World mine production is forecast to reach a peak of over 3,370 tonnes in 2019. Several new projects and expansions in Russia and Canada are expected to support higher mine supply, more than offsetting declining supply from the United States and Peru. Production in Canada is forecast to rise over the short term, increasing by 21 and 11 tonnes year-on-year in 2018 and 2019, respectively. In contrast, gold production in the United States reached a ten year high in 2017 of 246 tonnes, and is forecast to decline over the short and medium term, as long established mines reach the end of their production life. Russia’s Natalka project is expected to reach full capacity in 2018 and produce 15 tonnes per year.

Mine production set to decline over the medium term

World mine production is projected to decline after the peak in 2019, as long established projects reach life end and few new projects and expansions take their place. World mine production is projected to fall from 3,360 tonnes in 2020 to 3,040 tonnes in 2023. Declining world mine production is expected across most countries, and will be particularly evident in Australia, Russia and Mexico — which together will account for over 200 tonnes of decline between 2020 and 2023.

Recycled supply falls in 2017, but is expected to rise in the short term

World recycled supply — gold that is reclaimed from jewellery, industrial use and electronics — declined by 10 per cent in 2017, to 1,160 tonnes — falling from exceptionally high recycled output in 2016.

Recycled gold supply is forecast to rise by 5.1 per cent year-on-year to 1,220 tonnes in 2018, supported by higher gold prices. After 2018, recycled supply is projected to decline as gold prices slide in the second half of the outlook period.
10.5 Australia

Export values expected to peak in 2019–20

The value of Australia’s gold exports is forecast to set a record peak near $19 billion in 2019–20, driven by higher prices and export volumes. Export volumes are forecast to peak in the same year, rising by 2.0 per cent annually to reach 354 tonnes. Rising export volumes will be supported by higher local mine production in Western Australia and the Northern Territory. Export volumes will also be driven in the short term by imports of gold doré for refining, as production ramps up at the Ok Tedi mine in Papua New Guinea.

Export values and volumes are projected to decline after 2019–20, falling by 4.6 per cent annually to 308 tonnes worth over $15 billion in 2022–23. The steady decline will be driven by lower domestic production (discussed below) and lower imported gold doré, as production in Papua New Guinea is expected to decline from 2020 onwards.

Figure 10.8: Australia’s gold exports

The Australian gold price averaged A$1,754 a troy ounce in 2016–17, its highest level since the recent historical peak in 2011–12. The Australian gold price was supported by higher US dollar gold prices and a low AUD-USD exchange rate.

Over the short and medium term, the Australian gold price is projected to decline to an average of A$1,557 an ounce in 2022–23. The Australian dollar gold price will be weighed down by lower world gold prices, with the AUD/USD exchange rate assumed to remain around A$0.80 over the outlook.

Australian gold mine production set to peak in 2019–20

Australian gold mine production is forecast to increase by 3.8 per cent annually over the next three years, to reach a peak of 322 tonnes in 2019-20. Higher production will be driven by several new projects, including Gold Roads’ Gruyere project in Western Australia, and Regis Resources’ McPhillamys in New South Wales. Gruyere is expected to produce 8.4 tonnes annually commencing in the March quarter of 2019. McPhillamys is expected to produce 6.0 tonnes annually from the December quarter 2019 onwards. Other new mines include Capricorn’s Karlawinda in Western Australia and OZ Mineral’s Carrapateena, which are expected to produce around 3 tonnes annually from 2019 onwards.

Lower production in the medium term

After reaching a peak in 2019–20, Australian mine production is projected to decline by 5.6 per cent annually to 271 tonnes in 2022–23. Production will be weighed down by several mine closures and declining ore grades, as mature assets approach their end of life. Declining production will be partly offset by several new mines that are expected to come online in the second half of the outlook period, including Vista Gold’s Mount Todd in the Northern Territory. Set to commence in late 2020, Mount Todd is expected to become Australia’s fourth largest gold mine, producing around 15 tonnes of gold annually.
Exploration expenditure continues to increase

Australia’s gold exploration expenditure increased by 21 per cent in 2017 to $750 million — accounting for 44 per cent of Australia’s total minerals exploration expenditure during the year. Gold exploration expenditure was driven by high gold prices of recent years. Western Australia remains the centre of gold exploration activity in Australia, accounting for $550 million of exploration expenditure. Expenditure increased in most States, reaching $58 million in Queensland and $45 million in Victoria — the highest level since 2010.

Figure 10.11: Australian exploration expenditure

Table 10.2: Gold outlook

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<th>World</th>
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<th>2019 f</th>
<th>2020 z</th>
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<th>2022 z</th>
<th>2023 z</th>
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<td>1,719</td>
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<tr>
<td>– real</td>
<td>A$/oz</td>
<td>1,754</td>
<td>1,665</td>
<td>1,670</td>
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<td>1,537</td>
<td>1,564</td>
<td>1,559</td>
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</table>

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; z Projection; r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23.

Aluminium, alumina and bauxite

Resources and Energy Quarterly March 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

Key consumer markets for aluminium (tonnes)

- United States 5.6 million
- Germany 2.2 million
- China 3.2 million
- South Korea 1.4 million
- Japan 2 million
- India 1.2 million

Major Australian alumina deposits (Gt)

- <0.01
- 0.02-0.03
- 0.04-0.09
- 0.10-0.20
- 0.21-0.44
- >0.45

- Deposit
- Operating mine

Global uses of aluminium

- 41% Transport and manufacturing
- 20% Packaging
- 14% Construction
- 8% Electrical
- 7% Consumer durables
- 7% Machinery
- 3% Other
11.1 Summary

- Lower alumina and bauxite demand is projected to reduce the value of Australia’s aluminium, alumina and bauxite exports by around 2.4 per cent each year, with a decline to $11 billion (in real terms) by 2022–23.
- Global aluminium markets are expected to absorb the impacts of the United States’ 10 per cent tariffs on imported aluminium without significant disruption.
- Australian aluminium exporters are likely to benefit from the US tariff exemption in the event that US aluminium premiums rise.

11.2 Prices

Production cuts in China pushed up aluminium and alumina prices in 2017

Production cuts in China in the 2017–18 winter season were the main catalyst for price rises in 2017. The London Metals Exchange (LME) spot aluminium price increased by 20 per cent in 2017, to average US$2,014 a tonne in real terms, propelled by increased demand from America (up 6.2 per cent) and China (up 1.0 per cent), which is the world’s largest aluminium consumer. Reflecting the tighter market, LME stocks fell by 50 per cent in 2017, to 1.1 million tonnes — a nine-year-low. Over this period, a 2.8 per cent rise in world aluminium production boosted alumina demand and prices. The average FOB Australia alumina price was US$359 a tonne in real terms, up 38 per cent from 2016.

Environmental regulation in China is the key driver of aluminium and alumina prices in the short to medium term

In the short term, the average LME aluminium spot price and FOB Australia alumina prices are estimated to remain high, at around US$2,014, and US$349 a tonne in real terms in 2019, respectively, as capacity controls and environmental regulation are expected to continue to keep the market tight in China. The Chinese Government pledged a commitment to carry out further air pollution crackdowns at the Communist Party’s 19th National Congress in October 2017. This commitment, in turn, reduces the likelihood of aggressive capacity expansion in China, which is the world’s largest aluminium producer. In the United States, a 10 per cent tariff imposed on imported aluminium is likely to have minimal impacts on aluminium prices. The Trump Administration’s commitment to infrastructure spending is likely to support higher demand and prices for aluminium.

In the medium term, the Chinese Government’s policies of capacity and environmental regulation are expected to continue. Production in China is likely to grow at a more sustainable rate, which will support high aluminium prices. However, China’s demand growth is forecast to slow as a result of the Chinese Government’s effort to contain excess residential construction. Furthermore, a possible global trade war — from the imposition of US tariffs — would likely have negative impacts on aluminium prices. On balance, the average LME aluminium spot price is projected to fall at an annual average rate of 2 per cent, to around US$1,854 a tonne in real terms in 2023.

The Chinese Government’s environmental crackdowns are expected to influence global alumina demand and prices significantly in the medium term, given China’s importance in global aluminium markets.

Figure 11.1: World aluminium and alumina prices

enforced constraints on growth in smelting capacity are expected to continue over the next few years, leading to a more stable alumina pricing regime. As a result, the average FOB Australia alumina price is projected to remain just above US$300 a tonne in real terms by 2023.

In the short to medium term, the average FOB Kamsar Guinea bauxite price is forecast to fall from its current level of US$38 a tonne, due to abundant supply from Australia and Guinea, and the return of Malaysia to the global bauxite export markets. Bauxite mining in Malaysia was banned in January 2016.

11.3 Consumption

**China and US drove consumption growth in 2017**

In 2017, world aluminium consumption grew by 2 per cent to 59 million tonnes, driven by strong consumption growth in the United States (up 9.6 per cent to 5.6 million tonnes), as the US economy has continued strengthening. Consumption in China — accounting for 54 per cent of world aluminium consumption — increased by 0.9 per cent to nearly 32 million tonnes (a record high). The automotive sector is one of the largest aluminium consumers in China, and vehicle sales in China grew by 3.6 per cent in 2017, to nearly 29 million units. This is not likely to persist, as it reflects efforts by Chinese consumers to buy vehicles before an increase in the vehicle sales tax, which commenced January 2018.

Over this period, world alumina consumption increased by 1.7 per cent to 112 million tonnes, while global aluminium production rose by 2.8 per cent. Alumina consumption in China — the world’s largest alumina consumer — rose by 1.9 per cent to 61 million tonnes. This was in line with growth in aluminium production.

**Aluminium demand should continue to grow in the short to medium term**

World primary aluminium demand is projected to grow at an average annual growth rate of 2.0 per cent in the short to medium term, reaching 67 million tonnes in 2023. China’s aluminium consumption has grown for 28 consecutive years, from just 861,000 tonnes in 1990 to nearly 32 million tonnes in 2017. This growth is expected to continue over the next five years (reaching 37 million tonnes in 2023), supported by strengthening residential and infrastructure construction. Outside of China, an acceleration in global economic activity is expected to come from the US, Eurozone, and emerging market and developing economies. India’s aluminium consumption is projected to grow by 7 per cent per year, to 1.9 million tonnes in 2023, driven by infrastructure, power and transport initiatives.

Demand for automobiles (with an increasing proportion of aluminium components) and aluminium-based consumer durable goods, will remain strong in the short to medium term, as the middle class in China and the rest of Asia continues to expand. The Chinese Government has promoted the production and use of energy-efficient cars, which utilise higher aluminium content in order to reduce vehicle weight. It is now targeting 2 million units to be sold in 2020, increasing to over 3 million units in 2025. Yunnan Aluminium, a Chinese aluminium producer, has teamed up with Phinergy, an Israeli company, to produce aluminium batteries for electric vehicles. The joint-venture is expected to produce the world’s leading aluminium air battery technology within the next few years. Other potential areas of increasing aluminium demand are the manufacture of busbars —

**Figure 11.2: World aluminium and alumina consumption**

strips of metal used to conduct electricity — (traditionally used copper), and the construction of China’s high voltage and ultra-high voltage electrical networks.

However, a modest risk to the assessment is the rising use of recycled (secondary) aluminium — which requires up to 95 per cent less energy than primary aluminium production. The British firm Axion has recently joined the ground-breaking Jaguar Land Rover aluminium recycling project. Launched a decade ago, the project allowed the automaker to reuse over 75,000 tonnes of scrap aluminium in the production of new vehicles in 2017.

Growth in alumina demand in line with aluminium production

World alumina consumption is projected to grow at an average annual rate of 2.0 per cent in the short to medium term, reaching 125 million tonnes in 2023 — in line with the average annual growth rate of aluminium production. This reflects a future of more strictly controlled capacity approvals in China’s aluminium production, and the growth of recycled aluminium.

China continues to be the largest alumina consumer in the world, accounting for 54 per cent of global alumina demand. As personal income rises in China, the demand for durable goods and aluminium is expected to grow significantly.

The Middle East’s alumina consumption is projected to reach 12 million tonnes in 2023, driven by growing aluminium production in Iran as well as the Gulf Cooperation Council — which comprises Bahrain, Oman, Saudi Arabia, Qatar and the UAE.

India is also expected to contribute to growth in global alumina demand, increasing its usage from 5.2 million tonnes in 2018 to 6.9 million tonnes in 2023. However, this growth path is subject to risks, due to energy supply issues and the development of the country’s stretched transport infrastructure.

11.4 Production

World production increased sharply in 2017

World aluminium production increased by 2.8 per cent to nearly 60 million tonnes in 2017, driven by modest growth in China. Chinese smelters boosted their production in anticipation of production cuts in the 2017–18 winter season. Chinese refineries also ramped up their production (up 16 per cent) to meet increased demand. The rise in aluminium production lifted world alumina production by 9.1 per cent, to 125 million tonnes.

In response to increased aluminium and alumina production, global bauxite producers also accelerated their production. Production rose strongly in Australia — the world’s largest bauxite producer. Australian production rose by 5.2 per cent in 2017, to 88 million tonnes. In Guinea, bauxite production increased by 34 per cent, to 40 million tonnes. These rises contributed to a 7.3 per cent increase in global bauxite production in 2017, to 292 million tonnes.

Figure 11.3: World aluminium, alumina and bauxite production

Source: International Aluminium Institute (2018); World Bureau of Metal Statistics (2018); Department of Industry, Innovation and Science (2018)
Environmental regulation in China to slow world aluminium and alumina production in the short to medium term

In the short to medium term, world aluminium production is projected to grow at an average annual growth rate of 2 per cent, reaching 67 million tonnes by 2023. Supply growth is expected to be slowed by environmental initiatives in China, which seek to control capacity expansion and reduce air pollution in major cities. Small and inefficient Chinese aluminium smelters may choose permanent closure under the laws, which allow them to sell their capacity quota to new projects.

Aluminium production has also faced broader shifts within China: Henan province’s output of primary aluminium (12 million tonnes) has — for the first time in six years — surpassed that of neighbouring Shandong province (11 million tonnes), making it China’s largest aluminium producing city.

With Chinese production checked, production in non-China countries is expected to be the engine of global production growth. Iran plans to increase its annual aluminium production from 450,000 tonnes to 1.5 million tonnes by 2025. In India, Vedanta’s Jharsuguda expansion continues to ramp up production. India’s state-run smelter National Aluminium Company (Nalco) plans to boost aluminium capacity to 1.1 million tonnes by 2024. In Azerbaijan, the 500,000 tonnes per annum Ganja aluminium smelter — idle for over a decade — is expected to restart in 2018. Israeli conglomerate Delek Group is also planning to build a one million tonne per annum Ramat Hovav aluminium smelting operation, powered by natural gas.

The risks to this assessment lie in the addition of new capacity outside policy-affected regions, the restart of idled capacity, and the Chinese Government’s production curtailment exemption granted to large state-owned corporations. Chinese aluminium smelters have the potential to add capacity equivalent to around 15 per cent (or 9 million tonnes) of annual global aluminium supply. If this occurs, the aluminium prices and alumina demand will weaken in the short to medium term.

World alumina production is forecast to increase at an annual average rate of 1.4 per cent in the short to medium term, reaching 137 million tonnes in 2023. This growth rate is slower than that of the last few years, due to China’s aggressive supply reforms — which include capacity swaps, winter production cuts, and illegal capacity cuts. The 5 million tonnes per annum of illegal capacity that was shut down in 2017 is not expected to return to production, unless the market is undersupply.

New alumina capacities are not only subject to policy restraints, but also the availability of bauxite. Refining operations are typically set up close to quality bauxite sources in order to establish integrated supply chains. The Chinese Hongqiao Group is expanding bauxite exports from Guinea to China, and the company’s future refinery developments are being planned in closer proximity to bauxite resources in Guinea and Indonesia. In India, Vedanta has obtained permission from the Odisha State Government to expand its Lanjigarh Alumina refinery from 1 million tonnes per annum to 6 million tonnes per annum. The company is able to purchase bauxite — a longstanding supply problem — from the state-run Odisha Mining Corporation on a long term basis.

Australia and Guinea to contribute to a large rise in world bauxite production in the short to medium term

World bauxite production is forecast to grow at an annual rate of 7.3 per cent in the short term (2018 and 2019) and 1.4 per cent in the medium term, to reach 357 million tonnes by 2023. The gains will be driven by new capacity in Australia — notably the commissioning of Bauxite Hill and Amrun projects — and in Africa. Australia is forecast to produce over 103 million tonnes of bauxite by 2023.

The rise in bauxite production in Africa is dominated by a strong performance from Guinea, currently the world’s fourth largest bauxite producer. The Chinese transformer-production firm Tebian Electric Apparatus Stock Company has invested US$2.8 billion in Guinea to build a 10 million tonne per annum bauxite mine, with production commencing in mid-2019.
11.5 Australia

High prices to drive strong exports in 2017–18

Higher aluminium and alumina prices contributed to a 20 per cent year-on-year rise in total aluminium, alumina and bauxite export values in the first half of 2017–18, to $6.3 billion in real terms. The LME spot aluminium price reached a near 6 year high on 19 January 2018, at US$2,256 a tonne. The monthly FOB Australia alumina price reached a multi-year high in October 2017, at US$469 a tonne.

In 2017–18, Australia’s aluminium, alumina and bauxite exports are estimated to grow strongly, up 17 per cent at $13 billion in real terms, with aluminium and alumina prices estimated to remain high in 2018. The global aluminium market balance (production less consumption) is estimated to tighten further, from a surplus of 534,000 tonnes in 2017 to a surplus of just 150,000 tonnes in 2018. Chinese alumina output is expected to recover after the production cuts in the 2017–18 winter season, causing a flow-on rise in bauxite exports to China.

Lower prices lead to weaker export outlook in the short to medium term

After reaching a 10-year high of $13 billion in 2017–18, Australia’s aluminium, alumina and bauxite exports are projected to fall by an average 2.4 per cent annually to $11 billion (in real terms) by 2022–23, driven by an expected fall in aluminium and alumina prices. Environmental priorities are likely to remain an important influence on the Chinese aluminium, alumina and bauxite industries, and hence, Australian alumina and bauxite exporters. President Xi is committed to curb air pollution in major Chinese cities, and is expected to close smelters and refineries which fail to meet new environmental regulations. This will reduce demand for Australian alumina and bauxite in the short term.

The majority (87 per cent) of Australia’s aluminium and alumina production is destined for export markets. Although there are emerging opportunities for Australia from the projected sustainability of high aluminium and...
alumina prices, exports are likely to be constrained by capacity limits and increased competition from low-cost producers in other nations.

The US Government’s decision to impose 10 per cent tariffs on imported aluminium is likely to have positive impacts on Australian alumina exports. If the US responds to the imposition by restarting idled aluminium capacity, demand for alumina will likely rise, creating opportunities for Australian alumina refineries to expand sales to the US.

The Malaysian Government’s decision to extend its bauxite mining ban to the end of June 2018 is likely to create opportunities for Australian bauxite exporters to export more to China. Prior to the mining ban, Malaysia was the largest source of China’s bauxite imports.

Steady aluminium and alumina production, but moderate growth in bauxite production in 2017–18

Australia produced 784,000 tonnes of aluminium in the first half of 2017–18, up 12 per cent from the second half of 2016–17. This was due largely to the recovery of Portland Aluminium’s production following its power outage incident in December 2016.

Over the first half of 2017–18, Australia’s alumina production increased 0.5 per cent from the second half of 2016–17, to 10 million tonnes.

Australia’s bauxite production increased by 6.9 per cent year-on-year in the first half of 2017–18, driven by a higher output from Rio Tinto’s Gove and Weipa operations.

In 2017–18, Australia’s aluminium and alumina production is estimated to remain steady at 1.6 and 20 million tonnes, respectively. However, bauxite production in Australia is estimated to increase by 4.7 per cent, to nearly 89 million tonnes, driven by the commissioning of Metro Mining’s Bauxite Hills project in April 2018. In 2018, Rio Tinto is expected to mine 42 million tonnes of bauxite, refine 6.9 million tonnes of alumina, and smelt 1.2 million tonnes of aluminium.

New capacity contribute to a strong growth in bauxite production in the short to medium term

There are no planned/expansions or major disruptions expected at existing operations. This suggests little change in production in the short to medium term. However, there is a downside risk to aluminium production if the Liddell power station — which provides electricity to Tomago Aluminium — shuts in 2022, as proposed.

Australia’s bauxite production is projected to grow at an annual average rate of 7.8 per cent in the short term, to 103 million tonnes in 2019–20, and remains at this level until 2022–23. The engine of this strong growth is the addition of new capacity from the Bauxite Hills and Amrun projects. Metallica Minerals has obtained a mining lease from the Queensland Government. The lease opens the door to mining at the Urquhart bauxite project once the proper infrastructure is in place.

Figure 11.6: Australia’s bauxite exports and production

Box 11.1: US aluminium tariffs

The US Administration has imposed a 10 per cent tariff on aluminium imports into the United States following the US Department of Commerce’s release of investigations into the national security impact of aluminium and steel imports. The key findings from these investigations are that “aluminium is essential to the US national security; the US Government does not maintain any strategic stockpile of bauxite, alumina and aluminium; and the imports adversely impacts the economic welfare of the US aluminium industry” (US Department of Commerce).

US aluminium producers and workers are likely to benefit from the tariffs, as more output is produced domestically and more employment is created. However, aluminium consumers in the US are likely to suffer, as the cost of imported materials rises. There are expected inflationary pressures in aluminium-related industries, such as manufacturing, packaging and construction. Steve Fisher (CEO, Novelis Inc.) — an Atlanta based rolled and recycled aluminium company — estimates that “aluminium tariffs could add to US$1.0 billion per year to the cost of aluminium beverage cans and US$3.0 billion to the cost of producing automobiles every year”. This will add to inflationary pressures in the US economy.

Canada and China are the largest sources of US aluminium imports. In value terms, the US imported US$6.9 billion of aluminium from Canada, and US$1.8 billion from China in 2017. Exports of aluminium to the US account for around 0.7 per cent of Canada’s GDP (or US$11.6 billion), and 0.02 per cent of China’s GDP (or US$2.4 billion). Argentina, Australia, Brazil, Canada, Mexico, South Korea and the European Union (EU) have been given an exemption from tariff increases. As a result, China is likely to be the country most affected by President Trump’s decision.

The US will not impose tariffs on Australian aluminium. But even if tariffs were applied to Australian products, the impact would be minimal: Australia exported 48,000 tonnes of aluminium to the US in 2016–17, with a value of $127 million. This means the US accounts for just 4 per cent of Australia’s aluminium exports.

The exemption is likely to provide incentives to Australian aluminium exporters to divert export to the US from Asia, should US aluminium premiums rise.

However, US tariffs could indirectly cause harm to the Australian aluminium industry, with the primary risk being Asian aluminium exporters redirecting aluminium products they are unable to sell to the US into the Australian market.

The US tariffs are expected to have negligible impacts to the global aluminium markets, as the US accounts for less than 1 per cent of global aluminium production. Aluminium markets will likely absorb the impacts of tariff increase relatively easily, though there is a potential for escalation to a trade war should the EU and China retaliate against President Trump’s actions without first pursuing remedies through the World Trade Organisation (WTO) dispute settlement process.

The US’s tariffs on imported aluminium theoretically provides incentives to US aluminium producers to upgrade technology or develop new capacity. However, these options seem to be unviable. Such upgrades would not necessarily create long-term competitive installations, given the established technology footprint. Similarly, any development of greenfield smelters — integrated supply chain and cheap energy source — may come at a prohibitive capital cost (Source: AME Group).

The largest source of primary aluminium imports to the US is Canada, where aluminium smelters are powered by cheap hydro-electricity. With reliable and cost effective supply from neighbouring Canada and other major aluminium producers, the importation of overseas aluminium may prove more cost effective in the short to medium term.

Source: US Department of Commerce; AME Group (2017); Macquarie Research (2018)
### Table 11.1: Aluminium, alumina and bauxite outlook

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<th>Unit</th>
<th>2017</th>
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<th>2019 f</th>
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</table>

Notes: b Producer and LME stocks; c LME cash prices for primary aluminium; d In 2018 calendar year US dollars; e In 2017-18 financial year Australian dollars; f Forecast; z Projection; r Compound annual growth rate (per cent), for the period from 2017 to 2023, or from 2016-17 to 2022-23.

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 March 2018

Australia is the world’s 3rd largest exporter of copper ores and concentrates.

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
- 2.2-8.8
- >6.9

Key copper consumer markets (thousand tonnes), 2017
- Italy: 652
- South Korea: 656
- Japan: 974
- Germany: 1,200
- United States: 1,761
- China: 11,920

Global uses of copper
- Equipment: 31%
- Building Construction: 30%
- Infrastructure: 15%
- Transport: 12%
- Industrial: 12%
12.1 Summary

- World prices are expected to increase from an average of US$6,307 in 2017 to an average of US$8,400 a tonne in 2023, as consumption growth outpaces rising mine and refinery supply in the medium term.
- Australia’s copper exports are forecast to rise from 920,000 tonnes in 2016–17 to over 1 million tonnes in 2022–23 (in metal content terms), as new mines and expansion projects come online over the outlook period.
- The value of Australia’s copper exports is projected to increase from $7.7 billion in 2016–17 to $12 billion by 2022–23. Growth in export earnings will be supported by higher export volumes over the short term and higher copper prices over the medium term.

12.2 Prices

Copper prices reached a three-year high in 2017

The London Metal Exchange (LME) copper price averaged US$6,307 a tonne in 2017, ending five years of consecutive decline. The copper price was propelled higher by strong growth in global industrial production and several supply disruptions throughout the year.

Copper prices expected to taper over the short term

The LME copper price averaged near US$7,000 a tonne in the first quarter of 2018, but is forecast to decline over the remainder of 2018 to average US$6,500 a tonne. The world’s largest producers are performing strongly, and supply is expected to rise faster than consumption over the remainder of 2018. Rising copper supply will be driven by new mines and expansion projects across most major producing nations, with the world’s largest producer — Chile — benefitting from the recent expansion project at Escondida — the world’s largest copper mine. Rising mine supply is starting to show on the world’s major metal exchanges, where copper inventories increased by 11 per cent year-on-year in the March quarter 2018.
The global copper market is expected to record a surplus of 150,000 tonnes in 2018. Copper inventory — in terms of the number of weeks of consumption — is forecast to remain steady at around 2.3 weeks in 2018 and to then decline in 2019.

After 2020, growing copper consumption starts to outpace rising supply, leading to an expected market deficit of 227,000 tonnes in 2023. Increased demand for copper will be driven by rising energy needs in emerging markets, along with greater demand for renewable energy technologies and electric vehicles. Copper prices are projected to rise by 3.2 per cent annually over the outlook period to US$8,400 a tonne (in 2018 prices).

### 12.3 World consumption

**Copper consumption rises in 2017**

World refined copper consumption rose by 1.4 per cent year-on-year in 2017 to 24 million tonnes. Consumption was led by China where demand increased by 2.4 per cent to 12 million tonnes — 50 per cent of world consumption. Higher copper consumption was supported by firm growth in global industrial production which increased by 3.4 per cent in 2017.

**Copper consumption to grow moderately over the outlook period**

Global copper consumption is projected to rise from 24 million tonnes in 2017 to 27 million tonnes in 2023, increasing on average by 1.4 per cent each year. Higher copper consumption will be supported by growing global industrial production and the production of copper intensive renewable energy technologies and electric vehicles — which are expected to grow strongly over the outlook period.

China’s copper consumption is expected to grow over the outlook period, albeit at a more moderate pace than in recent years. China is expected to invest further in expanding the power grid to keep up with growing consumer demand for energy. China’s investment in fixed assets rose by 7.3 per cent in 2017. While this growth remains high by world standards, growth in fixed asset investment has been in steady decline since 2011, and is expected to moderate further over the outlook period.

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**Figure 12.3: World copper consumption and industrial production**


**Figure 12.4: China’s growing energy sector**


China’s construction sector is expected to grow at a more moderate pace over the outlook period, weighed down by tighter monetary conditions.
China’s economy is expected to rely increasingly on domestic consumption, with household spending on motor vehicles and durable goods expected to drive China’s copper usage.

**Figure 12.5: Chinese copper usage and Fixed Assets Investment**

Growing global demand for electric cars and renewable energy globally will lead to higher copper consumption over the outlook period. Increased production of electric and hybrid vehicles — which contain on average 90 and 45 kilograms of copper, respectively, compared to 25 kilograms for regular vehicles — is forecast to raise copper consumption by an estimated 2.7 million tonnes over the period of 2018 to 2023.

Copper is used extensively in renewable energy technology and infrastructure, particularly solar energy — with around four tonnes of copper used to produce one megawatt of solar voltaics. Installed solar capacity is expected to rise over the outlook period from 230 gigawatts in 2017 to over 600 gigawatts in 2023, requiring around 2.4 million tonnes of copper. Global electricity capacity from renewable sources is expected to increase by 4.4 per cent annually over the outlook period.

**12.4 World production**

**World copper mine production falls in 2017**

World mine copper production decreased by 1.3 per cent in 2017 to 20 million tonnes. Lower production was the result of supply disruptions in the first half of the year, including strike action at Escondida — the world’s largest copper mine — and export restrictions on Grasberg in Indonesia — the world’s fourth largest copper mine. Mine supply recovered in the second half of 2017, benefiting from the ramp up in production from a mill extension at Escondida. New mines and expansion projects in Peru and Kazakhstan also helped to offset some of the yearly decline.

**Figure 12.6: World copper production and prices**

Global copper mine production is forecast to rise from 20 million tonnes in 2017 to 23 million tonnes by 2019, representing an average increase of
4.3 per cent per year. Growth in world mine supply will be driven by new mines and expansions across most of the major producing nations.

Mine production is expected to rise by 5.7 per cent in 2018, with 780,000 tonnes of extra capacity from committed new projects and a further 290,000 tonnes from mine expansions. First Quantum Minerals’ Cobre Panama, and the new Qulong copper mine operated by Tibet Julong Mining, will make the two largest contributions to new mine supply over the short term, with an estimated annual capacity of 330,000 tonnes and 120,000 tonnes respectively. Several large expansion projects — Codelco’s Radmio in Chile and Southern Copper’s Toquepala in Peru — are expected to each contribute an additional 100,000 tonnes in 2018.

**Figure 12.7: Global mine growth and key producers**

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

In the medium term, mine production is projected to increase by 3.5 per cent annually to reach 25 million tonnes in 2023. Higher production is expected to be driven by new mines and expansion projects led by some of the world largest copper producers — ten of which are expected to account for nearly 75 per cent of additional supply expected to come online over the outlook period. Despite many mature assets facing declining ore grades, production in Chile — the world’s largest producer — is expected to increase over the outlook period. Chilean State-owned Codelco, is expected to increase production by 1.3 per cent annually to reach 1.5 million tonnes by 2023. The expansion of BHP’s Spence project in Chile is expected to increase capacity by 200,000 tonnes commencing in 2020.

**World refined copper production sets record high in 2017**

World refined copper production increased by 0.9 per cent year-on-year in 2017 to 23.5 million tonnes — the highest annual production on record. Higher production was led by China and Europe, which raised production by 453,000 and 87,000 tonnes year-on-year in 2017, respectively.

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

Global refined copper production is projected to rise by 2.4 per cent annually to 27 million tonnes in 2023. Higher refined production will be driven by new refineries and expansion projects in China, where production is expected to increase from 9.0 million tonnes in 2017 to 11 million tonnes in 2023 — 40 per cent of world refined supply.

Secondary production — from recycled copper — increased by 25 per cent year-on-year to 4.0 million tonnes in 2017. Secondary supply is expected to increase by 2.4 per cent annually over the outlook period to 4.6 million tonnes in 2023, driven by higher copper prices and higher availability of scrap supply, as greater quantities of copper consumed in end use goods reach the end of their useful life and return to the supply chain.

**12.5 Australia**

**Copper exports set to increase over the outlook period**

Australia’s copper export earnings declined by 1.0 per cent to $7.7 billion in 2016–17. Earnings were weighed down by lower export volumes of
refined copper, which more than offset the impact of higher world prices. Exports of refined copper to China declined by 44 per cent in 2017, however, exports of copper ores and concentrates increased by 21 per cent over the same period. China’s growing refinery capacity and Australia’s rising refinery costs have encouraged Australian producers to export ores and concentrates rather than refined copper.

**Figure 12.8: Australia’s copper exports**

![Graph showing Australia's copper exports from 2012-13 to 2018-19 with projections to 2022-23.]

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

The value of Australia’s copper export earnings is projected to increase from $7.7 billion in 2016–17 to $12 billion in 2022–23. Australia’s copper exports (in metal-content terms) are projected to increase by 2.1 per cent annually, from 920,000 tonnes in 2016–17 to 1 million tonnes in 2022–23. Australia’s export earnings from copper will be supported by new projects and mine expansions (described below).

**Mine disruptions weigh on production in 2017**

Australia’s mine output declined by 10 per cent in 2017, driven by supply disruptions affecting key producers — BHP, Glencore and Newcrest — which together accounted for over 80 per cent of the annual decline. Production at BHP’s Olympic Dam — Australia’s largest copper mine — was disrupted by ongoing expansion works to the smelter. Glencore’s Mount Isa operations were weighed down by smelter maintenance. Newcrest’s Cadia Valley mine was impacted by seismic activity earlier in the year. All three mines are expected to increase production in 2018.

**Improved outlook for mine production**

Australian production is projected to increase by 1.8 per cent annually, from 916,000 tonnes in 2016–17 to 1,020,000 tonnes by 2022–23. Higher Australian production will be driven by increased output at BHP’s Olympic Dam which is expected to produce over 210,000 tonnes annually after expansion works are completed in 2018–19. Production over the short term will benefit from several new mines. For example, Aditya Birla Minerals’ Capricorn copper project, which commenced late 2017, is expected to ramp up production to over 30,000 tonnes.

Over the medium term, several new mines are expected to come online and offset the closure of several mines that reach their end of life. OZ Minerals’ Carrapateena — the largest new mine to come online over the outlook period — is expected to produce over 60,000 tonnes annually, commencing in 2020. Eleven copper projects remain in the investment pipeline and higher world prices projected in the medium term will likely encourage positive investment decisions.

**Exploration expenditure is on the rise**

Australia’s copper exploration expenditure rose by 15 per cent in 2017 to $156 million. This was the third consecutive annual increase in exploration expenditure, reflecting an improved outlook for copper prices. Higher exploration expenditure was led by Queensland and New South Wales, where spending rose by $12 million and $8.4 million, respectively.
## Table 12.2: Copper outlook

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<th>2019 f</th>
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</tr>
</tbody>
</table>

Notes: b In 2018 calendar year US dollars; c Quantities refer to gross weight of all ores and concentrates; d In 2017–18 financial year Australian dollars; f Forecast; s Estimate; z Projection; r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23.

**Nickel**

**Resources and Energy Quarterly March 2018**

- **5th largest miner in the world**
- **Australia produces >200 thousand tonnes of nickel each year**
- **10% of world nickel mined is in Australia**
- **Nickel exports contribute more than $2b to Australia’s economy**

**Major Australian nickel deposits (Mt)**

- <0.05
- 0.06–0.21
- 0.22–0.58
- 0.59–0.83
- 0.84–1.69
- >1.70

- **Deposit**
- **Operating mine**

**Key nickel consumer markets (tonnes)**

- United States: 146,000
- European Union: 323,000
- Japan: 148,000
- China: 1,094,000

**Global uses of nickel**

- 68% Stainless steel
- 16% Alloys
- 9% Plating
- 3% Casting
- 3% Batteries
- 1% Other
13.1 Summary

- Global market conditions for nickel remain firm, supported by higher stainless steel production in China and Indonesia. Rising battery use will also help to support nickel demand in the 2020s.
- Strong demand conditions are expected to encourage development of two large new mines in Australia, lifting domestic mine production from 163,000 tonnes in 2017–18 to 293,000 tonnes by 2022–23.
- Australia’s nickel export earnings are projected to lift from a low of $2.1 billion in 2017–18 to $2.7 billion by 2022–23.

13.2 Prices and stocks

Nickel prices are still growing from a low point in mid-2017

Nickel prices rose to just over US$14,000 a tonne in mid-February 2018 before easing back in March. Prices have been supported by the emergence of a significant supply deficit, due to higher demand arising from strong stainless steel production.

Figure 13.1: Nickel LME spot prices and stocks

Prices are expected to remain high during 2018, before easing off as growth in the production of stainless steel slows and supply of pig-iron nickel rises. However, longer-term demand for new battery and medical technology (nickel is the biggest component of most medical implants) is expected to put a floor under prices, which are projected to average just over $US10,000 a tonne in 2023.

13.3 World consumption

Rising stainless steel and battery output is driving nickel usage

Nickel consumption is expected to rise in the short term, supported by the production of stainless steel (which uses nickel as a component).

Chinese stainless steel production accounts for 40 per cent of all global nickel use, and production in Chinese stainless steel mills is rising following the conclusion of a maintenance cycle in December. Stainless steel production is also rising in Indonesia, where smelting capacity has expanded in recent years.

Recent rapid growth in global stainless steel output is not expected to persist over the full outlook period. A run-up of stainless steel stocks will likely lead to some tapering of production in Chinese mills and potential crowding out of high cost mills in other countries.

However, electric vehicle stocks are currently rising by more than 50 per cent each year, and renewable energy is projected to record the most rapid long-term growth of any energy form in International Energy Agency forecasts. These trends are expected to start driving battery forward orders over the next two years, with demand for direct production of batteries set to lift noticeably shortly after.

This mix of high stainless steel output (in the short term) and growing battery demand (in the medium term) is expected to push nickel consumption up from 2.3 million tonnes in 2018 to 2.8 million tonnes by 2023.
13.4 World production

Production is rising as governments seek to remove constraints

Nickel supply has expanded rapidly in recent years. However, Chinese supply edged off temporarily as the year turned, with nickel pig iron producers entering a maintenance cycle. Offsetting this, Indonesia surprised markets by re-allowing exports of low-grade nickel. Indonesia is a significant supplier of mined nickel — and this decision, in conjunction with rising pig iron nickel supply from the Philippines — is likely to increase global supply noticeably in the near term.

However, supply of non-pig iron sources remains tight, and is expected to remain in shortfall until new capacity comes online. The supply deficit may ease somewhat, however, if China stems its stainless steel production to prevent excessive stockpiles.

Global mine output is projected to lift from 2.3 million tonnes in 2018 to 2.9 million tonnes by 2023, supported by new mines across southern Asia and the removal of production constraints in Indonesia and the Philippines.

**Figure 13.2: World mined nickel production, monthly**


13.5 Australia

Exploration expenditure continued to rise in the December quarter

Fuelled by rising prices, nickel and cobalt exploration expenditure almost tripled year-on-year, to reach $48.9 million in the December quarter. The majority of this expenditure was in Western Australia.

**Figure 13.3: Australia's nickel and cobalt exploration expenditure, quarterly**


Australian production is expected to recover over the outlook period

Australia's nickel production has been constrained by mine and facility closures. However, production is expected to rebound swiftly given Australia's substantial resources and the current good price outlook. Among the new mines in prospect are BHP Billiton's Yakabindie mine, which is located near BHP's existing Mount Keith project in Western Australia. The Yakabindie deposit is large, shallow and of a moderate grade, and could share transport and capital facilities with the nearby Mouth Keith mine. Open pit production could commence from 2021, with the mine ultimately becoming one of the largest in Australia.
Norilsk Nickel’s Honeymoon Well deposit, which has been under feasibility study for almost 40 years, is expected to finally move into production towards the end of the outlook period. The mine has long faced issues with poor quality of its concentrates and lack of saleable by-products. However, the site has some high-grade ore zones, which could be used in early stages to repay capital costs. A range of other operations have also opened in proximity to the deposit in recent years, ensuring better access to shared facilities and a trained workforce. It is expected that the mine will begin production towards the end of outlook period.

Beyond the two potential new mines, a new refinery is expected to open at Gladstone in Queensland by around 2022. The refinery commissioning has been stalled since it was granted State and Federal approval in 2009. But the approval remains in effect and the refinery, upon opening, could treat laterite ores from Gladstone Pacific Nickel’s Marlborough deposits as well as imported material from mines in the South Pacific. The output material — nickel cathode — is used extensively in batteries, and rising demand for batteries could improve prospects for the facility.

Higher refined nickel output is also expected from BHP’s Kwinana plant, where upgrades are expected to lift nameplate capacity to 100,000 tonnes a year from early 2019, with another upgrade to follow.

The addition of two substantial mines over the outlook period is expected to increase Australia’s mine production from 163,000 tonnes in 2017–18 to 293,000 tonnes by 2022–23. Refined production is expected to rise from 134,000 tonnes to 193,000 tonnes over the same period.

Export earnings are expected to rebound from a low point in 2017–18. Australia’s nickel export earnings have dropped for several successive years, but are expected to bottom out at $2.1 billion in 2017–18. Higher production — from a combination of facility upgrades and production from new mines — is expected to drive a real rise in export values over each of the subsequent five years. Export earnings are projected to reach $2.7 billion by 2022–23, with the bulk of this coming from refined product exports.
Table 13.1: Nickel outlook

<table>
<thead>
<tr>
<th>World</th>
<th>Unit</th>
<th>2017</th>
<th>2018 f</th>
<th>2019 f</th>
<th>2020 z</th>
<th>2021 z</th>
<th>2022 z</th>
<th>2023 z</th>
<th>CAGR r</th>
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<td><strong>Production</strong></td>
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<tr>
<td>– mine</td>
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<td>2,746</td>
<td>2,694</td>
<td>2,871</td>
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<td>kt</td>
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<td>2,687</td>
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<tr>
<td><strong>Consumption</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>kt</td>
<td>2,159</td>
<td>2,283</td>
<td>2,388</td>
<td>2,485</td>
<td>2,586</td>
<td>2,691</td>
<td>2,798</td>
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<td>533</td>
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<td>10.5</td>
<td>-3.3</td>
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<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>– nominal</td>
<td>US$/t</td>
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<td>12,013</td>
<td>11,688</td>
<td>10,600</td>
<td>9,813</td>
<td>10,450</td>
<td>11,300</td>
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<td></td>
<td>Usc/lb</td>
<td>472</td>
<td>545</td>
<td>530</td>
<td>481</td>
<td>445</td>
<td>474</td>
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<td>12,013</td>
<td>11,439</td>
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<td>9,666</td>
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<td></td>
<td>Usc/lb</td>
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<td>545</td>
<td>519</td>
<td>462</td>
<td>420</td>
<td>438</td>
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<tr>
<td><strong>Production</strong></td>
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<tr>
<td>– mine cs</td>
<td>kt</td>
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<td>163</td>
<td>168</td>
<td>178</td>
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<td>265</td>
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<tr>
<td>– refined</td>
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<td>112</td>
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<td>145</td>
<td>148</td>
<td>177</td>
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<td>– intermediate</td>
<td>kt</td>
<td>37</td>
<td>26</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>-12.9</td>
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<tr>
<td><strong>Export volume ds</strong></td>
<td></td>
<td>175</td>
<td>169</td>
<td>172</td>
<td>193</td>
<td>208</td>
<td>221</td>
<td>256</td>
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<td>A$m</td>
<td>2,199</td>
<td>2,098</td>
<td>2,259</td>
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<td>2,292</td>
<td>2,388</td>
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<td>A$m</td>
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<td>2,098</td>
<td>2,207</td>
<td>2,297</td>
<td>2,136</td>
<td>2,172</td>
<td>2,726</td>
<td>3.3</td>
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</table>

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 2017–18 financial year Australian dollars; f Forecast, s Estimate, r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23; z Projection
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 March 2018

Australia produces more than 800,000 tonnes of zinc each year.
Zinc exports contribute more than $2.5 billion to the Australian economy.

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

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

Key zinc consumer markets
1. China 6,724kt
2. United States 819kt
3. India 689kt
4. South Korea 622kt
5. Germany 481kt
6. Japan 470kt

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

- Zinc prices remain high, due to high demand and low inventories, and are expected to average over $US3,200 a tonne in 2018.
- Australia’s production is to rise sharply over the next two years, before settling to a slow and steady growth pattern out to 2023.
- Export values are expected to rise sharply by 2018–19 and then ease off slightly, in line with price movements.

14.2 Prices and stocks

Zinc prices have lifted strongly due to supply constraints

The LME zinc price has remained extremely strong in recent months, averaging over $US3,200 a tonne during the December 2017 quarter. Prices are expected to remain around this level over 2018.

Zinc inventories have been in decline for around 10 years, making prices particularly responsive to supply concerns. Low “buffer” inventories have magnified the impact of the recent shortfall in refined zinc.

Volatility in prices may increase further as a result of the Trump Administration’s plans for tariffs on steel and aluminium, which may invite retaliation by other countries and potential disruption of global commodity trade. Winter capacity cuts in China may also reduce zinc output and push up prices, though the scope and impact of these cuts remain unclear.

Though some price volatility is thus likely to persist, market fundamentals should keep prices generally elevated until new supply enters the market. Growing secondary production (zinc can be recycled infinitely without deterioration) is also helping zinc supply to track demand more closely. Prices are expected to remain relatively high and stable until 2019, before gradually easing to around $US2,400 a tonne by 2023.

Figure 14.1: Zinc prices and stocks

Source: LME (2018) zinc spot price

Figure 14.2: Annual change in global steelmaking and zinc use

Source: IMF (2018), Department of Innovation, Industry and Science estimates
14.3 World consumption

Consumption growth is steady in Asia, but unpredictable in the US

World refined zinc consumption is projected to lift from 15 million tonnes in 2018 to 18 million tonnes by 2023. Zinc demand is heavily linked to industrial production, infrastructure development and car sales, which are in turn, heavily linked to income growth and development needs in emerging economies.

The impact of infrastructure spending and government policy on zinc demand is less clear. Both the US and China have substantial infrastructure plans on paper, but both plans are subject to uncertainties. China, which consumes around half of all mined zinc, may temper its infrastructure plans in light of high local government debt and attempts by the Government to improve the quality of infrastructure spending. In the US, infrastructure spending plans — which would create substantial new demand for galvanised steel — are yet to be approved by Congress.

14.4 World production

World mine output is expected to rise steadily over the outlook period

The surge in prices during 2017 has led to a rapid deployment of capital to address supply issues. Global exploration rose across a range of countries in 2017, with new supply expected to begin entering markets in 2018. Several very large mines expected to commence production in the short term include East Siberian Metals’ Ozernoye field project and Mehdiabad mine, Vedanta’s new Gamsberg mine in South Africa, and Trafigura’s Castellanos project in Cuba. Output is also rising from a number of smaller mines in China, though new environmental policies may curb some of this supply in the short term. Declining ore quality among some traditional producers including Peru and Mexico may also constrain output slightly.

On balance, mined output is projected to rise from 14 million tonnes in 2018 to 17 million tonnes by 2023. Zinc production is already highly fragmented (the 20 largest mines account for only one-third of global production) and likely to become more so over the outlook period.

Refined production is expected to rise, but with a risk of disruption

Given the shortage of mine concentrates, refined zinc supply has largely tracked with mine production over the past few years. This trend is expected to continue, with rising output from Asian smelters matching growth in mined supply, leading to an expansion in refined output from 15 million tonnes in 2018 to 18 million tonnes by 2023. However, refined production faces some risks, due to industrial disputes and disruption at large refineries in Quebec (Canada), which add double uncertainty to the supply outlook.

14.5 Australia

High prices have led to a strong rebound in exploration expenditure

Australia’s expenditure on zinc, lead and silver exploration rose to $29 million during the December quarter — more than double the level of a year ago. The bulk of exploration occurred in Northern Australia, where zinc deposits are concentrated.

Figure 14.3: Australia’s silver, lead and zinc exploration expenditure

Australian mined production is starting to recover after falls in 2015–16

Australia's zinc production is likely to grow significantly as new production commences from a range of mines. The Century mine — once the largest zinc mine in the world — is expected to re-commence operations in 2018. New Century Resources, which acquired the mine in 2017, will initially focus on extracting ore from the tailings dam, which potentially holds more than 2.3 million tonnes of zinc. Gas supply issues — previously an obstacle to the project — have been overcome following a deal with Santos, and production is expected to commence in late 2018. Feasibility studies are also underway to determine whether extraction can extend to nearby resources, which would extend the project's life out to the 2030s.

Red River Resources' Thalanga mine, which was placed on care and maintenance by its previous owners, was re-opened in September 2017 and is expected to reach 55,000 tonnes of annual production by 2022.

The largest new mine of recent years is MMG's Dugald River project. This deposit holds significant high-quality reserves, and MMG has already invested more than A$1 billion to open up the resource. Production began in the September quarter of 2017, and is now ramping up, with MMG recently completing construction of a connected processing plant.

These mines are projected to lift production to more than 1,400,000 tonnes by 2019–20, with slower growth over the rest of the outlook period.

**Zinc exports are expected to grow in line with rising production**

Higher mine production is expected to feed through to export volumes, with refined metal exports projected to grow at an average rate of 8 per cent each year over the outlook period. As with production, export volume growth will likely be concentrated in the early part of the outlook period as new mines enter the market, with the rate of growth slowing after 2020.

Export earnings are forecast to rise significantly in 2017–18 and 2018–19, driven by rising production and high prices. A subsequent easing in prices will curb some of the windfall to exporters, but significant opportunities will remain as Asian nations continue with large infrastructure investments.
### Table 14.1: Zinc outlook

<table>
<thead>
<tr>
<th></th>
<th>World</th>
<th>Unit</th>
<th>2017</th>
<th>2018 f</th>
<th>2019 f</th>
<th>2020 z</th>
<th>2021 z</th>
<th>2022 z</th>
<th>2023 z</th>
<th>CAGR r</th>
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<tbody>
<tr>
<td><strong>Production</strong></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– mine</td>
<td></td>
<td>kt</td>
<td>13,438</td>
<td>14,272</td>
<td>14,563</td>
<td>14,624</td>
<td>15,727</td>
<td>16,301</td>
<td>16,921</td>
<td>3.9</td>
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<tr>
<td>– refined</td>
<td></td>
<td>kt</td>
<td>14,129</td>
<td>14,990</td>
<td>15,340</td>
<td>15,455</td>
<td>16,599</td>
<td>17,258</td>
<td>17,965</td>
<td>4.1</td>
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<td>kt</td>
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<td>14,901</td>
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<td>16,642</td>
<td>17,301</td>
<td>18,009</td>
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<td>– weeks of consumption</td>
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<td>5.5</td>
<td>5.4</td>
<td>5.3</td>
<td>5.3</td>
<td>4.6</td>
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<tr>
<td><strong>Price</strong></td>
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<td></td>
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</tr>
<tr>
<td>– nominal</td>
<td></td>
<td>US$/t</td>
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<td>3,275</td>
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<tr>
<td>USc/lb</td>
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<td></td>
<td>131</td>
<td>149</td>
<td>132</td>
<td>127</td>
<td>116</td>
<td>113</td>
<td>109</td>
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<tr>
<td>– real b</td>
<td></td>
<td>US$/t</td>
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<td>2,850</td>
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<td>2,312</td>
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<tr>
<td>USc/lb</td>
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<td>149</td>
<td>129</td>
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<td>105</td>
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<tr>
<td><strong>Australia</strong></td>
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<tr>
<td>Mine output</td>
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<td>Refined output</td>
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<tr>
<td>– ore and conc. c</td>
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<tr>
<td>– nominal</td>
<td></td>
<td>A$m</td>
<td>2,688</td>
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<td>3,726</td>
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<td>3,473</td>
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</table>

**Notes:** b In 2018 US dollars; c Quantities refer to gross weight of all ores and concentrates; d In 2017–18 Australian dollars; f Forecasts; z Projection; r Compound annual growth rate for the period from 2017 to 2023, or from 2016–17 to 2022–23; 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 (2017); World Bureau of Metal Statistics (2018)
Trade summary charts
Figure 15.1: Contribution to GDP


Figure 15.2: Figure 16.2: Principal markets for Australia’s resources and energy exports, 2017–18 dollars

Source: ABS (2017) International Trade in Goods and Services, 5368.0

Figure 15.3: Principal markets for Australia’s resources exports, 2017–18 dollars

Source: ABS (2017) International Trade in Goods and Services, 5368.0

Figure 15.4: Principal markets for Australia’s energy exports, 2017–18 dollars

Source: ABS (2017) International Trade in Goods and Services, 5368.0
**Figure 15.5:** Principal markets for Australia's total exports, 2017–18 dollars

Source: ABS (2017) International Trade in Goods and Services, 5368.0

**Figure 15.6:** Principal markets for Australia's total imports, 2017–18 dollars

Source: ABS (2017) International Trade in Goods and Services, 5368.0

**Figure 15.7:** Proportion of goods and services exports by sector

Source: ABS (2017) Balance of Payments and International Investment Position, 5302.0

**Figure 15.8:** Proportion of merchandise exports by sector

Source: ABS (2016) Balance of Payments and International Investment Position, 5302.0
### Table 15.1: Principal markets for Australia’s thermal coal exports, 2017–18 dollars

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</tr>
</thead>
<tbody>
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<td>Japan</td>
<td>$m</td>
<td>8,503</td>
<td>8,210</td>
<td>7,471</td>
<td>7,102</td>
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<tr>
<td>South Korea</td>
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<td>2,953</td>
<td>2,809</td>
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<td>Taiwan</td>
<td>$m</td>
<td>1,830</td>
<td>1,768</td>
<td>1,860</td>
<td>1,636</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$m</td>
<td>298</td>
<td>369</td>
<td>614</td>
<td>510</td>
</tr>
<tr>
<td>Thailand</td>
<td>$m</td>
<td>260</td>
<td>308</td>
<td>287</td>
<td>326</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>17,817</td>
<td>17,881</td>
<td>16,910</td>
<td>15,312</td>
</tr>
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</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0

### Table 15.2: Principal markets for Australia’s metallurgical coal exports, 2017–18 dollars

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<tbody>
<tr>
<td>India</td>
<td>$m</td>
<td>5,043</td>
<td>5,149</td>
<td>5,278</td>
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<tr>
<td>Japan</td>
<td>$m</td>
<td>6,548</td>
<td>5,887</td>
<td>4,855</td>
<td>4,527</td>
</tr>
<tr>
<td>China</td>
<td>$m</td>
<td>5,063</td>
<td>6,269</td>
<td>5,024</td>
<td>4,022</td>
</tr>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>2,671</td>
<td>2,631</td>
<td>2,505</td>
<td>2,167</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$m</td>
<td>1,269</td>
<td>1,246</td>
<td>1,200</td>
<td>1,009</td>
</tr>
<tr>
<td>Netherlands</td>
<td>$m</td>
<td>1,069</td>
<td>1,074</td>
<td>876</td>
<td>950</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>24,665</td>
<td>24,891</td>
<td>22,955</td>
<td>20,542</td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0
### Table 15.3: Principal markets for Australia’s crude oil and refinery feedstocks exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>$m</td>
<td>2,439</td>
<td>2,114</td>
<td>1,914</td>
<td>654</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$m</td>
<td>330</td>
<td>331</td>
<td>35</td>
<td>368</td>
</tr>
<tr>
<td>China</td>
<td>$m</td>
<td>2,166</td>
<td>5</td>
<td>28</td>
<td>732</td>
</tr>
<tr>
<td>Thailand</td>
<td>$m</td>
<td>897</td>
<td>1,748</td>
<td>1,327</td>
<td>721</td>
</tr>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>1,701</td>
<td>681</td>
<td>1</td>
<td>466</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$m</td>
<td>879</td>
<td>314</td>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>11,485</td>
<td>11,897</td>
<td>9,109</td>
<td>5,651</td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0

### Table 15.4: Principal markets for Australia’s LNG exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>$m</td>
<td>14,055</td>
<td>16,115</td>
<td>15,065</td>
<td>10,932</td>
</tr>
<tr>
<td>China</td>
<td>$m</td>
<td>656</td>
<td>682</td>
<td>1,376</td>
<td>3,051</td>
</tr>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>691</td>
<td>469</td>
<td>1,001</td>
<td>1,742</td>
</tr>
<tr>
<td>India</td>
<td>$m</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>523</td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>$m</td>
<td>287</td>
<td>186</td>
<td>42</td>
<td>166</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$m</td>
<td>0</td>
<td>0</td>
<td>117</td>
<td>195</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>15,690</td>
<td>17,452</td>
<td>17,779</td>
<td>17,206</td>
</tr>
</tbody>
</table>

Notes: ABS data for LNG exports by destination in 2016–17 and total LNG exports. Australia’s LNG exports by destination before 2016–17 are estimates based on International Trade Centre data.

### Table 15.5: Principal markets for Australia’s iron ore exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$m</td>
<td>46,107</td>
<td>61,043</td>
<td>44,307</td>
<td>40,250</td>
</tr>
<tr>
<td>Japan</td>
<td>$m</td>
<td>9,472</td>
<td>10,344</td>
<td>7,047</td>
<td>4,860</td>
</tr>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>5,417</td>
<td>6,527</td>
<td>4,259</td>
<td>3,169</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$m</td>
<td>1,646</td>
<td>1,830</td>
<td>1,365</td>
<td>1,060</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$m</td>
<td>61</td>
<td>44</td>
<td>29</td>
<td>56</td>
</tr>
<tr>
<td>India</td>
<td>$m</td>
<td>52</td>
<td>44</td>
<td>115</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>62,749</td>
<td>79,926</td>
<td>57,373</td>
<td>49,616</td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0

### Table 15.6: Principal markets for Australia’s aluminium exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>745</td>
<td>729</td>
<td>808</td>
<td>1,158</td>
</tr>
<tr>
<td>Japan</td>
<td>$m</td>
<td>1,104</td>
<td>1,193</td>
<td>1,533</td>
<td>723</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$m</td>
<td>501</td>
<td>475</td>
<td>514</td>
<td>309</td>
</tr>
<tr>
<td>Thailand</td>
<td>$m</td>
<td>410</td>
<td>333</td>
<td>306</td>
<td>283</td>
</tr>
<tr>
<td>China</td>
<td>$m</td>
<td>164</td>
<td>249</td>
<td>53</td>
<td>97</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$m</td>
<td>273</td>
<td>209</td>
<td>144</td>
<td>98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$m</td>
<td>3,602</td>
<td>3,724</td>
<td>4,023</td>
<td>3,364</td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0
### Table 15.7: Principal markets for Australia’s copper exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$m</td>
<td>3,338</td>
<td>4,216</td>
<td>3,836</td>
<td>3,723</td>
<td>2,753</td>
</tr>
<tr>
<td>Japan</td>
<td>$m</td>
<td>1,775</td>
<td>1,739</td>
<td>2,094</td>
<td>1,482</td>
<td>1,384</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$m</td>
<td>744</td>
<td>654</td>
<td>554</td>
<td>641</td>
<td>877</td>
</tr>
<tr>
<td>India</td>
<td>$m</td>
<td>1,220</td>
<td>1,012</td>
<td>845</td>
<td>532</td>
<td>697</td>
</tr>
<tr>
<td>South Korea</td>
<td>$m</td>
<td>482</td>
<td>625</td>
<td>384</td>
<td>509</td>
<td>455</td>
</tr>
<tr>
<td>Philippines</td>
<td>$m</td>
<td>155</td>
<td>305</td>
<td>264</td>
<td>228</td>
<td>405</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$m</strong></td>
<td><strong>8,843</strong></td>
<td><strong>9,319</strong></td>
<td><strong>8,912</strong></td>
<td><strong>8,419</strong></td>
<td><strong>7,724</strong></td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0

### Table 15.8: Principal markets for Australia’s gold exports, 2017–18 dollars

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$m</td>
<td>4,686</td>
<td>6,406</td>
<td>8,507</td>
<td>7,218</td>
<td>8,945</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>$m</td>
<td>2,876</td>
<td>685</td>
<td>613</td>
<td>4,088</td>
<td>3,993</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>$m</td>
<td>121</td>
<td>162</td>
<td>199</td>
<td>2,620</td>
<td>9,809</td>
</tr>
<tr>
<td>Singapore</td>
<td>$m</td>
<td>1,039</td>
<td>2,433</td>
<td>3,277</td>
<td>1,241</td>
<td>308</td>
</tr>
<tr>
<td>Thailand</td>
<td>$m</td>
<td>1,397</td>
<td>476</td>
<td>944</td>
<td>263</td>
<td>543</td>
</tr>
<tr>
<td>Switzerland</td>
<td>$m</td>
<td>315</td>
<td>369</td>
<td>16</td>
<td>90</td>
<td>230</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$m</strong></td>
<td><strong>16,553</strong></td>
<td><strong>13,926</strong></td>
<td><strong>13,731</strong></td>
<td><strong>16,283</strong></td>
<td><strong>18,384</strong></td>
</tr>
</tbody>
</table>

Source: ABS (2017) International Trade in Goods and Services, 5368.0
Appendix
Appendix A  Assumptions and definitions

A.1 Conversion to real dollars

Nominal values and prices are converted to real dollars using 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.2 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.

Table A9: Exchange rate and inflation assumptions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AUD/USD exchange rate</td>
<td>0.77</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Inflation rate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>97.7</td>
<td>100.0</td>
<td>102.0</td>
<td>104.1</td>
<td>106.1</td>
<td>108.1</td>
<td>110.2</td>
</tr>
<tr>
<td>Australia</td>
<td>98.0</td>
<td>100.0</td>
<td>102.4</td>
<td>104.8</td>
<td>107.3</td>
<td>109.9</td>
<td>112.7</td>
</tr>
</tbody>
</table>

Notes: The inflation rate for Australia is used to convert Australian export values to real 2017–18 dollars. The inflation rate for the United States is used to convert commodity prices denominated in USD to real 2018 dollars.

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 A2: OCE terminology for time horizons**

<table>
<thead>
<tr>
<th>Outlook period</th>
<th>Years</th>
<th>Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current period</td>
<td>Current (Incomplete data or subject to revision)</td>
<td>Estimate</td>
</tr>
<tr>
<td>Short term</td>
<td>1 to 2 years</td>
<td>Forecast</td>
</tr>
<tr>
<td>Medium term</td>
<td>3 to 5 years</td>
<td>Projection</td>
</tr>
</tbody>
</table>

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 A3: Resources and energy commodities groupings and definitions**

<table>
<thead>
<tr>
<th>Resources (non-energy)</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
</tr>
<tr>
<td>Resource commodities are non-energy minerals and semi-manufactured products produced from non-energy minerals</td>
<td>Energy commodities are minerals and petroleum products that are typically used for power generation</td>
</tr>
<tr>
<td>Australian Harmonised Export Commodity Classification (AHECC) chapters</td>
<td>25 (part); 26 (part); 28 (part); 31 (part); 73 (part); 74; 75; 76; 78; 79; 80; 81</td>
</tr>
<tr>
<td>Commodities for which data is published, forecasts are made and analysed in detail in this report</td>
<td>Aluminium; alumina; bauxite; copper; gold; iron ore; crude steel; nickel; zinc</td>
</tr>
</tbody>
</table>

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  Methodology

Figure B1: Forecasting process

1. Global economic conditions
   - GDP growth (IMF)
   - Other macroeconomic forecasts: Industrial production, monetary conditions etc. (World Bank, OECD, Oxford Economics, other)

2. Demand
   - Energy demand (IEA)
   - Demand by sector
   - Urban population growth (UN)
   - Technological change
   - Technical assumptions
   - Government plans and policies
   - Research papers, company reports

3. Supply
   - Surplus/Deficit Stock changes

4. Surplus/Deficit
   - Stock changes

5. Price
   - Australian production
   - Australian export unit values
   - Australian export volumes
   - Australian export values
   - Margin and cost curves (AME Group)
   - Statistical models (internal)
   - Consensus forecasts
   - Supply and demand dynamics

Notes: Numbers refer to accompanying explanatory text in the Appendix. This is a stylised visual representation of the conceptual forecasting framework used by the OCE. It is not an exhaustive depiction of the methodology and data sources used, and the exact approach varies by commodity. Sources in parenthesis where relevant.

Source: Department of Industry, Innovation and Science (2018)
B.1 Forecasting methodology

The Office of the Chief Economist (OCE) forecasts prices, export volumes, and export values for Australia’s resource and energy commodities (see Appendix A for the list of these commodities). The forecasts for commodity prices and Australia’s resources and energy exports are underpinned by the OCE’s outlook for world demand and supply.

The OCE’s forecasts are supported by supply and demand models, economic analyses, and an assessment of data and information available at the time. This appendix describes the forecasting process outlined in Figure B1, and the general principles and methodology underpinning the OCE’s forecasts. The exact approach to forecasting varies across the commodities, depending on the characteristics of the market, the time horizon being considered (see Appendix A for a discussion of time horizons), and data availability. Specific examples are discussed where relevant.

Global economic conditions

The forecasting process begins with establishing the outlook for global economic conditions. The OCE does not construct its own macroeconomic forecasts but instead, draws on reputable, public sources, such as the IMF, World Bank and OECD. However, economic conditions sometimes change noticeably between forecast releases, so adjustments to these forecasts may be made if a sharp deterioration or improvement is anticipated from assessing a range of leading economic indicators and more recent data.

Demand (consumption and imports)

The importance of different drivers of demand depends on the time horizon being considered. In the short term, economic growth and industrial production growth are the key leading/coincident indicators of demand for resource and energy commodities. And steel production is actually a short term leading indicator of the world industrial production cycle (see Figure B2).
Supply (production and exports)
In the short term, production forecasts are driven by guidance from company reports and presentations, industry intelligence, and mine-level data from a private data provider. Production is assumed to be relatively fixed in the short-term, but factors such as changes to capacity utilisation, and identified new developments and expansions, are taken into account.

In the medium to long term, commodity production is assumed to respond to changes in price from market imbalances (as a result of changes to consumption), such that the market reverts to equilibrium. After a forecast for total world production is established, production by country is determined by examining mining and transport costs, and other non-economic factors, such as government policy.

World trade and stock changes
Exports and imports are forecast for the bulk commodities (iron ore, metallurgical coal, thermal coal, and gas). While consumption, production and trade are interconnected, it is seaborne trade that typically determines world benchmark prices. The distinction between trade and consumption/production is substantial enough for bulk commodities such that exports and imports are forecast for these commodities at the country or regional level.

For storable commodities, stock changes are mechanically derived after consumption and production forecasts are determined.

Commodity prices
In the short term, changes to commodity prices are driven by mismatches in demand and supply, and broader political, economic and financial conditions. The approach used to forecast prices in the short-term depends on the nature of the market and the availability of data, and includes an assessment of the supply and demand dynamics and statistical models.

In the medium term, supply is assumed to respond to changes in price to follow demand. The price should theoretically trend toward the level that covers the costs of the last unit of production needed to meet demand.

The OCE uses margin curves — where data is available — to forecast prices, and makes adjustments to the data to reflect reality — some producers will continue to produce even if they are uneconomic (for example, if they are state-owned or vertically integrated with downstream processing facilities). This method requires two inputs: demand forecasts, and assumptions regarding the loss-making share of production.

Where margin and cost data is not available, other information and methods that are used to forecast prices includes:

- consensus forecasts
- supply and demand dynamics
- statistical models
- other assumptions and structural relationships (for example, the price forecast for Australian LNG is largely determined by the oil-linked contract price, which is in turn driven by the OCE’s oil price forecast).

Box B1: Reconciliation and Balancing
Forecasts for consumption, production, trade and stock changes are reconciled and balanced at the country, regional and world level to ensure internal consistency over the medium term. This is facilitated by the use of the following system of identities:

1. \( \text{Net exports by country} = \text{Production by country} - \text{Consumption by country} - \text{Change in stocks} \)
2. \( \text{World trade} = \text{Sum of exports by country} = \text{Sum of imports by country} \)
3. \( \text{Sum of net exports by country} = 0 \)
4. \( \text{World production} = \text{Sum of production by country} \)
5. \( \text{World consumption} = \text{Sum of consumption by country} \)
6. \( \text{World production} = \text{World consumption} + \text{Change in stocks} \)
Australia’s production, export volumes and export values

The OCE forecasts Australia’s production volumes at the mine or facility level, which is then aggregated and reported at the national level. In the short term, production forecasts are underpinned by guidance from company reports, presentations, and announcements, and data and intelligence provided directly from company representatives. In the medium term, production forecasts are guided by long-term production targets from company reports where available, and data on resource depletion from a private data provider.

The further into the outlook period, the more risks there are regarding projections for Australia’s production, particularly for projects that are still in the investment pipeline. Projects that have received a positive final investment decision (FID) are generally included in projections, unless the company announces a delay or cancellation. Projects that have not yet received a positive FID are not guaranteed to begin production. Whether they proceed depends on a range of factors, including the final evaluation of commercial prospects, market conditions, whether they can obtain all necessary regulatory approvals, and obtaining access to, or development of, rail and port infrastructure. In assessing the likelihood of whether a project will come online in the outlook period, the OCE considers its progress in the project development cycle, and data and analysis of mining costs and profitability from a private data provider. The OCE takes a conservative approach, and only incorporates into production forecasts those projects that are considered likely to proceed.

Export volumes are generally derived from an assumption regarding the relationship between a country’s production and consumption (usually based on a historical ratio). For LNG, export projections are underpinned by the contractual arrangements that Australian exporters have in place with buyers. Australia’s production and exports are reconciled and balanced with forecasts for the rest of the world using the system of identities outlined in Box B1. Export values are then mechanically derived from multiplying forecast export unit values (which is driven by forecast prices) by export volumes.

Box B2: Risk and uncertainty

The OCE produces point forecasts of consumption, production, price, and Australian export volumes and values, based on the information available at the time. However, actual outcomes will differ from initial point forecasts due to the effects of risk, uncertainty and unforeseeable events.

Risk refers to possible factors or events that have been identified — and on which an assessment can be made — regarding their likelihood and their impact on commodity prices. For example, a persistent risk to the price forecasts for many commodities is the possibility of government policy in China that limits domestic output due to tighter environmental regulations. The forecasts in the Resources and Energy Quarterly attempt to account for and balance a range of upside and downside risks, and the accompanying commentary aims to describe the likelihood and impact of possible events. Where possible, analysis is undertaken to assess the sensitivity of the forecasts to different scenarios.

There are also many factors that affect commodity prices that are uncertain (that is, where it is not possible to assess their likelihood or impact) or inherently unforeseeable, including:

- unexpected changes to government policy
- geopolitical events
- changes to technology and preferences
- supply disruptions (e.g. due to an unplanned shutdown of production or port facilities because of an operational issue, extreme weather events, or industrial action)
- financial market sentiment and speculative trading (while traders tend to follow fundamentals, speculative activity in a relatively illiquid market can exaggerate price swings).

For these reasons, decision and policy makers are strongly encouraged to read the accompanying commentary in the Resources and Energy Quarterly. The commentary is fundamental to gaining an understanding of the underlying drivers to the outlook for commodity markets and Australia’s resource and energy exports, and the risks and uncertainty surrounding the forecasts.
## Appendix C Commodity analysts and contact details

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Analyst</th>
<th>Email</th>
</tr>
</thead>
<tbody>
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<td>Steel and iron ore</td>
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