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Department of Industry, Science, Energy and Resources

Office of the Chief Economist

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Contents

Foreword

Australia's resource and energy export earnings are forecast to hit a record $425 billion in 2021–22. While this represents a significant increase on 2020–21, exports are expected to fall back to $370 billion in 2022–23 and then fall further in real terms over the period to 2027. Driving the fall will be the return of bulk commodity prices to more 'normal' levels, following the elevated levels experienced recently, including as a result of the Russian invasion of Ukraine.

Each March edition of the *Resources and Energy Quarterly* (REQ) provides an extended five-year outlook, rather than the usual two-year horizon. This allows us to consider additional structural factors and longer-term influences. Structural issues include the global energy transition and the reorganisation of world trade — as geopolitical alliances solidify.

There have been a few developments since the December 2021 REQ that have the potential to have a noticeable impact on the global resources and energy sector over the first half of the outlook period. The most significant has been the Russian invasion of Ukraine. As we go to print, the impact on world financial and commodity markets is still playing out. Sanctions are being applied on Russia, a major energy exporter, and there are potentially more in prospect. How long these sanctions stay in place is difficult to predict. As this happens, world trade (and associated investment flows) could see some bifurcation in line with geopolitical alliances over the outlook period.

China has relaxed macroeconomic policy in recent months, to allow economic growth to pick up from last year's slowdown. Other developments include a new (Omicron) variant of the COVID-19 virus which has swept the world, while wet weather has impacted on the output/export of bulk commodities. The La Niña weather pattern appears set to end in mid-2022, removing some of the threat to the supply of Australian thermal coal over much of the outlook period. With energy stocks in the Northern Hemisphere well below normal, supply disruptions will act to keep prices high in the short run.

Inflation has picked up in most major economies, and the major central banks have started to withdraw monetary support as the economic impact of the worst pandemic in 100 years recedes. Of high relevance to energy and resource markets, the IMF forecasts China's GDP growth to be 4.8% in 2022 and 5.2% in 2023. The Chinese Government has set a growth target of 5.5% for 2022, as it attempts to overcome new outbreaks of COVID-19. After a rise of 5.9% in 2021, the IMF forecasts world GDP growth to be 4.4% in 2022 and 3.8% in 2023. Growth of 3.0-3.5% is forecast over the remainder of the outlook period.

International coal and gas/LNG prices are at record levels — on the back of both supply and demand factors — which promises to boost Australia's export earnings sharply in the short term. However, these high prices will impact growth in nations that are net fossil fuel consumers, and provide an incentive to minimise exposure to a range of energy sources.

Australian iron ore earnings are forecast to decline noticeably in the outlook period. The global economic recovery and constrained supply saw prices exceed US$230 a tonne in mid-2021, but sharp cuts in Chinese steel output contributed to large price declines in the latter half of 2021. The ongoing recovery in Brazilian supply, and gains in output elsewhere, are set to push iron ore prices down over the outlook period. A stronger outlook for base metals and lithium partly offsets the impact of forecast lower iron ore export earnings.

The risks to the export earnings forecast for 2021–22 and 2022–23 are equally skewed. A severe disruption to commodity supply emanating from Russia's invasion of Ukraine could push prices up further. There is potential for a (related) further rise in global inflation, and a risk of tighter monetary policy in response. New, vaccine-resistant COVID-19 strains also pose risks. In the latter half of the outlook period, global efforts to build energy and transport systems based on lower emission sources, are expected to partly offset the impact of energy exports coming off their near-term highs.

About this edition

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

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

Underpinning the forecasts/projections 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/projections 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* attempts to factor in these changes, and makes appropriate alterations to the forecasts/projections by estimating the impact on Australian producers and the value of their exports.

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

Unless otherwise stated, all Australian and US dollar figures in this report are in nominal terms. Inflation and exchange rate assumptions are provided in tables 2.1 and 2.2 in the *Macroeconomic outlook* chapter.

Information in this edition of the *Resources and Energy Quarterly* is current as of 23 March 2022.

Resources and Energy Quarterly publication schedule

Publication	Expected release date	Outlook period final year
June 2022	4 July 2022	Australian data: 2023–24 World data: 2024
September 2022	4 October 2022	Australian data: 2023–24 World data: 2024
December 2022	19 December 2022	Australian data: 2023–24 World data: 2024
March 2023	3 April 2023	Australian data: 2027–28 World data: 2028

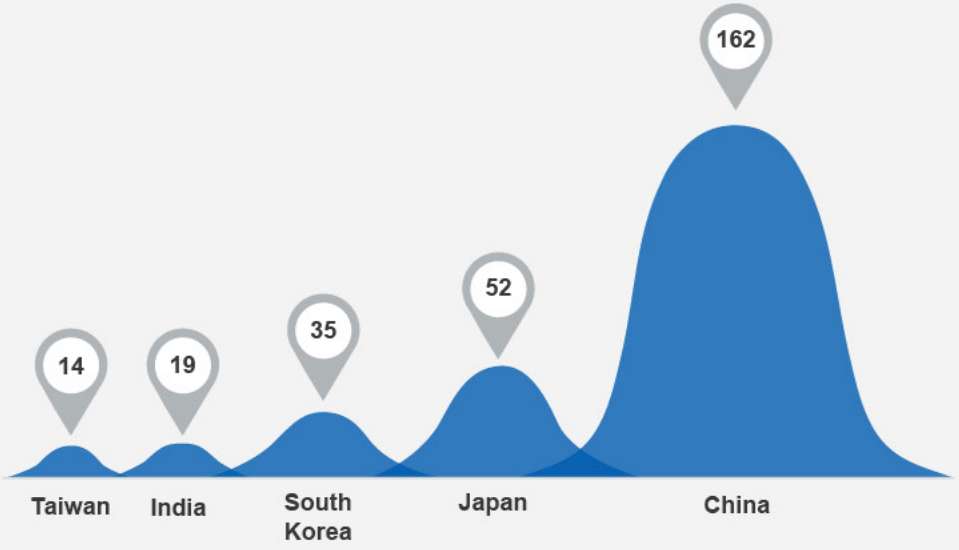
Source: Department of Industry, Science, Energy and Resources (2022)

Overview

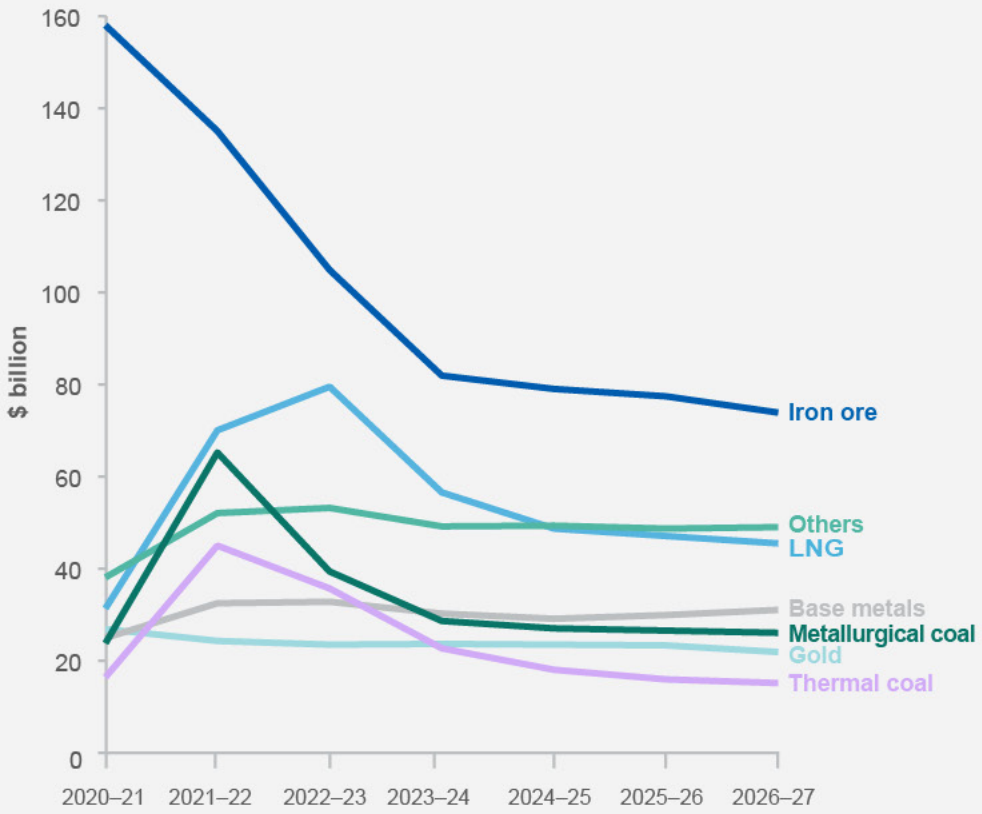
Australia's mining sector

- Around 10% of GDP
- More than **two-thirds of Australia's** total merchandise exports
- Directly employs **more than** a quarter of a million people

Major markets for Australia's resources and energy exports in 2021, A$billion



Australia's resources and energy exports



1.1 Summary

- The outlook for Australia's mineral exports remains strong, as the world economy rebounds from the impact of the COVID-19 pandemic and energy shortages persist. High prices, good volume growth and a weak Australian dollar are driving a surge in export earnings. Some decline in prices is likely in 2023, as supply rises and demand growth moderates.
- Export earnings are forecast to lift by 33% to a record $425 billion in 2021–22, then fall to $370 billion (in real terms) in 2022–23. Earnings should steady out at $263–293 billion over the rest of the outlook.
- Energy prices have jumped, on the prospect that the fallout from Russian invasion of Ukraine will intensify energy shortages. Commodity prices will settle back, as inventories rebuild and as world trade reorganises.

1.2 Export values

Australia's export values are estimated at $425 billion in 2021–22

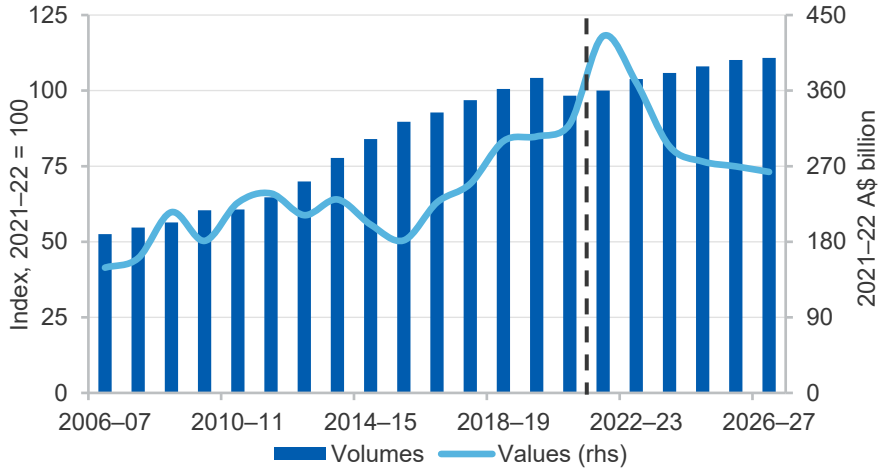
In the March quarter 2022, the Office of the Chief Economist's (OCE) Resources and Energy Export Values Index rose 49% from the March quarter 2021; a 6% rise in volumes added to a 42% gain in prices.

Exports are forecast at a record $425 billion in 2021–22, up from $320 billion in 2020–21 (Figure 1.1). Exports should fall to $370 billion (real terms) in 2022–23. With volumes growing modestly, price changes are forecast to account for much of the move in future earnings (Figure 1.2). Commodity prices are set to fall as demand growth slows and supply rises.

Energy shortages and supply deficit concerns to help boost earnings

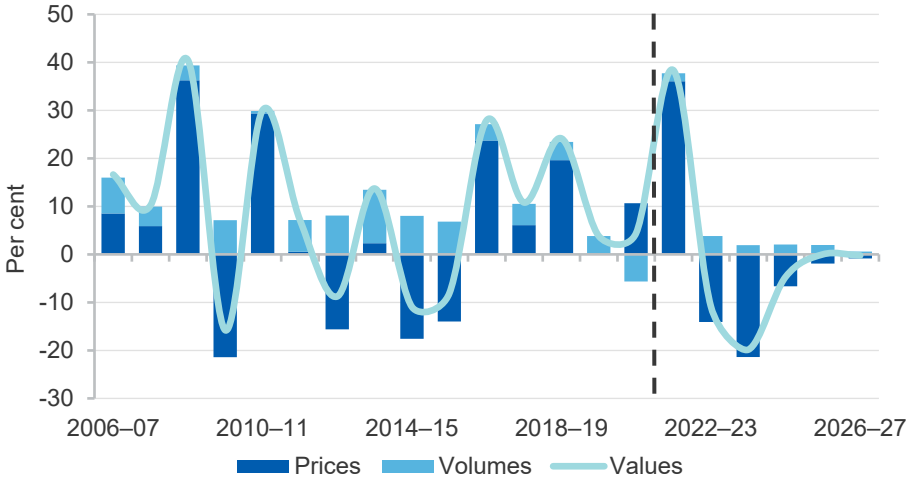
In Australian dollar terms, the OCE's Resources and Energy Commodity Price Index rose by 24% (preliminary estimate) in the March quarter 2022, and was up 49% on a year ago. In US dollar terms, the index rose by 22% in the quarter, and was 32% higher than a year ago. The index of prices for resource (mainly metals) commodity exports (Australian dollar terms) fell by 9% in the year to the March quarter 2022. Energy commodity prices rose by 171% (Figure 1.3) from March quarter 2021, as market deficit concerns (primarily due to supply problems) added to existing shortages.

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



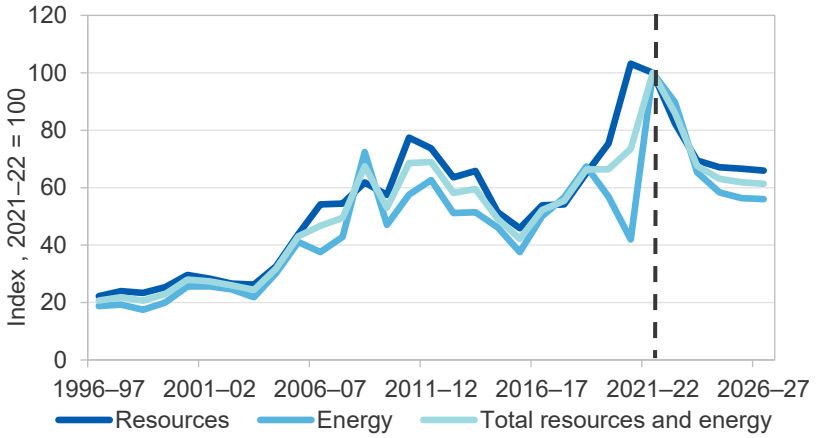
Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

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



Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

Figure 1.3: Resource and energy export prices, AUD terms



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

Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

1.3 Macroeconomic, policy, trade and other factors

The recovery in world economic activity continues to be hampered by COVID-19 outbreaks and an energy shortfall in the Northern Hemisphere. The fallout from the Russian invasion of Ukraine poses a further risk to world growth in the short term: any disruption to Russian energy exports to the rest of the world is likely to keep energy prices high.

The Russian invasion of Ukraine has driven some consumers to switch from Russia as a supply source. In the short term, this may mean that more, rather than less, thermal coal will be consumed in Western nations, as Russian energy supply (mainly gas/LNG) is shunned. Efforts to reduce emissions are likely to come back into focus once energy security can be assured, impacting further on coal demand in developed nations over time.

Commodity trade is re-organising rapidly: Russian commodities that would normally head to developed nations are being shunned by some customers, and may be diverted to China and India; China and India may then have less need for non-Russian cargoes, and these could be diverted to developed nations. High prices will prompt a supply response if producers believe Russian supply will be locked out for some years. The supply of Iranian (and Venezuelan) oil could return to world markets, offsetting any loss of Russian supply. The strong rise in US LNG exports expected over the next few years is likely to displace Russian gas/LNG supply to the West, as these nations seek to avoid Russian supply.

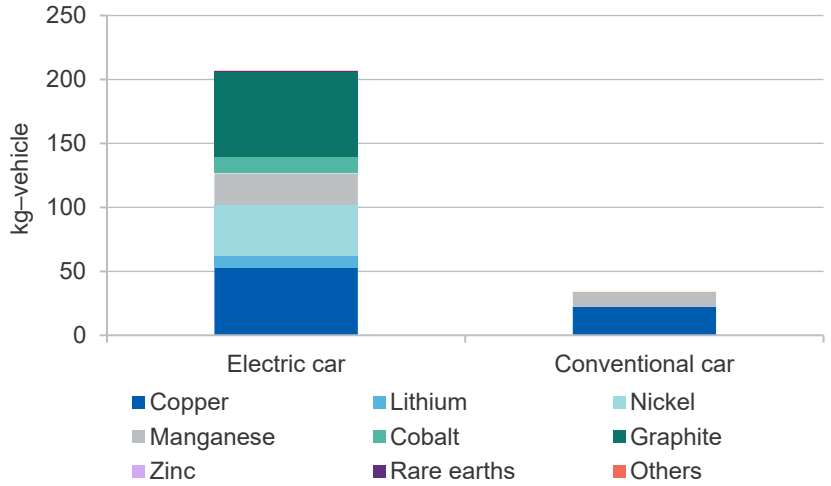
Late in 2021 and in early 2022, the Chinese Government took measures to improve Chinese economic growth. The measures came after a noticeable slowing in growth in 2021. Beijing's 'zero COVID-19' policy is likely to continue to impact on economic activity in 2022, causing supply chain disruptions and constraining commodity demand. Chinese industrial activity is likely to pick up with the Beijing Winter Olympics now completed. The pace of Chinese economic growth will remain an important driver of resource and energy commodity demand over the outlook period. However, the absolute size of China's economy (and thus its appetite for commodities) now means that the prospect of Chinese economic growth of 4–6% doesn't constitute the same concern to commodity markets as it would have done 7 or 8 years ago — when growth was consistently 7–9%.

The US Federal Reserve appears likely to move towards a more neutral monetary policy stance over 2022, as US inflation becomes a concern and the economic recovery continues. However, the pace at which the US Fed moves will depend on the extent of the fallout of the Russia invasion of Ukraine.

Prior to the Russian invasion of Ukraine, the outlook was for strong growth in the world economy in 2022 and 2023, as COVID-19 vaccination rates and infection medications improved and became more accessible. The latest IMF forecasts put world GDP growth at 4.4% in 2022 and 3.8% in 2023, after growth of 5.9% in 2021. World economic growth returns to 3.0–3.5% in the 2024–27 period. The prospects for 2022 are now more uncertain, with much depending on the length and depth of sanctions on Russia.

Surging electric vehicle (EV) sales in the major nations have implications for a range of critical minerals and metals in the outlook period. In addition to using about 9kg of lithium, the average light EV requires around 200kg of other key minerals and metals (Figure 1.4) — about 6 times the volume used in a car with an internal combustion engine.

Figure 1.4: Key minerals used in electric vehicles



Source: IEA (2021)

Resource commodity demand should thus show significant growth over the outlook period. Australian coal and LNG exporters should achieve high prices, as energy shortages persist and Russian exports are shunned. However, after 2022, as global coal and LNG supply lifts and demand growth moderates, prices are likely to slide noticeably.

Our projections suggest that resource and energy export earnings will reach $425 billion in 2021–22, but then decline to $370 billion in real terms in 2022–23. Earnings should steady out at $263–293 billion over the rest of the outlook period.

Higher global interest rates — in response to persistent inflation — pose a downside risk to global economic activity, and hence the resource and energy export forecasts.

1.4 Prices

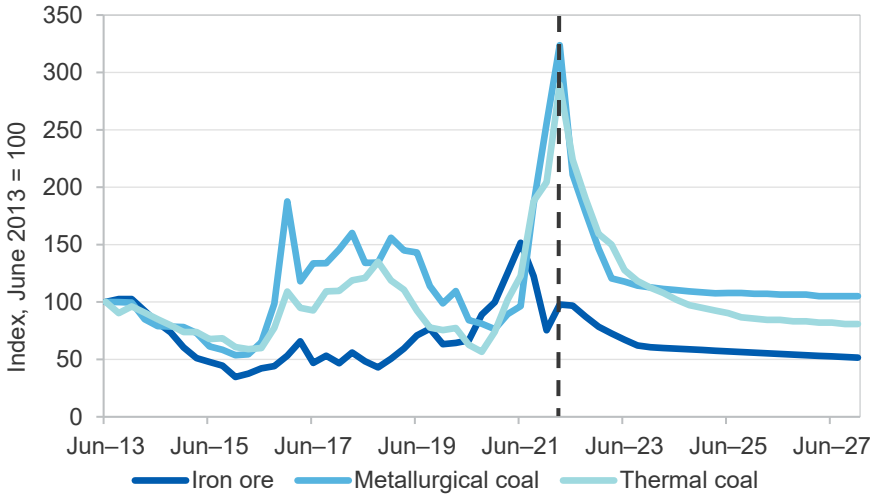
Since the December 2021 *Resources and Energy Quarterly*, the iron ore price has made modest gains but is well below mid 2021 levels. The likelihood of improved Chinese demand has added to the impact of supply problems in major exporting nations (Figure 1.5). Prices are expected to ease over the outlook period, as Brazilian supply recovers and growth in world demand moderates.

Australian metallurgical coal prices are at, or close to, record highs as bad weather in Australia impacts production and transportation. Prices are expected to ease over the outlook period, as supply recovers. Thermal coal prices are also at record levels: with rebounding economic activity and utilities shunning Russian supply, buyers are scrambling to rebuild stocks. Prices are likely to hold at relatively strong levels in the short term but decline from 2023, as demand falls back and supply expands (Figure 1.5).

Oil prices recently hit their highest level since 2008, as the market anticipates the loss of some Russian supply against a backdrop of low world inventories. The oil price seems capable of further short term gains but is then likely to fall back, as an improvement in global supply more than matches the recovery in demand. Contract LNG prices are forecast to ease, as oil prices settle. Spot LNG is likely to be high for some time.

Gold briefly rose above US$2,000 an ounce as Russia's invasion of Ukraine saw flows into safe havens. Gold also seems highly capable of more short term gains, but is then likely to fall in the next few years, as the withdrawal of widespread central bank stimulus lifts real bond yields. In mid-March 2022 — as in mid-December 2021 — all 6 base metals traded on the London Metal Exchange were in backwardation — where spot prices exceed some/all prices further out on the futures curve. This reflects tight supply: inventories have recently stayed very low or fallen further, as supply disruptions added to the impact of strong demand (following the rebound in economic activity). Base metal usage should rise, as world industrial activity recovers and as the energy transition continues. Prices should fall as supply slowly catches up with demand and stockpiles build.

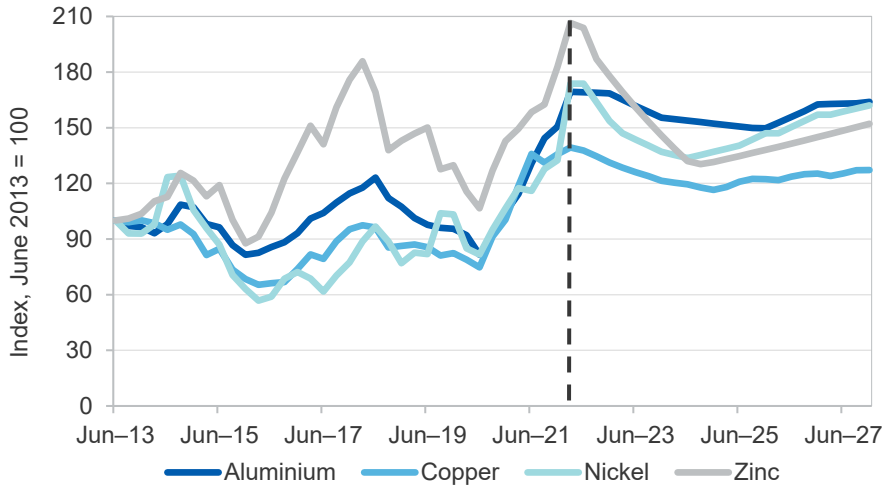
Figure 1.5: Bulk commodity prices



Notes: Prices are in US dollars, and are the international benchmark prices

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2022)

Figure 1.6: Base metal prices



Notes: Prices are in US dollars, and are the international benchmark prices

Source: Bloomberg (2021); Department of Industry, Science, Energy and Resources (2022)

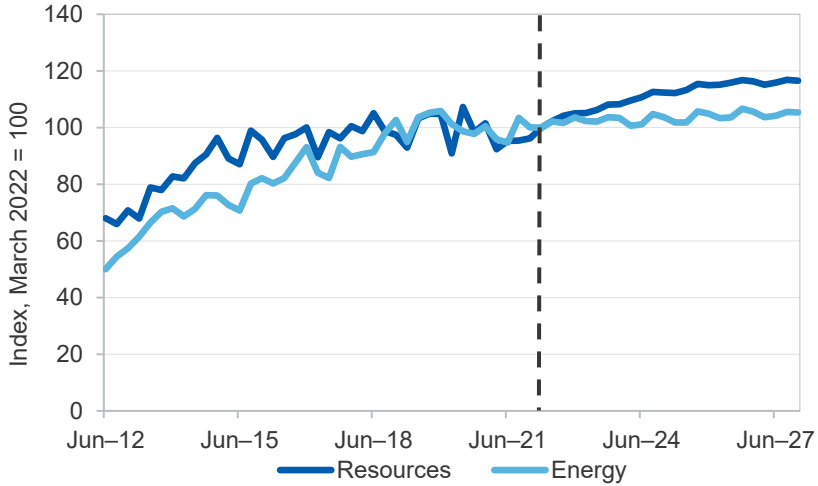
1.5 Export volumes

March quarter export volumes rose, driven by resource exports

The OCE's Resources and Energy Export Volumes Index (preliminary estimate) rose by 2% in the March quarter 2022 from the last quarter of 2021, and was 6% higher than a year before (Figure 1.7). Within this total, resource commodity volumes rose 8% in the year to the March quarter 2022, and energy commodity volumes rose by 4%. The improvement in energy exports was driven by the rebound in demand, as world activity (and thus power demand) recovered from the impact of COVID-19.

In volume terms, resource exports are likely to show further significant growth over the outlook period. Economic growth and industrial production continue to recover amongst our main trading partners, increasing demand for our ferrous and non-ferrous metals. The production of electric vehicles and new energy technologies will see growing demand for commodities such as copper, aluminium, lithium and nickel. The volume of energy exports is forecast to show only minor growth during the outlook period. Record high prices will impact adversely on near-term demand.

Figure 1.7: Resource and energy export volumes



Source: Department of Industry, Science, Energy and Resources (2022)

1.6 Contribution to growth and investment

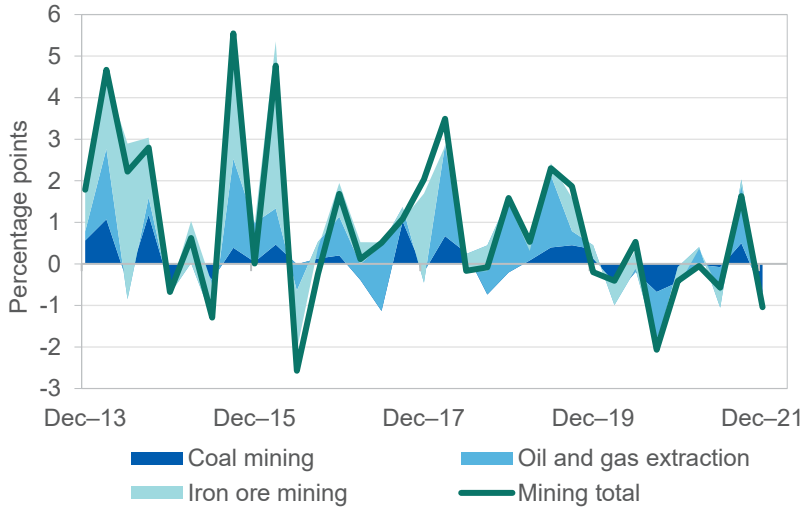
Mining industry expanded while the overall economy contracted

Australia's real Gross Domestic Product (GDP) rose by 3.4% in the December quarter 2021, and was up 4.2% over the year since the December quarter 2020.

Mining value-added fell by 1.0% in the December quarter, and was down 0.1% over the previous twelve months (Figure 1.8). Coal mining was impacted by bad weather, and the oil/gas sector by operational problems.

In the coming five years, it is likely that the resources and energy sectors will make a significant contribution to real GDP growth. In the short run, coal producers will lift output and exports in response to high prices and margins. However, absent significant investment, coal production is likely to struggle to grow significantly in the latter half of the outlook period. Ferrous and non-ferrous metal production should show stronger growth than energy production, as the global energy transition gathers pace.

Figure 1.8: Contribution to quarterly growth, by sector

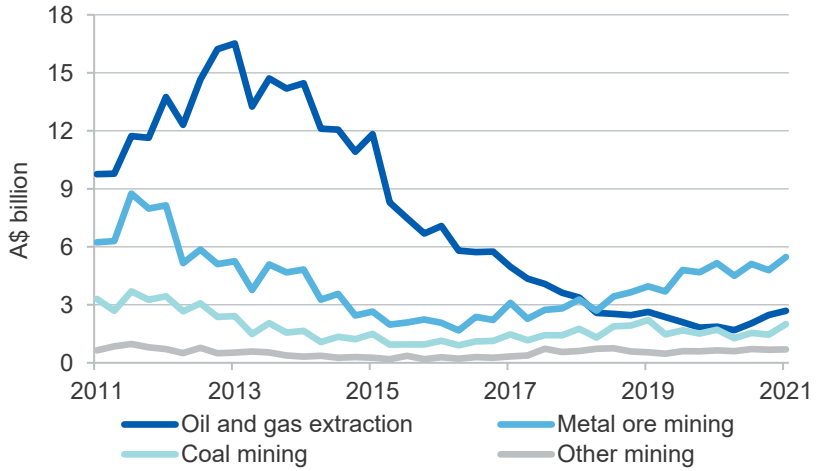


Source: ABS (2022) Australian National Accounts, 5206.0

Mining investment is picking up

The ABS Private New Capital Expenditure and Expected Expenditure survey of December quarter 2021 shows that Australia's mining industry invested $10.9 billion in the quarter. This was up by 15% in the quarter, and 16% from the December quarter 2020. Strong iron ore prices supported growth in investment by the metal ore mining sector during 2021, though growth has now become more broadly based (Figure 1.9).

Figure 1.9: Mining industry capital expenditure by commodity

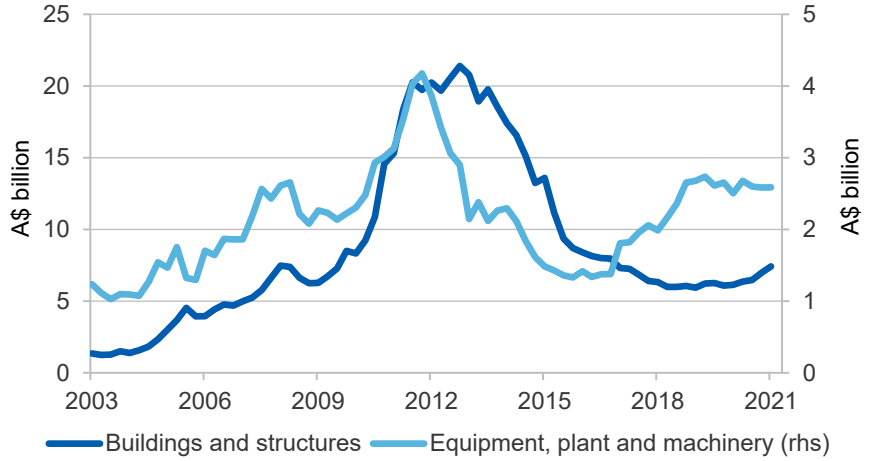


Notes: Other mining includes non-metallic mineral mining and quarrying and exploration and other mining support services; chart data is in nominal, original terms

Source: ABS (2022) Private New Capital Expenditure and Expected Expenditure, 5625.0

Expenditure lifted slightly for buildings and structures, while holding steady for machinery and equipment in the December quarter 2021 (Figure 1.10). Spending on plant and equipment remains well above its average level of recent years, though the reverse trend has been evident in buildings and structures. Forward expectations suggest that investment in 2021–22 and 2022–23 will be slightly higher than in 2020–21 (Figure 1.11). Strong prices for gold and various minerals used in low-emissions energy have been leading to new investment plans, including the re-opening of mines.

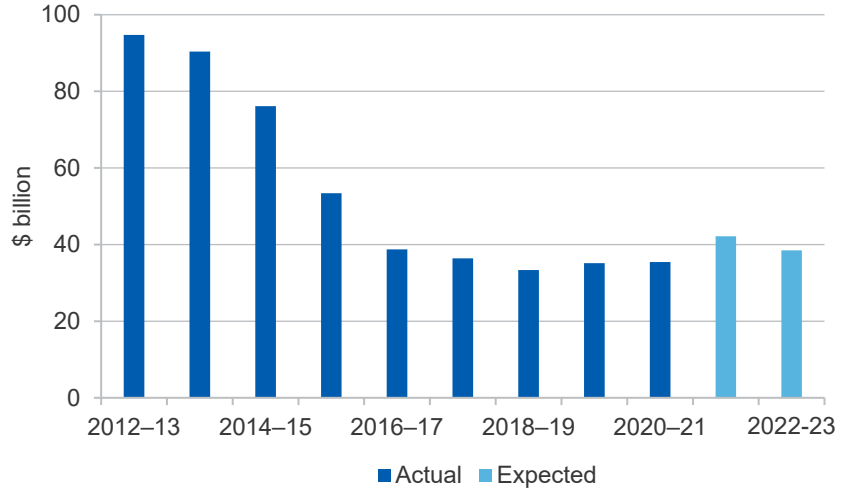
Figure 1.10: Mining industry capital expenditure by type, quarterly



Notes: Chart data is in nominal terms, seasonally adjusted.

Source: ABS (2022) Private New Capital Expenditure and Expected Expenditure, 5625.0

Figure 1.11: Mining industry capital expenditure, fiscal year

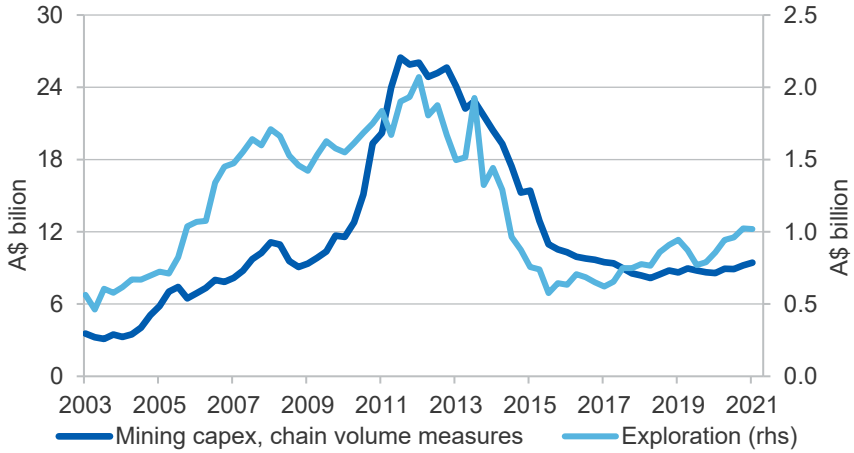


Notes: Chart data is in nominal terms

Source: ABS (2022) Private New Capital Expenditure and Expected Expenditure, 5625.0

Data on exploration spending (adjusted for inflation) suggests that mining capital expenditure continues to build up (Figure 1.12). Exploration spending was largely steady in the December quarter at $1.0 billion. This follows five consecutive quarterly rises, representing a sustained lift from the recent low of $769 million in the June quarter 2020.

Figure 1.12: Mining capital expenditure vs exploration, quarterly



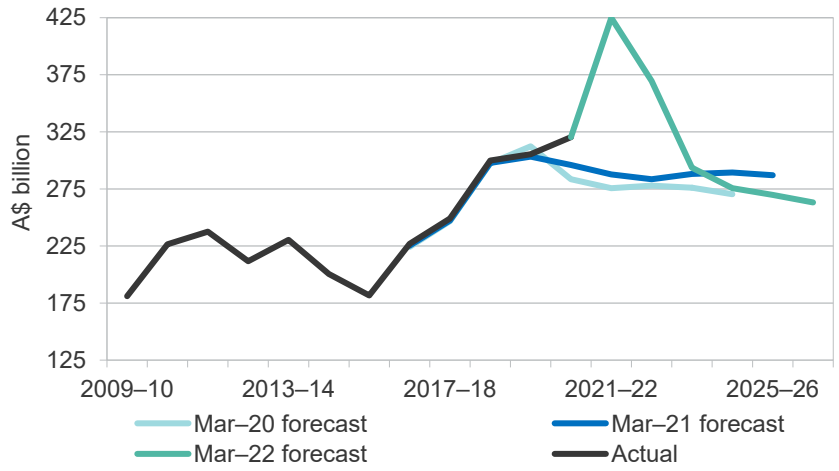
Source: ABS (2022) Private Capital Expenditure Survey, Chain Volume measure, 5625.0

1.7 Revisions to the outlook

At $425 billion, the forecast for Australia's resources and energy exports in 2021–22 is $46 billion higher (in nominal terms) than those contained in the December quarter 2021 *Resources and Energy Quarterly* (REQ). The Russian invasion of Ukraine has seen an unprecedented surge in metallurgical and thermal coal and LNG prices in 2021–22. Iron ore earnings have benefited from a rebound in prices, as world demand rises and bad weather affects supply.

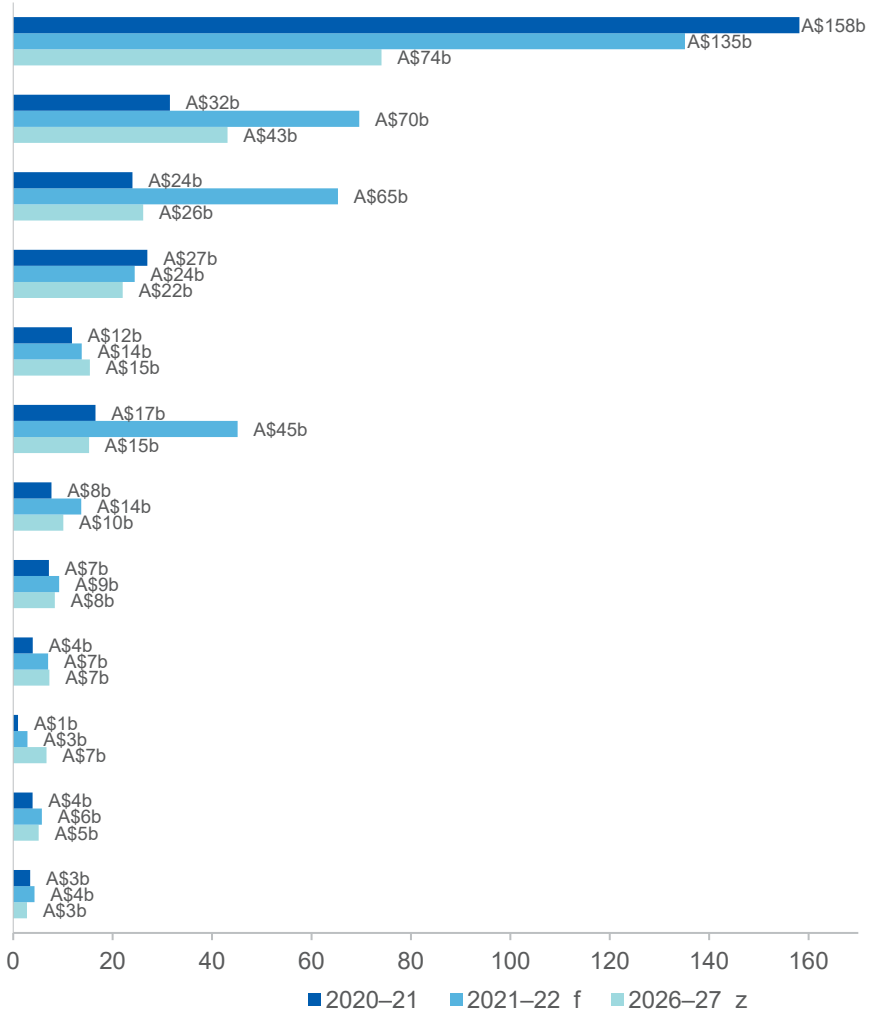
The forecast for $372 billion (nominal terms) in export earnings in 2022–23 is up around $62 billion from the December quarter 2021 REQ. The likelihood that energy prices will remain higher than expected — as the exclusion of a significant amount of Russian oil, gas and coal exports from world markets leaves shortages — has driven the upward revision.

Figure 1.13: Resource and energy exports, by forecast release



Source: Department of Industry, Science, Energy and Resources (2022)

Figure 1.14: Australia's major resources and energy commodity exports, 2021–22 dollars



	% change from 2020–21			CAGR % change from 2020–21		
	2021–22			2026–27 z		
	volume	EUV	value	volume	EUV	value
Iron ore	3	-17	-15	3	-15	-12
LNG	6	108	121	1	5	5
Metallurgical coal	0	172	173	1	0	1
Gold	1	-10	-9	5	-8	-3
Copper	-7	25	17	1	3	5
Thermal coal	7	154	173	1	-3	-1
Oil & condensate	2	75	78	2	2	5
Alumina	-2	31	29	0	3	3
Nickel	51	19	79	10	0	11
Lithium	19	149	197	19	16	38
Aluminium	4	42	48	1	3	5
Zinc	-11	41	25	-2	-1	-3

Notes: f forecast. EUV is export unit value.
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

Table 1.1: Outlook for Australia's resources and energy exports in nominal and real terms

Exports (A$m)	2020–21	2021–22[f]	2022–23[f]	2023–24[f]	2024–25[z]	2025–26[z]	2026–27[z]	CAGR[f]
Resources and energy	309,863	424,855	381,175	310,848	299,151	300,157	300,159	-0.5
– real[b]	320,333	424,855	369,635	293,614	275,566	269,749	263,171	-3.2
Energy	81,229	200,317	180,061	130,926	117,992	115,495	115,481	6.0
– real[b]	83,974	200,317	174,610	123,667	108,689	103,794	101,250	3.2
Resources	228,634	224,538	201,114	179,923	181,159	184,662	184,678	-3.5
– real[b]	236,360	224,538	195,025	169,947	166,877	165,955	161,921	-6.1

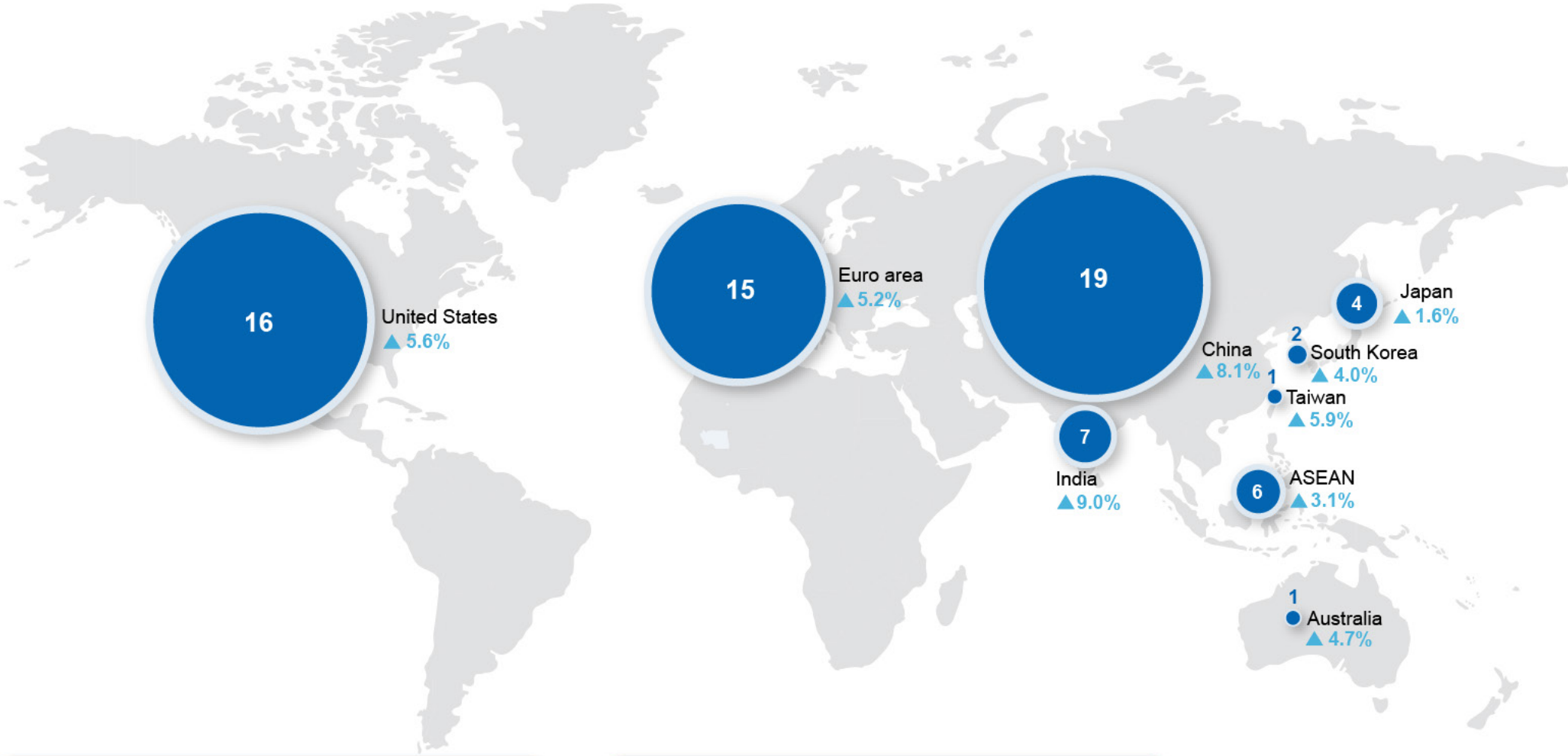
Notes: **b** In 2020–21 Australian dollars; **f** forecast; **r** Compound annual growth rate for forecast period; **z** projection.
Source: ABS (2021) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2021)

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

	Prices				Export volumes				Export values, A$b		
	Unit	2020–21	2021–22[f]	2026–27[z]	Unit	2020–21	2021–22[f]	2026–27[z]	2020–21	2021–22[f]	2026–27[z]
Iron ore	US$/t	140	118	64	Mt	867	897	1,044	158	135	74
LNG	A$/GJ	7	16	12	Mt	77	82	80	32	70	46
Gold	US$/oz	1,850	1,789	1,576	t	283	285	372	27	24	22
Metallurgical coal	US$/t	123	348	151	Mt	171	171	184	24	65	26
Thermal coal	US$/t	76	193	71	Mt	192	206	209	17	45	15
Copper	US$/t	7,971	9,716	8,926	Kt	896	834	965	12	13	14
Crude oil	US$/bbl	54	92	71	Kb/d	276	281	316	7.7	13.8	10.1
Alumina	US$/t	282	382	372	Mt	18,600	18,250	18,314	7.2	9.2	8.4
Nickel	US$/t	16,267	22,736	23,438	Kt	181	273	326	3.9	7.0	7.3
Zinc	US$/t	2,657	3,476	2,684	Kt	1,392	1,234	1,217	3.4	4.3	2.8
Aluminium	US$/t	2,029	2,905	2,969	Kt	1,357	1,417	1,474	3.9	5.8	5.1
Lithium	US$/t	448	1,043	806	Kt	1,628	1,936	4,668	1.0	2.8	6.7
Uranium	US$/lb	30	42	53	t	6,166	4,944	5,980	0.6	0.5	0.7

Notes: **a** Export data covers both crude oil and condensate; **f** forecast; **z** projection. **Price information:** Iron ore fob (free-on-board) at 62 per cent iron content estimated netback from Western Australia to Qingdao China; Metallurgical coal premium hard coking coal fob East Coast Australia; Thermal coal fob Newcastle 6000 kc (calorific content); LNG fob Australia's export unit values; Gold LBMA PM; Alumina fob Australia; Copper LME cash; Crude oil Brent; Aluminum LME cash; Zinc LME cash; Nickel LME cash; Lithium spodumene ore.
Source: ABS (2021) International Trade in Goods and Services, Australia, Cat. No. 5368.0; LME; London Bullion Market Association; The Ux Consulting Company; US Department of Energy; Metal Bulletin; Japan Ministry of Economy, Trade and Industry; Department of Industry, Science, Energy and Resources (2021)

Macroeconomic Outlook



In 2021, global economic activity increased by 5.9%. Growth is expected to slow to 4.4% in 2022 due to ongoing impacts from the Omicron variant of the COVID-19 pandemic as well as the persistence of supply chain disruptions.

Risks include the impacts of Russian invasion of Ukraine on global growth, the potential for new variants of the pandemic, as well as the persistence of supply chain disruptions through the year. Inflationary price pressures are also expected to weigh heavily on markets through 2022.

● = Share of global GDP

▲ = Economic growth in 2021

▼ = Economic contraction in 2021

2.1 Summary

- The global recovery is expected to continue in 2022, but at a slower pace than in 2021. This slower growth will reflect the ongoing impacts from the Omicron variant of the COVID-19 pandemic across major nations as well as the persistence of supply chain disruptions into 2022.
- The world economy is forecast to grow by 4.4% in 2022 and 3.8% in 2023. Global growth is then expected to trend toward lower, longer-run levels from 2024 as the pent up demand impulse recedes, and as stimulatory fiscal and monetary policies are scaled back.
- Risks to global growth in the short term remain skewed to the downside. This reflects the flow-on impacts from Russian invasion of Ukraine, the potential for new variants of the pandemic, as well as the persistence of supply chain disruptions through the year. Inflationary price pressures are also expected to weigh heavily on markets through 2022.

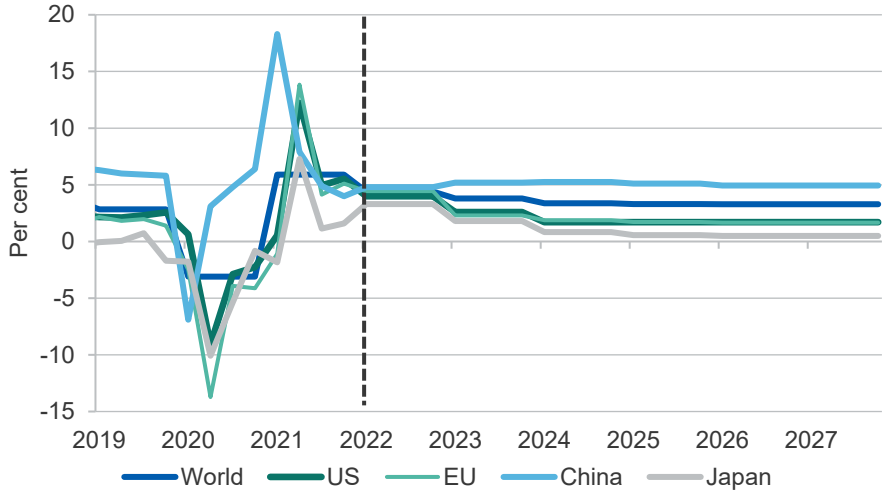
2.2 World economic outlook

The pace of the global recovery likely to slow in 2022

In its January 2022 Outlook, the International Monetary Fund (IMF) projects the world economy to grow by 4.4% in 2022 (Figure 2.1). This is a downward revision of half a percentage point from its October 2021 update. The downward revision reflects ongoing impacts from the Omicron variant of the COVID-19 pandemic across many major economies; as well as the persistence of global supply chain constraints — in both seaborne trade and onshore logistic networks — that have continued to build through the second half of 2021 and into 2022.

The US, China, Euro area and the United Kingdom have all had 2022 growth projections revised down from the October 2021 Outlook, due to outbreaks of the Omicron variant, and the impact of supply chain disruptions on industrial output. These economies are now expected to have stronger growth in 2023 than previously forecast, as they emerge from these challenges.

Figure 2.1: GDP growth forecasts



Source: Bloomberg (2022); IMF (2022)

World economic growth is expected to continue to ease over the outlook period. Global growth is forecast at 3.8% in 2023, and is expected to fall to longer-run trend levels of 3.3% by 2027, as pent up demand recedes globally and government support is removed.

Tighter monetary policy has been signalled across major economies such as the US and Europe in 2022 in response to persistent price pressures that have built through 2021. Tighter monetary policy should act as a drag on economic growth over the first half of the outlook period. An additional consideration weighing on assessments of the pace of monetary tightening will be the extent of the wider economic fallout of the Russian invasion of Ukraine. Moreover, this tightening cycle may be at least partially offset by more expansionary monetary conditions in China this year.

In the latter half of the five year outlook period, growth should receive a boost from investment in the global energy transition as governments and businesses focus on 2030 emissions targets.

There are a number of key risks to the outlook. Heightened geopolitical tension and flow-on impacts from the Russian invasion of Ukraine and associated sanctions represents the biggest downside risk to the global outlook. In March, IMF analysis on the economic impacts of the invasion stated the global outlook was subject to 'extraordinary uncertainty' and that the ongoing war and associated sanctions will have a severe impact on the global economy. The IMF signalled it would be downgrading growth projections, but still expected world growth to be positive. As the IMF growth forecasts discussed throughout this chapter were prepared in January they predate the invasion. Updated IMF forecasts are scheduled for release in April.

An indication of the potential scale of impacts is provided by recent OECD scenario analysis that considers shocks to commodity and financial markets following the onset of the Russian invasion of Ukraine. This analysis indicates a large hit to global GDP over the next 12 months — of at least 1 percentage point — and an increase in global CPI of 2.5 percentage points, with far greater impacts if the war intensifies.

In addition to the humanitarian crisis, the economic impacts of the invasion have been widespread, affecting global markets for food, energy, industrial metals and bulk commodities. The invasion is also amplifying wider risks associated with supply shortages, shipping and transport delays and price pressures in many countries, particularly given the potential for further sanctions and actions taken in response by major economies. (See *Box 8.1: Impact of Russia's invasion of Ukraine on global oil and gas markets*).

Liquidity pressures in China's residential property market could also continue to constrain economic growth in China in 2022, with implications for global resource and commodity markets over the early outlook period.

Easing growth in global trade and production after a historic 2021

Following a historic peak in early 2021, global merchandise trade continued to trend lower for much of the second half of 2021. However, growth of 7.1% year-on-year in December, suggests this slowdown may now be stabilising. Global goods trade is forecast to grow by more than 4.0% in 2022. This reflects supply disruptions that are expected to continue to hamper industrial production in the near term, as well as a slackening global demand for merchandise imports in recent months. However, the trade outlook for Australia's major trading partners remains positive, with GDP growth forecast to reach 4.4% in 2022[1].

Global industrial production also showed signs of stabilisation in December 2021, growing by 4.1% year-on-year (Figure 2.2). Global industrial output is forecast to grow by 4.3% in 2022. While this is consistent with a return to more moderate, longer-run growth rates, it also reflects the near-term disruptions that persisted in many economies in 2021 as a result of the COVID-19 pandemic and supply chain issues.

Figure 2.2: World industrial production, trade and PMI

Notes: PMI data is to February 2022; IP and trade data only available to December 2022
Source: IHS Markit (2022); CPB Netherlands Bureau for Economic Policy Analysis (2022)

[1] RBA Statement on Monetary Policy – February 2022

The Global Manufacturing Purchasing Managers Index (PMI) was 53.6 in February 2022. While this marked the 20th month of expansionary conditions from the COVID-lows, the February reading, up from 53.2 in January, was also the joint second-lowest reading over the past 16 months. Supply chains continued to show signs of strain in February, however supplier delivery times increased at the lowest rate in over a year. Input costs and output charges saw a mild re-acceleration in February, with inflation stronger in developed countries than emerging markets.

Global services trade growth slowed to a 3-month low in December 2021, in response to rising cases of the Omicron variant (particularly consumer services). Service industries remain susceptible to renewed outbreaks over the outlook period.

Supply chain disruptions to persist in 2022

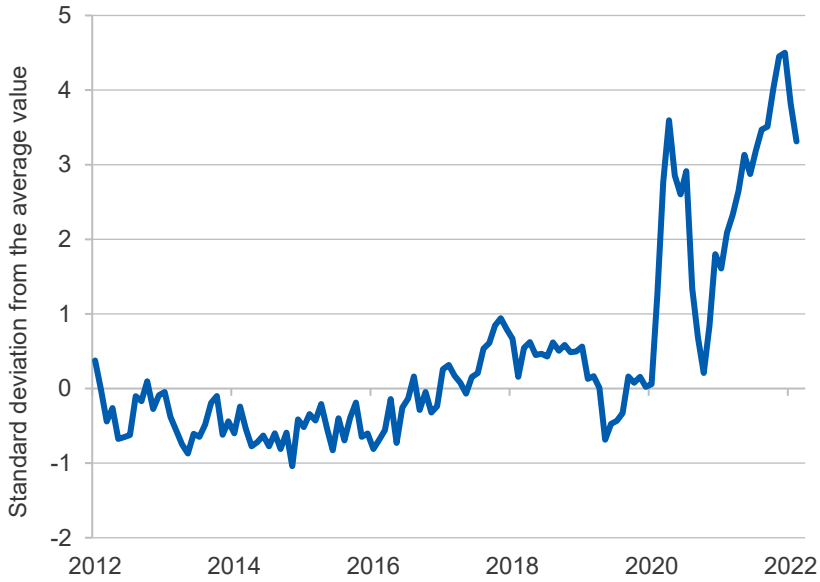
A strong recovery in world trade and industrial production in 2021 has seen building pressure on global supply chains over the last 12 months. IMF modelling suggests supply disruptions lowered global growth in 2021 by as much as 0.5 to 1.0 percentage points.

After easing slightly in late 2021 container shipping and air freight rates have hit record highs, with ocean freight rates up to 10 times higher than pre-pandemic levels. Congestion at major destination ports in Europe and the US, and issues with onshore logistics networks have continued to intensify. This is contributing to increased delivery delays and rising input costs. The Global Supply Chain Pressure Index — a new measure developed by the Federal Bank of New York measuring cross-border transportation costs, delivery times, and order backlogs — hit its highest levels on record in December 2021 (Figure 2.3).

The Russian invasion of Ukraine is driving further upheaval to global shipping, with the International Chamber of Shipping warning that combined, both countries account for 15% of the global seafaring workforce. Recent sanctions, including countries closing their ports to Russian ships, as well as difficulties for vessels obtaining insurance, will worsen global supply chain problems in coming months. How quickly global shipping can reorganise is unclear, with the International Maritime Organisation holding emergency sessions in March to discuss the situation.

The comparatively higher demand for goods (relative to services) that was seen throughout the pandemic may recede somewhat in 2022, which would help to alleviate supply chain pressures. However, some critical market segments are expected to see further supply chain disruption in 2022. For example, many are now expecting the shortage in semiconductor chips — responsible for as many as 7.7 million fewer vehicles being made in 2021 — to persist into 2023. Some chipmakers, such as Toshiba, have warned that the Russian invasion of Ukraine will further delay supplies due to the latter's role as the world's major supplier of purified gases such as neon, which are essential in chip manufacture. Similar issues are emerging due to disruption to supply of automotive wiring harnesses produced in Ukraine which is restricting vehicle production in European factories.

Figure 2.3: Global Supply Chain Pressure Index

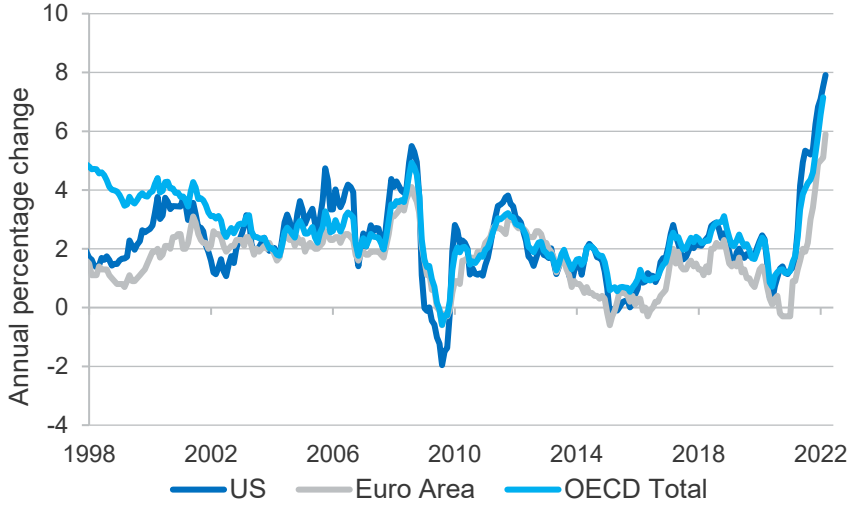


Source: Bloomberg (2022); New York Federal Reserve (2022)

Inflationary price pressures to spur further monetary tightening in 2022

High energy and food prices, and global supply chain disruptions, led to significant inflationary price pressures across both advanced and emerging economies through 2021 and early 2022. This saw US CPI reach 7.9% year-on-year in February 2022 — a 40-year high, and inflation in the Euro zone reach 5.9% — the highest on record (Figure 2.4).

Figure 2.4: Consumer Price Indices – US, Europe and OECD



Source: Bloomberg (2022); Board of Governors of the Federal Reserve System (2022); U.S. Bureau of Economic Analysis (2022); OECD (2022)

These price pressures have already seen some major economies raise interest rates, with tighter monetary conditions expected across a number of major economies through 2022.

In the US, the Federal Reserve approved its first interest rate increase in more than three years in March, and stated it anticipated that ongoing increases in the target range would be appropriate. This followed January's announcement of an accelerated end to quantitative easing due to strong price and wage pressures. Surveys of market analysts suggest the US tightening cycle may peak in 2023 or early 2024. Much depends on the success of the US Fed in bringing inflation back to target levels of around 2.0%.

Re-organisation of commodity trade flows

World commodity trade is likely to re-organise significantly over the outlook period. As more US LNG capacity comes online, Western Europe is likely to switch away from Russian supply to United States exports. As a result, Russian gas exports may increasingly flow to China, although additional infrastructure would need to be built. The European Commission is discussing proposals to reduce the EU's dependence on Russian gas by two thirds before the end of 2022 as part of a plan to become independent from all Russian fossil fuels before 2030. With European LNG import terminals now approaching capacity, transition away from Russian gas will depend on the rate at which new LNG import capacity can be built.

2.3 Major trading partners' economic outlook

China expected to see more moderate growth in 2022

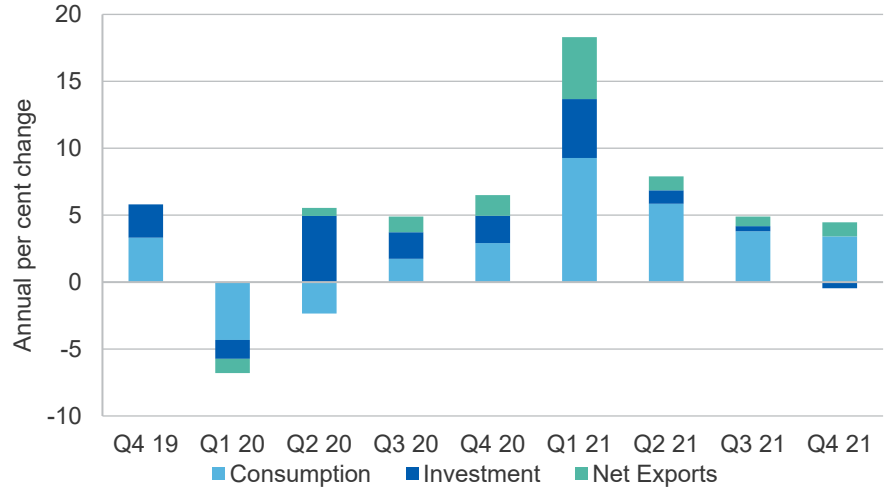
China's economy grew by 4.0% year-on-year in the December 2021 quarter, the slowest quarterly rate in 18 months (Figure 2.5). New outbreaks of the pandemic, combined with a zero-COVID containment strategy, inhibited economic activity in the second half of 2021. This was further exacerbated by acute energy shortages and ongoing weakness in the residential property sector. For calendar 2021, China's economy grew by 8.1% year-on-year.

Manufacturing grew by 3.1% year-on-year in the December 2021 quarter, the lowest growth since March 2020. The construction and real estate sectors also saw further weakness, recording a second consecutive period of contraction (declines of 2.1% and 2.9% year-on-year respectively).

China's industrial output grew by 7.5% year-on-year in February, down from 14.1% growth in March 2021. Industrial activity in the March quarter 2022 has been dampened by production curbs that had been placed on Northern provinces in preparation for the Beijing Winter Olympics. New cases of the Omicron variant and the first province-wide lockdowns since

the Wuhan outbreak in early 2020 have also dampened output. China's official Manufacturing PMI in February was 50.2 and the Caixin-Markit Manufacturing PMI — a broader-based survey of over 500 companies — increased to 50.4 in February, up from 49.1 in January. However, conditions remain subdued with new orders and external demand, the big drivers of industrial output and economic growth in 2021 remaining weak.

Figure 2.5: China GDP growth (quarter-on-quarter)



Notes: Consumption is made up of both household and government sectors.
Source: Bloomberg (2022); National Bureau of Statistics of China (2022)

More expansionary fiscal and monetary policy has been signalled for 2022, with the Chinese Government announcing a growth target of around 5.5% for 2022. Cuts to lending rates (the first in a number of years) and the bank reserve requirement ratio (RRR) in recent months has seen an improvement in China's credit conditions — though year-on-year growth remained negative as of January 2022. Local government spending — particularly on infrastructure — is also expected to surpass 2021 levels, with 102 mega projects already earmarked for fast tracking in 2022, with activity likely to concentrate in the March quarter (see *Steel* chapter).

Weakness in China's residential property market remains a major risk to economic growth in 2022, as developers seek to deleverage and manage ongoing liquidity concerns. New property starts continued to trend lower in February 2022 (12% lower year-on-year), and new home prices have also been subdued, with zero month-on-month growth in February following 0.2% growth in January. A broader slowdown in China would have significant implications for global growth, and resource and energy markets over the outlook period.

The IMF is forecasting China to grow by 4.8% in 2022. The 0.8 percentage point downgrade (from the October 2021 IMF Outlook) reflects recent waves of the pandemic, as well as the ongoing liquidity pressures amongst residential property developers. The forecast does not account for the Russian invasion of Ukraine. The IMF projects growth will rise to 5.2% in 2023, as disruptions ease, but lifting this growth rate to the Government's 5.5% target will require management of significant economic headwinds. Over the outlook period to 2027, China's economic growth is projected to stabilise at around 5.0% annually. This reflects slowing population growth in China, as well as the continued shift toward quality-oriented (rather than quantity) consumption-led growth.

Japan's strong growth in December quarter 2021 to moderate in 2022

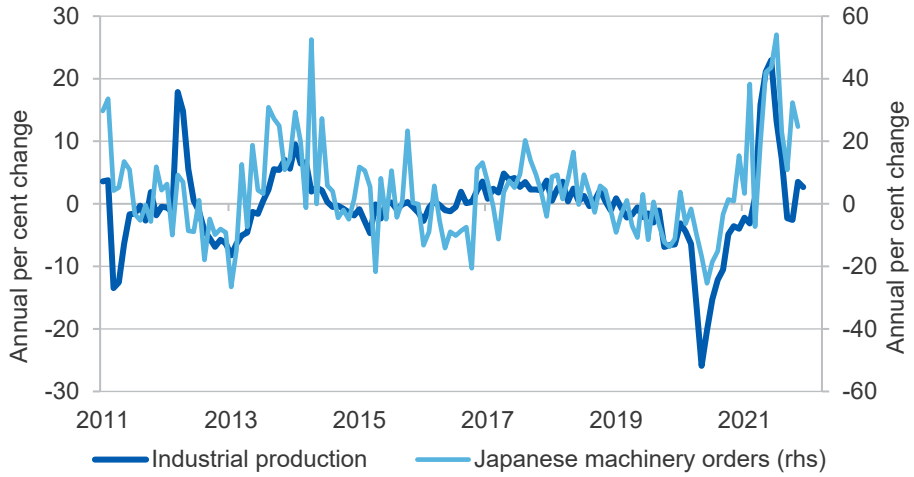
Strong growth of 1.3% (quarter-on-quarter) in the December quarter 2021 helped lift the Japanese economy into positive growth following two years of contraction. Japan's GDP increased 1.7% in 2021.

The December quarter result reflected a recovery in household consumption and business investment, as the fall in COVID-19 cases saw the government lift the state of emergency in October.

Japan's industrial output has begun to stabilise, growing 2.7% year-on-year in December following two years of substantial volatility. Machinery orders have followed a similar pattern over the period, with orders up 24.7% year-on-year in November following a lull in September (Figure 2.6).

Lead indicators for the March quarter 2022 are mixed. While remaining positive, the Jibun Bank Manufacturing PMI for Japan slipped from 55.4 in January to 52.7 in February, bringing to an end a thirteen month run of improvements in operating conditions. Manufacturers continue to report supply chain pressures, due to material shortages and growing delivery delays. These will likely push up input costs. Firms are increasingly finding it difficult to absorb these input price increases, with manufacturing output prices growing at the highest rate since July 2008.

Figure 2.6: Japan industrial production and machinery orders



Notes: IP data is to December 2021; machinery orders data only available to November 2021
Source: Bloomberg (2022)

Jibun Bank's Japan Services PMI indicates that after positive growth in the last three months of 2021, rising COVID-19 cases have seen Japan's services PMI fall sharply from 52.1 in December to 47.6 in January 2022. The IMF is now projecting Japanese economic growth of 3.3% in 2022. This is a slight increase of 0.1 percentage points from the October 2021 Outlook. While growth is expected to moderate, the IMF has revised up its forecast for 2023 by 0.4 percentage points to 1.8% in 2022.

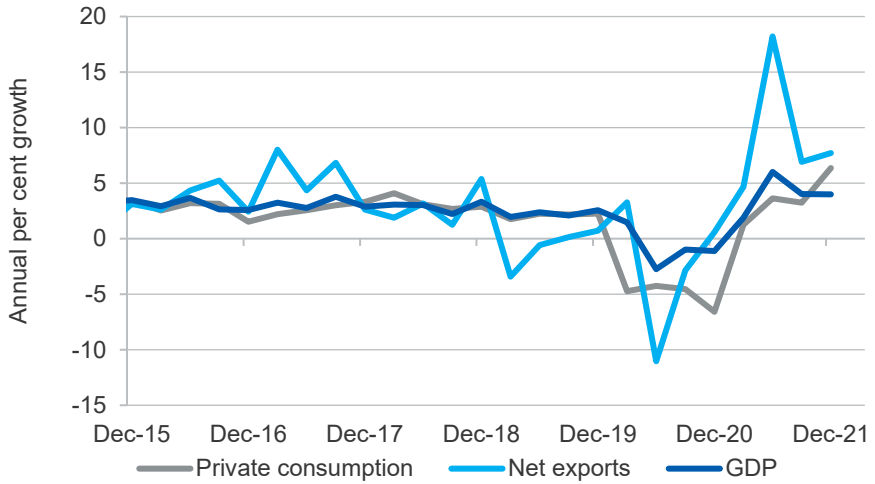
In the latter half of the outlook period, growth is expected to settle at about 0.5%, as Japan's demographic trends of an ageing and declining population and shrinking workforce continue to slow GDP growth.

South Korea's 2021 GDP growth the highest in 11 years

South Korea's economy grew by 4.0% year-on-year in the December quarter 2021. This follows strengthening household consumption, as the nation emerged from a severe wave of the COVID-19 pandemic in mid-2021, as well as rising exports from the 2021 global trade recovery.

For the full year 2021, South Korea's economy grew 4.0% year-on-year, the fastest yearly rate of expansion since 2010. This included robust growth in household consumption and government spending (6.4% and 8.1% year-on-year), as well as a record boom in exports (up 6.1% year-on-year) (Figure 2.7).

Figure 2.7: South Korea quarterly GDP, consumption and trade



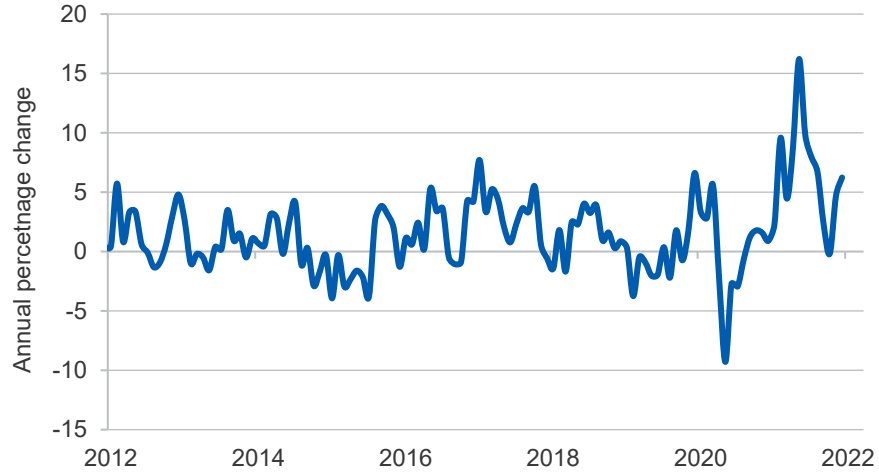
Source: Bloomberg (2022)

Despite renewed outbreaks of the pandemic in the second half of 2021, South Korea's industrial production has remained resilient, growing 4.8%

year-on-year in 2021 (Figure 2.8). South Korea's manufacturing PMI reading in January 2022 of 52.8 marked 16 consecutive months of expansion. However, firms continue to highlight intense supply side challenges (such as lengthy supplier delivery times, port congestion and container shortages) as well as acute cost pressures.

Inflationary price pressures are expected to see the Bank of Korea raise policy rates further in 2022 (following a 25 basis points increase in both August and November 2021). Managing tighter monetary conditions while maintaining robust economic growth presents a key challenge to South Korea over the outlook period (given current debt levels). The country also remains vulnerable to further global supply chain disruption, given its high dependency on exports.

Figure 2.8: South Korea monthly industrial production



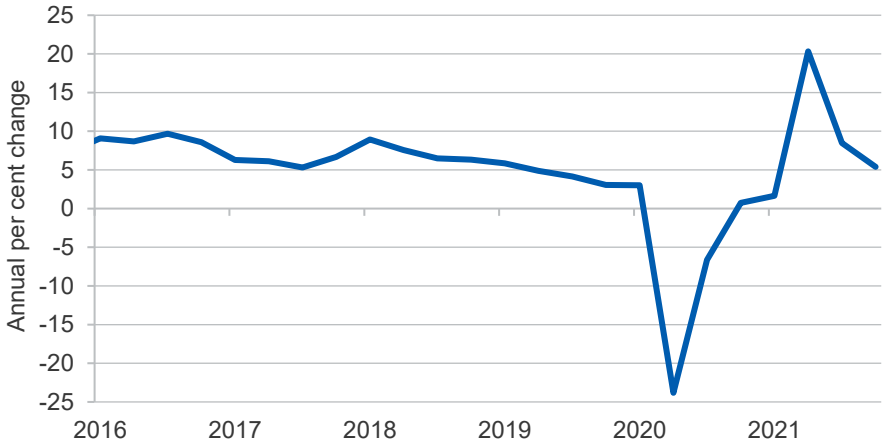
Source: Bloomberg (2022)

The IMF is projecting South Korea's economic growth to remain robust in 2022 (3.0% year-on-year) and 2023 (2.9% year-on-year) as household consumption and global trade continue to improve. South Korea's advanced manufacturing industry — including products such as semi-conductor chips — is expected to continue as a vital component of its economy. This will be supported by the recently announced New Deal, which aims to support new growth industries and products as part of a transition to an increasingly digital and green global economy. The latter part of the outlook period is likely to see growth moderate to around 2.5%.

India's recovery slows but outlook remains healthy

India's growth slowed in the December quarter 2021 to 5.4% year-on-year as the base effect from the 2020 recession faded. The result was below market expectations of 6.0% and down from 8.5% in the September quarter and 20.3% in the June quarter (Figure 2.9).

Figure 2.9: India quarterly GDP



Source: Bloomberg (2021)

Output growth in all major goods and service sectors fell in the December quarter as a third wave of COVID-19 infections saw further restrictions on mobility. Weak construction activity, down 2.8% in the December quarter (year-on-year), contributed to the slowdown. Supply chain disruptions, including semi-conductor shortages, saw manufacturing activity flatten in the quarter, growing just 0.2% year-on-year. Activity in the Trade, Hotels, Transport & Communication sector fell from 9.5% year-on-year in the September quarter 2021 to 6.1% in the December quarter.

Growth in industrial production in December 2021 slowed to 0.4% year-on-year, reflecting weaker output growth across mining and quarrying, manufacturing and utilities.

Private consumption was the main driver of growth in the December quarter, up 7% year-on-year. However, the emergence of a number of supply side issues in recent months is dampening business confidence. In particular, concerns about the intensification in the pandemic and further containment measures may further dampen economic activity and consumption and add to inflationary pressures during 2022.

India's composite PMI (combining manufacturing and services) fell from 56.4 in December 2021 to 53.0 in January 2022, with slowing evident in both manufacturing and services activity. Although new orders continued to rise, the rate of expansion was the slowest in six months. After receding in December, input cost inflation gathered pace in January with service providers reporting a stronger upturn in cost burdens. In January, manufacturing business confidence slipped to its lowest level in 18 months. However, India's manufacturing PMI showed some improvement in February, rising to 54.9, up from 54.0 in January.

Beyond these immediate concerns, the overall outlook for India's economy over the next two years remains healthy. The IMF forecasts India's economic growth at 9.0% in 2022 and 7.1% in 2023, an upward revision of 0.5 percentage points in each year from its October 2021 Outlook. The upward revision reflects stronger-than-expected financial sector performance, with the resulting expected improvements to credit growth flowing through to stronger investment and consumption.

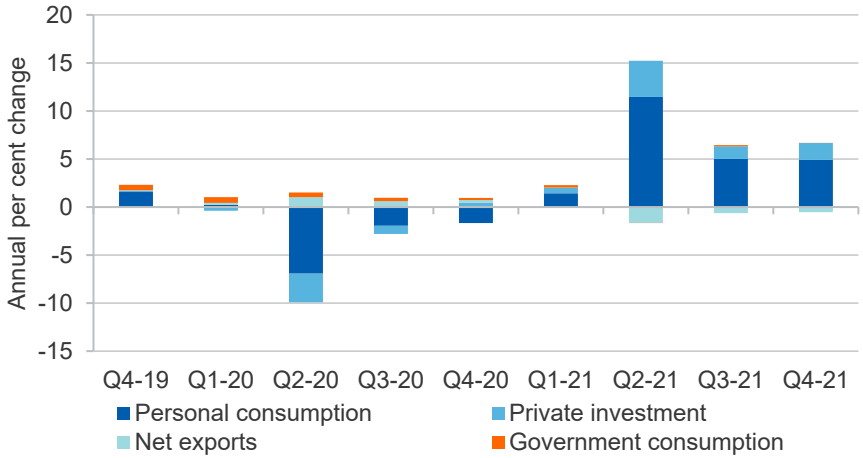
Further out, India's GDP growth is likely to average just over 6.0% a year. This reflects a resumption of the healthy growth trajectory seen in the decade prior to the COVID-19 shock where ongoing industrialisation and favourable demographics helped push India's economy to among the fastest growing in the world.

Stronger US growth in Q4 despite persistent supply chain pressures

The US economy grew at 5.5% year-on-year (an annualised rate of 6.9%) in the December 2021 quarter, a stronger-than-expected result. This was led by increased business investment (up 8.6% year on year) and consumer spending (up 7.1% year on year) (Figure 2.10).

For 2021, US GDP grew 5.7% year-on-year, its fastest rate since 1984. The release of pent up demand was a major driver of the US recovery in 2021, with household spending growing by 7.9% year-on-year. This was supported by fiscal stimulus, as well as record levels of private savings accumulated during the pandemic (Figure 2.11). However, with stimulus spending now unwinding and net private savings back to longer-run levels, this spending impulse is expected to recede in 2022.

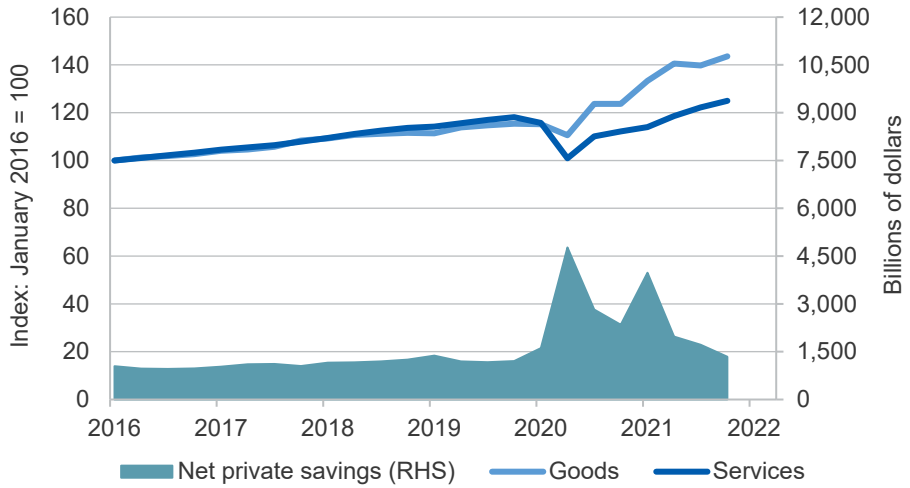
Figure 2.10: US GDP growth (year-on-year)



Source: Bloomberg (2022)

Industrial output expanded by 4.5% in the December 2021 quarter, down from a peak of 14.7% in mid-2021. The US Manufacturing PMI index remained in expansionary territory (57.3) in February, but down from the peaks seen in 2021. Input shortages and long lead times remained an ongoing concern, however the rise in input prices was the slowest in nine months, suggesting some reprieve in cost pressures.

Figure 2.11: US personal consumption and net private savings



Notes: Personal Consumption Expenditures; seasonally adjusted data; January 2016 =100
Source: U.S. Bureau of Economic Analysis (2022)

Supply chain disruptions seen through 2021 continue to be a concern, with US port congestion still at historic highs, and continued labour shortages in the transportation and logistics sectors. This has led to growing inflationary pressures, with CPI growth hitting 7.9% in February. Monetary conditions are expected to steadily tighten in 2022, with the US Fed signalling an accelerated taper for asset purchases, and that it anticipates multiple rate rises in the next 12 months. In announcing the 25 basis point increase in March 2022 the Fed increased its estimate for US inflation to 4.1% in 2022 and sharply revised down expected GDP growth to 2.8%.

The IMF's January 2021 World Economic Outlook update projects the US economy to grow by 4.0% in 2022. This is a 1.2 percentage point reduction from the October 2021 outlook, due to the earlier withdrawal of monetary accommodation, and continued supply shortages. The IMF expects growth of 2.6% in 2023. However, in March 2022 the IMF stated it expects substantially lower global growth in 2022 due to the Russian invasion of Ukraine, with updated growth and inflation forecasts scheduled for release in April.

Over the rest of the outlook to 2027, US economic growth is projected to trend toward a lower, longer-run level of around 1.7% annually. Factors affecting growth over this period will include future revenue and spending measures employed to address significant increases in public debt, rising healthcare costs and population ageing, and how the global energy transition reshapes the post-pandemic economy.

Europe recovery hampered by Omicron and supply chain disruptions

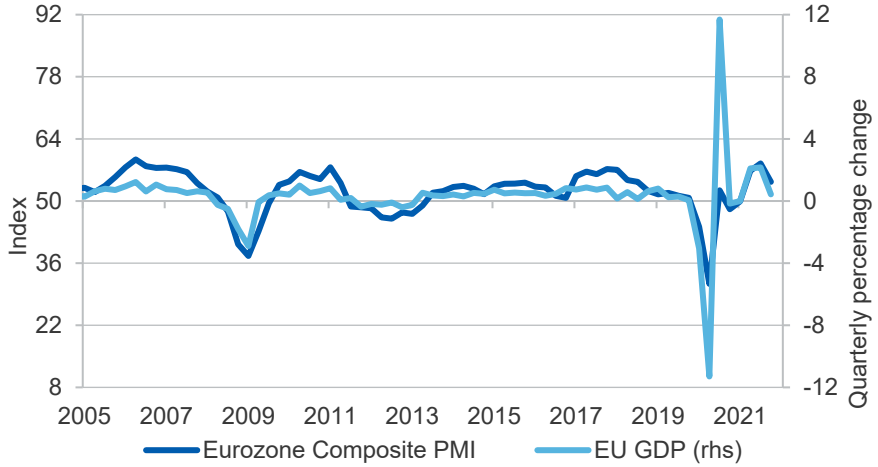
The EU economy grew by 4.8% year-on-year in the December 2021 quarter. This was 0.4% higher quarter-on-quarter, representing a considerable easing from the 2.2% growth seen for the September 2021 quarter (Figure 2.12). This slowdown reflects the impacts from the most recent omicron-wave of the pandemic, as well as subdued manufacturing activity due to ongoing supply chain disruptions. For the full year 2021, EU GDP grew by 5.2%, however in level terms EU GDP remained around 1.2% lower than the level achieved in 2019.

European manufacturing continued to be hampered by Omicron outbreaks and supply chain disruptions in the second half of 2021, with industrial production in the Eurozone only 1.5% higher year-on-year in the month of December following a fall in November. However, the Eurozone Manufacturing PMI reading of 58.2 in February 2022 suggests some stabilisation in 2022, with demand for Eurozone goods rising at the fastest rate since August 2021. Some firms also indicated in February that supply chain delays were beginning to show signs of easing.

Headline inflation in the Eurozone reached 5.9% (year-on-year) in February 2022 — its highest level on record. Energy prices have been the major driver of these inflationary pressures (up 32% year-on-year in February 2022), with shortages of oil and gas leading to multi-year price highs in the second half of 2021 and early 2022 (see *LNG* chapter). Estimates suggest Europe will see energy costs of more than US$1 trillion

in 2022 (up from US$500 billion in 2019). High inflation has raised expectations of monetary tightening in Europe in 2022.

Figure 2.12: Eurozone GDP and Composite PMI (quarterly)



Source: Bloomberg (2022)

The Russian invasion of Ukraine is the largest risk to Europe's outlook in 2022. European economies are being hit hard due to their business, economic and energy links to Russia and Ukraine, as well as impacts from the fastest refugee flow in Europe since the Second World War. Alongside energy price volatility, the invasion could lead to further sanctions and actions by major economies that could further impact trade and economic activity throughout Europe.

The IMF's January 2022 forecasts project the European Union economy to grow by 4.0% in 2022. This is a 0.4 percentage point reduction from the October 2021 outlook, and is the result of supply disruptions (particularly on manufacturing), and a resurgence in COVID cases. For 2023, growth is forecast at 2.8%. Over the remainder of the outlook to 2027, economic growth is projected to trend toward a lower, longer-run annual level of about 1.7%.

Table 2.1: Key IMF GDP assumptions

	2021	2022[a]	2023[a]	2024[a]	2025[a]	2026[a]	2027[a]
Economic growth[b]							
Advanced economies	5.0	3.9	2.6	1.7	1.6	1.6	1.6
Australia	4.2	4.1	2.5	2.6	2.6	2.6	2.6
European Union	5.2	4.0	2.8	1.9	1.7	1.7	1.7
France	6.7	3.5	1.8	1.5	1.4	1.4	1.4
Germany	2.7	3.8	2.5	1.4	1.2	1.1	1.1
Japan	1.6	3.3	1.8	0.8	0.6	0.5	0.5
New Zealand	5.1	3.3	1.7	1.9	2.2	2.4	2.4
South Korea	4.0	3.0	2.9	2.6	2.5	2.4	2.4
United Kingdom	7.2	4.7	2.3	1.6	1.5	1.5	1.5
United States	5.6	4.0	2.6	1.7	1.7	1.7	1.7
Emerging economies	6.5	4.8	4.7	4.5	4.4	4.4	4.4
ASEAN-5d[d]	3.1	5.6	6.0	5.6	5.4	5.4	5.4
China [e]	8.1	4.8	5.2	5.2	5.1	4.9	4.9
India	9.0	9.0	7.1	6.3	6.2	6.1	6.1
Latin America	6.8	2.4	2.6	2.3	2.4	2.4	2.4
Middle East	4.1	4.4	3.4	2.9	0.0	2.8	2.8
World [c]	5.9	4.4	3.8	3.4	3.3	3.3	3.3

Notes: a Assumption; b Year-on-year change; **c** Calculated by the IMF using purchasing power parity (PPP) weights for nominal country gross domestic product; **d** Indonesia, Malaysia, the Philippines, Thailand and Vietnam. **e** Excludes Hong Kong.
Sources: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022); IMF (2022)

Table 2.2: Exchange rate and inflation assumptions

	2020	2021[a]	2022[a]	2023[a]	2024[a]	2025[a]	2026[a]	2027[a]
AUD/USD exchange rate[b]	0.69	0.75	0.74	0.76	0.77	0.76	0.75	0.75
Inflation rate[c]								
United States	1.2	3.7	3.5	2.7	2.6	2.5	2.3	2.3
	2019–20	**2020–21[a]**	**2021–22[a]**	**2022–23[a]**	**2023–24[a]**	**2024–25[a]**	**2025–26[a]**	**2026–27[a]**
Australia	1.3	1.6	3.4	3.1	2.7	2.5	2.5	2.5

Notes: a Assumption; **b** Average of daily rates; c Change from previous period. US inflation assumptions are from IMF World Economic Outlook Database (October 2021).
Sources: ABS (2021) Consumer Price Index, 6401.0; Bloomberg (2022); Department of Industry, Science, Energy and Resources; RBA (2022); IMF (2021).

Steel

26 Fe 55.845

6 C 12.011

Australian steel refineries

Steel facts

- Made in specialised blast furnaces mostly out of **iron and carbon**
- 1,000 kg of steel requires 1,400 kg of iron and 800kg of coal to make
- Pure steel is **1,000 times stronger** than iron
- Steel is the **world's 2nd largest industry**

World consumption

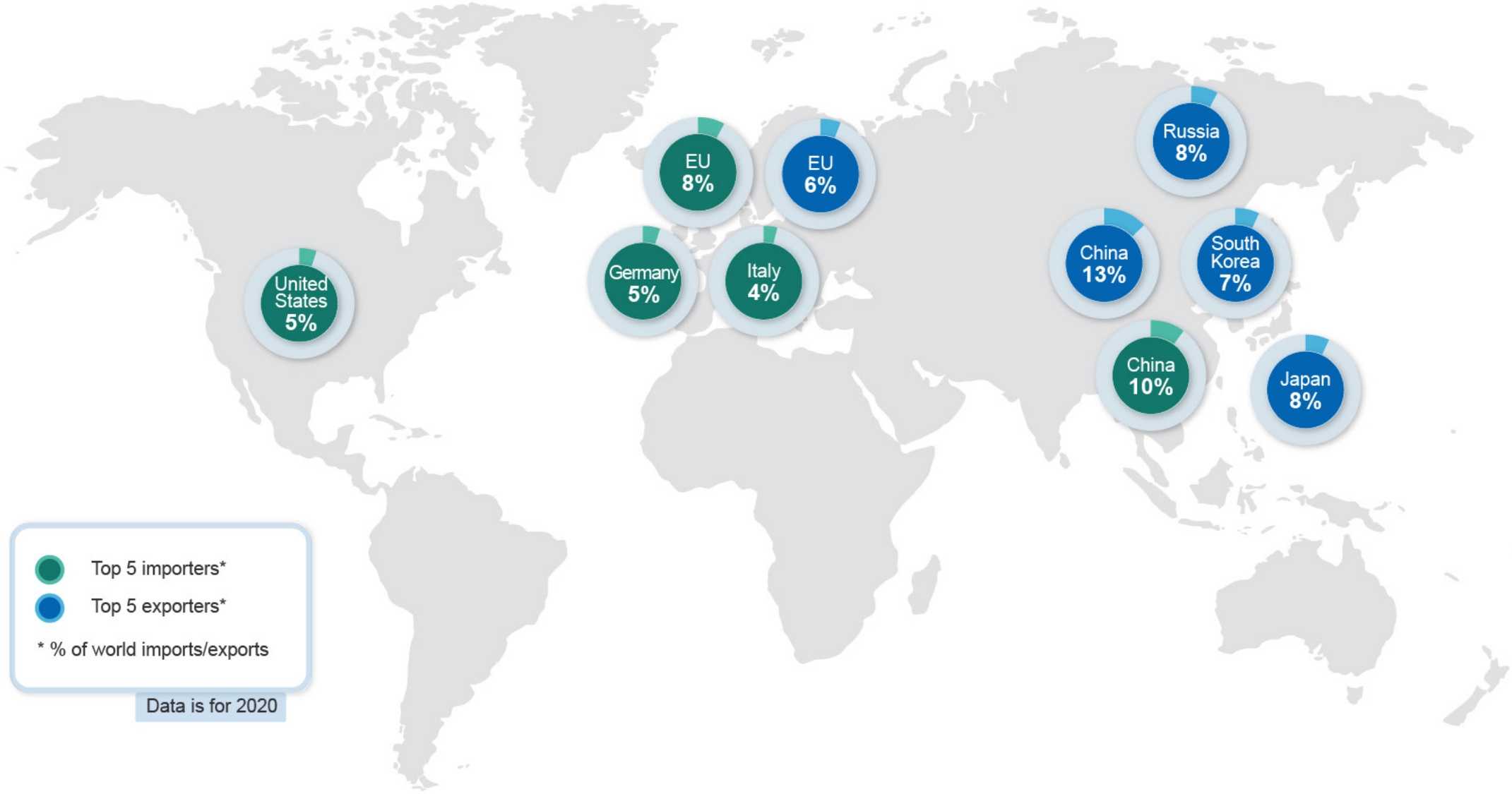
- **52%** Construction
- **16%** Mechanical machinery
- **12%** Other applications
- **12%** Automotive
- **5%** Other Transport
- **3%** Electrical Equipment

Australia's steel

- **5.7m tonnes** produced each year
- **100,000+** employed in steelmaking
- **Significant export markets**
  - China
  - Japan
  - South Korea
  - Taiwan
  - India

Steel

Trade map | March 2022



3.1 Summary

- World steel consumption is estimated to have grown 3.8% year-on-year in 2021, reflecting a rebound in industrial production as the world recovers from the COVID-19 pandemic.
- Global steel production rose by 3.7% year-on-year in 2021. A recovery among producers such as the US, Europe, Japan, and India more than offset a 3.0% fall in output in China, the world's largest producer.
- World steel output is forecast to grow by 2.2% in 2022. However, the potential for further energy shortages amongst major producers, and the Russian invasion of Ukraine presents significant risks to this forecast.
- Over the outlook to 2027, world steel output is projected to grow by an average of 1.2% a year. Low growth in China's steel output is expected to be offset by more rapid growth from India, Brazil and South East Asia.

3.2 World consumption and production

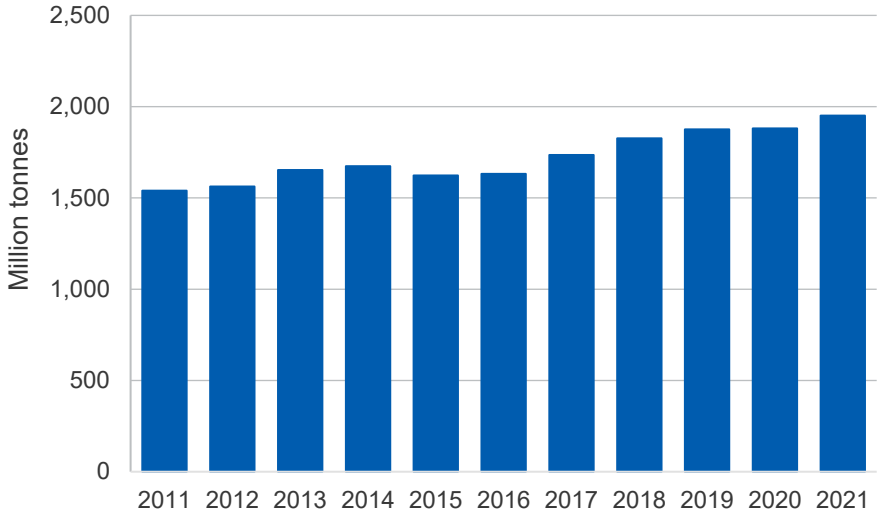
Growth in world steel production to ease in 2022

World steel output in calendar 2021 reached 1.95 billion tonnes. This was 3.7% higher compared with 2020, and 4.0% higher than 2019 levels (Figure 3.1). The impressive rise in steel production was underpinned by a strong rebound of the global economy following impacts in 2020 from the COVID-19 pandemic, with world GDP rising by 5.9% in 2021.

However, the strong rise in global steel output in 2021 reflected a mixed performance across major producers. China — with around half of global production — recorded a 3.0% year-on-year fall in 2021. This was China's first fall in annual steel output since 2015, and the largest drop in at least 15 years. This followed emission-related steel production curbs enforced throughout 2021, as well as weakening domestic demand for steel.

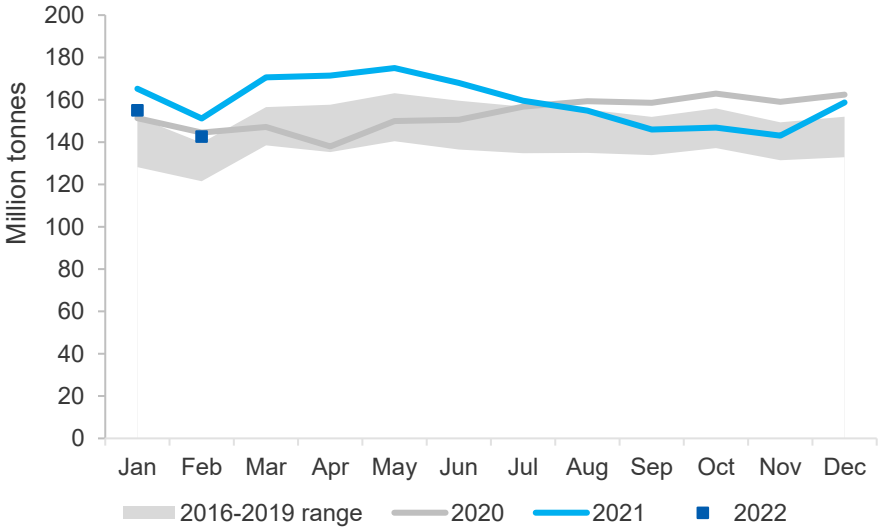
At the same time, ex-China production in 2021 grew by 13% year-on-year (and was 4.3% above the 2019 total). This included significant recoveries for the US (up 18% year-on-year), India (up 18%), Japan (up 16%) and the EU (up 15%), with industrial production resilient despite renewed waves of the COVID-19 pandemic.

Figure 3.1: Global annual steel production



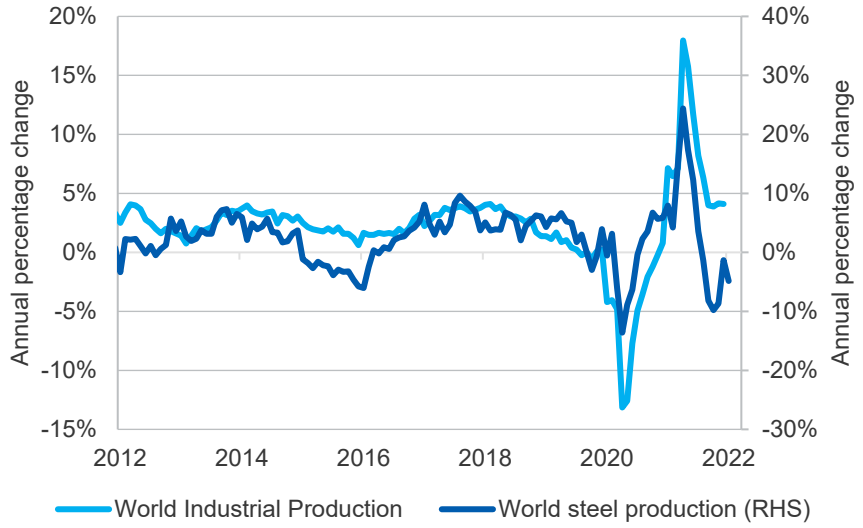
Source: World Steel Association (2022)

Figure 3.2: Global monthly steel production



Source: World Steel Association (2022)

Figure 3.3: World industrial production and steel output



Source: World Steel Association (2022); Bloomberg (2022); CPB (2022)

On a monthly basis, global steel output slowed considerably in the second half of 2021, falling from a peak of 24% growth year-on-year in April, to a contraction of 9.8% year-on-year by October (Figure 3.2).

The decline in steel output growth over the period reflects the intensification of steel production curbs in China in the second half of 2021. Further to this, the slowdown echoed a comparable slowdown in global industrial production growth, as the post-COVID pandemic recovery matures and low-base effects from 2020 wear off. The downtrend appears to have stabilised to some degree by the end of 2021, with month-on-month growth in industrial production and steel output in December of 1.2% and 11% respectively (Figure 3.3).

In January this year, the IMF was forecasting the pace of global GDP growth to ease to 4.4% in 2022, reflecting a return to longer-run growth levels, and continuing near-term impacts from the COVID-19 pandemic (see *Macroeconomic Outlook* chapter). This was expected to see growth in global steel output moderate to around 2.2% in 2022.

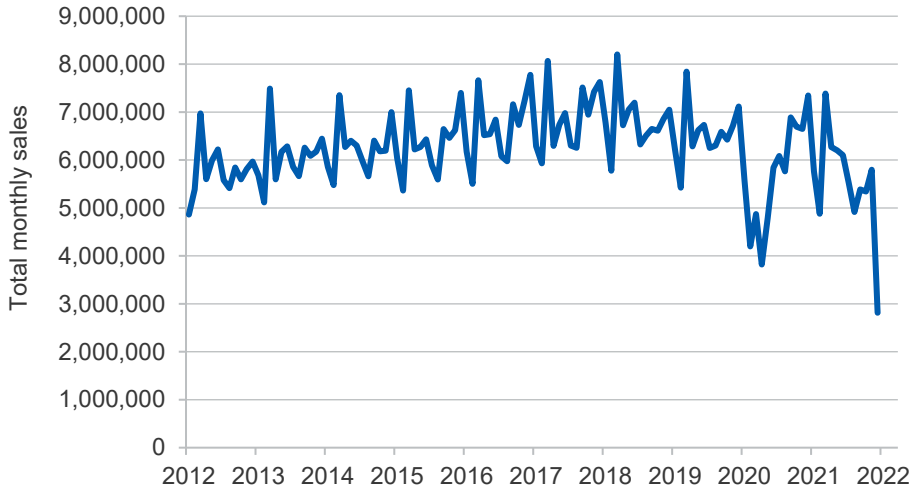
However, the current Russian invasion of Ukraine carries the potential to further constrain the global steel market in 2022. As the world's 5th and 14th largest steel producers respectively, Russia and Ukraine's combined output in 2021 (97 million tonnes) represented around 5% of global production. Russia was also the world's second largest exporter of steel for the most recently available data (2020), with major export markets including the EU (22%), Asia (23%), and Central Asia and Eastern Europe (20%). Energy shortages amongst other major producers — including China, the EU and India — also pose risks to supply in the near term.

Over the rest of the outlook period, diminishing pent up demand and the removal of pandemic-related fiscal and monetary support in most countries, is expected to see growth in steel demand ease to lower (but still positive), longer-run levels. World steel production is projected to grow at an average annual rate of 1.0%, from 1.99 billion tonnes in 2022 to 2.10 billion tonnes in 2027.

Amongst the major producers, China's annual steel output is projected to remain relatively flat over the outlook period. This follows reports of similar production caps in 2022 as in 2021 (capped at or below 2020 levels); the Chinese Government's stated aim for peak steel emissions by 2030; the current deleveraging of its residential property sector; and its ongoing ambition to shift its economy away from investment-reliant growth. However, this outlook remains susceptible to shorter-run policy changes. China's pushing back of its aim of peak steel emissions (from 2025 to 2030) in February this year, and recent easing in domestic credit conditions signals the Chinese Government's intent to meet stated GDP growth targets. This could provide a tailwind to steel production in 2022.

Existing major producers, such as the EU, Japan and South Korea, are all expected to see positive but low growth over the outlook period, with an ongoing focus on pursuing higher-efficiency/lower-emissions production, and a shift toward electric arc furnace (EAF) and hydrogen-based steelmaking. The biggest growth in global steel production over the outlook period is expected to come from emerging producers, such as India (with 4.9% annual growth to 2027), South East Asia (4.8% annual growth) and Brazil (3.3% annual growth).

Figure 3.4: Global monthly automotive sales



Source: Bloomberg (2022)

World demand for steel set to grow due to construction (and infrastructure)

Global steel consumption is projected grow at an average annual rate of 1.2%, increasing from 1.96 billion tonnes in 2021, to around 2.11 billion tonnes by 2027.

Construction — representing about 50% of global steel demand — is expected to see solid growth over the outlook. This expansion will be spurred by considerable levels of infrastructure investment, pledged across many major nations in the last two years to support the global transition to low carbon emissions. This includes the US$1.2 trillion Bipartisan Infrastructure Framework — signed into law by US President Biden in November 2021 — as well as similar packages for the EU and India.

Following severe impacts in 2021 from the global semiconductor chip shortage (and other supply chain issues), the automotive sector had expected to see some improvement in conditions in 2022. The chip shortage contributed to global car sales in December 2021 falling to their lowest levels since the 1990s (Figure 3.4).

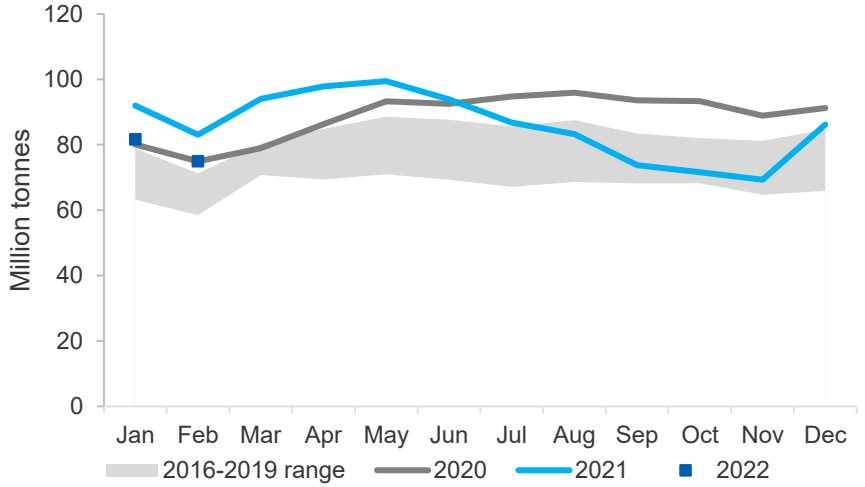
However, intensified impacts are now expected for global car production in 2022 due to the current Russian invasion of Ukraine. Ukraine and Russia are the world's largest producers of neon and palladium respectively, which are critical inputs to semiconductor chips and catalytic converters. This, and other shortages have already seen major producers in Europe announce new production cuts from March, with preliminary estimates of 2.6 million less light vehicles to be produced globally in 2022 and 2023.

Over the outlook period, the sector will be buoyed by the projected rise of electric vehicles. In 2021, global EV sales doubled (year-on-year) to reach 6.5 million. Market share has also tripled over the past two years, with EV sales now representing close to 9% of the global car market.

China's steel output in 2021 records biggest fall in over 15 years

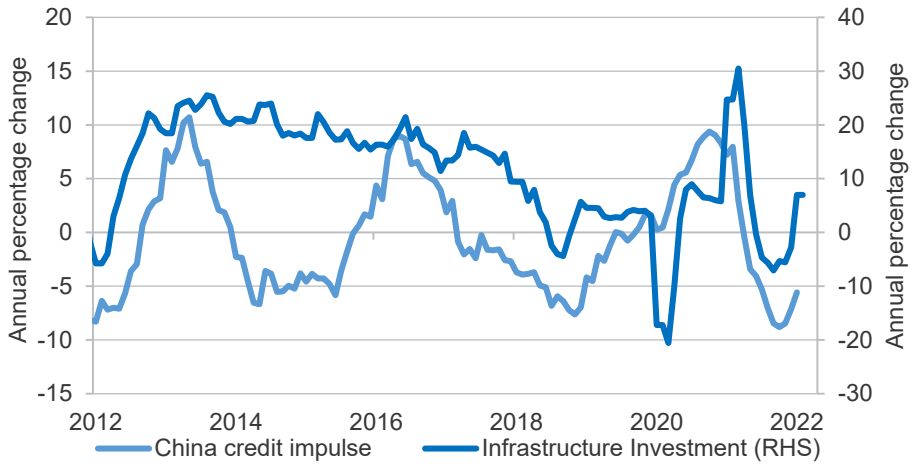
Following record output for the first half six months of 2021 (up 12% compared with the same period in 2020), China's total steel production of 1.03 billion tonnes for the whole of 2021 was 3.0% lower than previous year. This included output for the months of September, October and November that were more than 20% lower than in the same month in 2020 (Figure 3.5).

Figure 3.5: China monthly steel production



Source: Bloomberg (2022); World Steel Association (2022)

Figure 3.6: China's fiscal and monetary conditions



Notes: Infrastructure investment year-on-year change based on 3 month moving average; China credit impulse is constructed by Bloomberg Economics and measures the impacts of new lending increment to GDP growth

Source: Bloomberg (2022)

The fall in steel production reflects emissions-related production curbs introduced by China's Central Government last year, as part of the country's efforts at the time to achieve peak steel emissions by 2025 and net zero emissions by 2060.

Output curbs were initially placed on China's biggest steel-producing city Tangshan in February, with an order for many mills to achieve a 30-50% reduction on levels in 2020. However, these restrictions were expanded to China's 30 other provinces from June 2021, with mills instructed to maintain full year output at 2020 levels.

A power supply crunch in China from September also impacted steel output in the second half of 2021. Thermal coal shortages saw more than half of China's 31 provinces implement power rationing and forced blackouts, severely hampering steel production over the period (see *Thermal coal* chapter). Direct production cuts appeared to have primarily impacted long steel producers, while reduced industrial production saw muted demand for flat steel products.

Winter steel production curbs have been enforced for much of the March 2022 quarter. These curbs — intended to mitigate pollution levels in the northern provinces — required mills to maintain output around 30% below 2021 levels for the period 1 January to 15 March. Steel output in January-February 2022 was also impacted by efforts from China's Central Government to reduce industrial activity and ensure reduced air pollution (and blue skies) for the Beijing Winter Olympics.

For the remainder of 2022, signs are emerging that China's fiscal policy will be more expansionary, which should bolster demand for steel. China is expected to increase new infrastructure investment — which typically represents around 20-25% of China's total consumption of steel — in the first half of this year. For 2022, the Government has announced a quota of 1.46 trillion yuan (US$229.8 billion), which will include the front loading of financing of 102 mega infrastructure projects (roads, rail, power, industrial parks, etc) in the first six months of the year. Flow through of this funding is expected to boost construction activity from the June quarter 2022.

Credit conditions are also expected to be eased this year, following a more contractionary policy stance in 2021 (Figure 3.6). Recent cuts to both the bank Reserve Ratio Requirement (RRR) and benchmark mortgage rate signal strong policymaker intent to stabilise the economy, after slowing growth conditions in the second half of 2021. More expansionary monetary conditions are expected to assist, by boosting consumption and domestic activity.

China's manufacturing sector appears to have recovered from the country's recent power crunch, with the manufacturing output increasing by 7.3% year-on-year in February 2022 (from a low of 2.5% growth in September last year). However, with the US and many other major economies expected to tighten monetary conditions in 2022, this sector remains exposed to a potential weakening in global demand for China's exports in the first half of the outlook period.

However, renewed outbreaks of the COVID-19 pandemic in a number of provinces in recent months poses some risks to China's total steel output in 2022. This includes lockdowns and other emergency restrictions placed on China's largest steel production hub — Tangshan — from late March.

China's property sector remains critical to steel demand in 2022

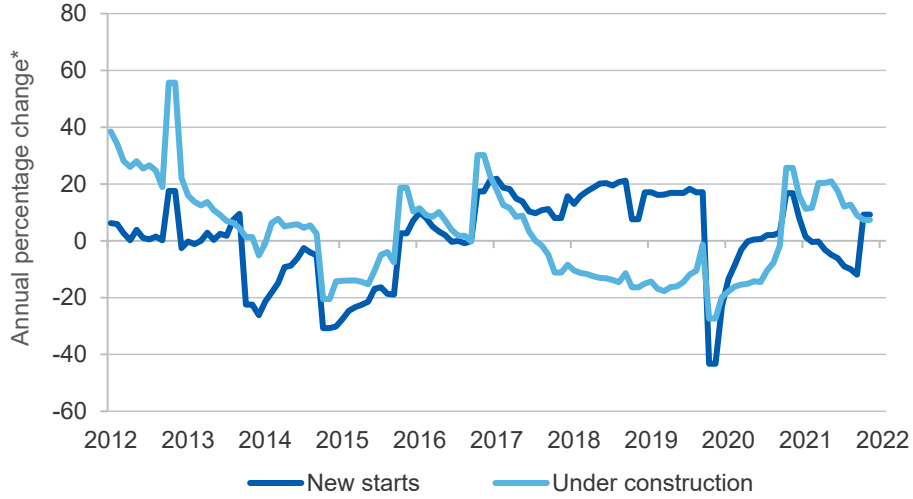
A key risk to steel demand this year remains the continued weakness in the Chinese residential property sector, which typically accounts for around 35-40% of China's total steel consumption.

China's property sector continues to experience liquidity pressures, with a number of major developers having recently defaulted on offshore and onshore-held debt, and many offloading housing stock in order to meet interest payments. This led to significant falls in construction starts in the second half of 2021 (Figure 3.7), as well as total new home sales in January 2022 for China's top 100 developers falling around 40% year-on-year. Weakness in the sector has also stalled new land sales in China's top 50 cities, which were down close to 80% year-on-year in January 2022. This carries broader implications for China's economy and government spending over the outlook, with land sales typically accounting for a significant proportion of local government revenue.

In recent months, China's Government appears to have taken further steps to stabilise the property sector and ensure the completion of existing projects. Many state-owned developers have taken over assets of distressed private developers and are making land purchases. The Central Government also appears to have loosened its Three Red Lines policy, with previously-restricted funding now available to developers to finish existing projects.

The Chinese Government has also reiterated its aims to shift its economy away from investment- and exports-driven 'quantity' growth and toward a more consumption-oriented 'quality' growth in coming years. Over the outlook period, China's total steel production is projected to remain relatively flat at around 1.03 billion tonnes annually (Figure 3.8). While China recently pushed back its aim for peak emissions from its steel industry (from 2025) to 2030, decarbonisation efforts are still expected to have a growing impact on output over the coming years. This also includes a greater share of production coming from scrap-based EAF production, with the Chinese Government aiming for 300 million tonnes of scrap-based steel production by 2025.

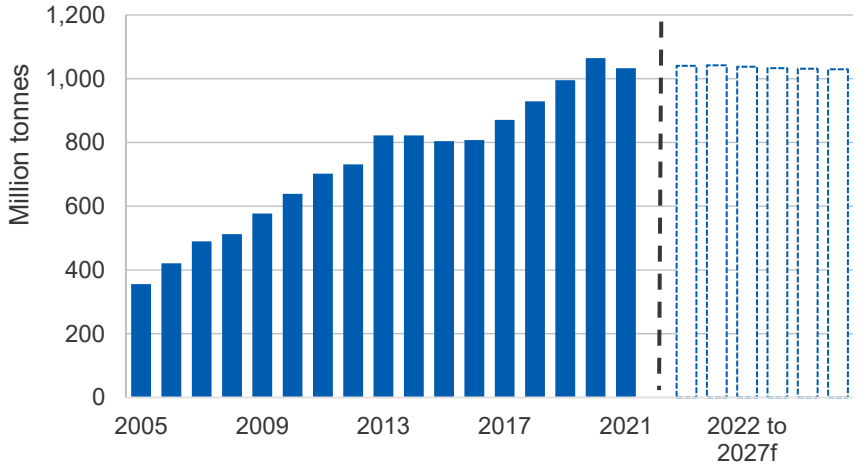
Figure 3.7: China's residential property sector



Notes: * Annual percentage change is calculated based on an average of the same month for the past two years; both series based on million square metres of floor space.

Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022)

Figure 3.8: China steel production to 2027



Notes: **f** forecast

Source: World Steel Association (2022); Department of Industry, Science, Energy and Resources (2022)

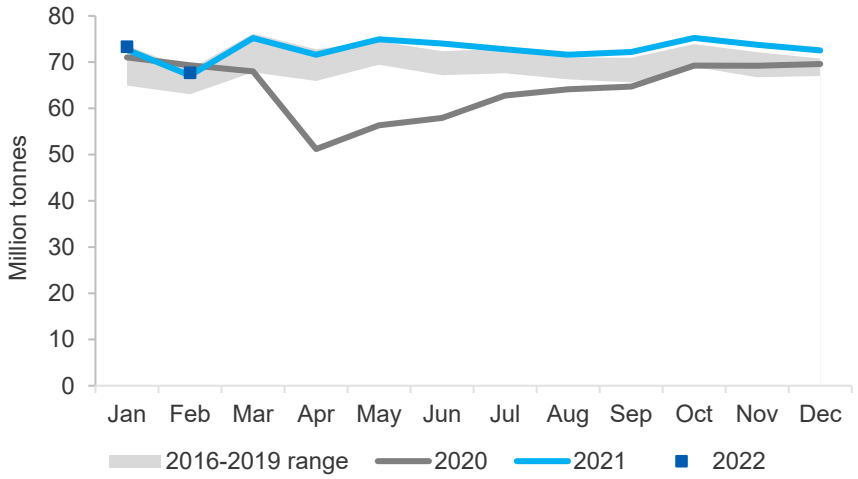
Strong recovery in 2021 steel output for major producers outside China

Despite new outbreaks of the pandemic and other supply chain disruptions, production was resilient across other major steel-producing economies throughout 2021. For the full year, world steel output (excluding China) was 918 million tonnes, an increase of 13% year-on-year for 2020, and 4.3% higher compared to 2019 levels (Figure 3.9).

Steel production in the EU — the world's second largest steel-producer — grew 15% year-on-year in 2021 (and was 1.5% higher than the same period in 2019).

After a rapid expansion in economic activity in the June quarter, Eurozone GDP growth slowed considerably in the second half of 2021. This follows a waning base effect — with economic activity most subdued in the June 2020 quarter — as well as renewed waves of the COVID-19 pandemic, and acute global supply chain disruptions. These issues have seen Euro area industrial output trend lower for the last nine months (from April 2021), to reach a low of zero growth (year-on-year) in January this year (Figure 3.10).

Figure 3.9: Monthly steel production – Global (exc. China)



Source: World Steel Association (2022)

The Eurozone Manufacturing PMI in February showed some stabilisation of this downtrend, with a reading of 58.2. This included increased momentum in 'new orders' and 'employment', as producers looked through the most recent Omicron wave. Supply delays also appeared to be easing, though lead times remained stretched for many critical inputs. With average factory gate prices also at record highs, consumer price inflation is expected to remain elevated in the first half of 2022.

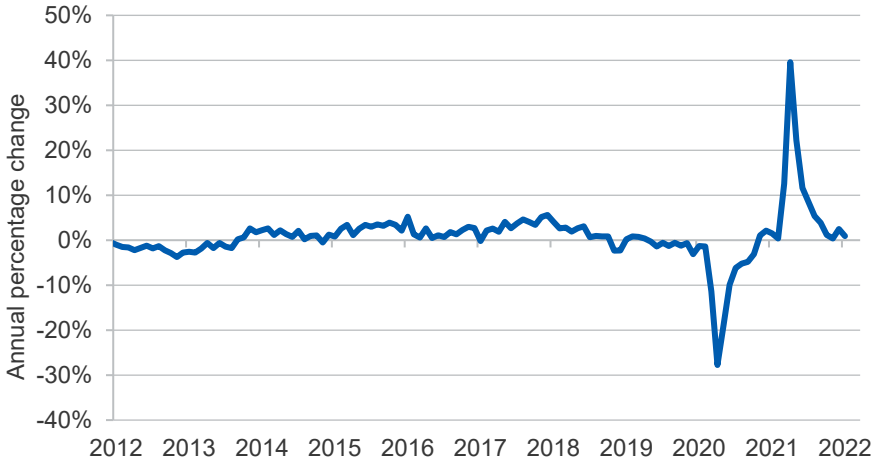
The Euro area continues to be heavily affected by the global semi-conductor shortage. Major automakers, such as BMW, Renault and Volkswagen, were forced to idle production in the second half of 2021, and December global car sales fell to their lowest levels since the 1990s. The industry was expecting chip shortages to persist well into this year (with some easing), however this may now be further exacerbated by the current Russian invasion of Ukraine, given the potential for shortages of a number of critical raw inputs.

The Eurozone is projected to experience low, but steady, growth in steel consumption over the outlook period (Figure 3.11). A major driver of demand will be Europe's construction sector, which accounts for around 35% of the region's steel consumption. The Eurozone Construction PMI reading was 56.6 in January 2022, the sharpest rise in activity in 4 years. Ongoing housing shortages, combined with relatively low growth in new home permits over the last two years, is expected to bolster construction activity in coming years, along with new infrastructure investment — committed as part of the European Green Deal.

However, risks to this outlook remain: Europe's natural gas and oil supplies remain at risk of further shortages, given the current Russian invasion of Ukraine. Alongside energy price volatility, the conflict could lead to further sanctions and actions by major economies that would disrupt trade and economic activity throughout Europe.

Rising price pressures have also seen inflation reach its highest levels in decades in February this year. While supply chain disruptions were expected to ease in 2022, price pressures are raising expectations of a new cycle of monetary tightening in Europe over the next few years.

Figure 3.10: EU monthly industrial production



Source: Bloomberg (2022)

US steel production grew by 18% year-on-year in 2021. However, production remained around 2.0% below calendar 2019.

2021 saw record prices in the US for a number of finished steel products, most notably hot-rolled coil. This reflected a slow recovery in domestic mill capacity, coupled with a stimulus-led recovery in steel use, that saw demand dramatically outpace supply through much of 2021. Prices eased noticeably from November, as domestic mills brought supply back online and imports lifted. This has also been helped by the US-EU agreement in October 2021 to cut US tariffs on steel imports from the EU.

The global semiconductor shortage that has impacted US automakers throughout 2021 looks set to continue into 2022. As a consequence of the disruptions, many major US auto manufacturers are beginning to investigate internal supply chain opportunities to develop chips, though any production remains years away. The impact of current chip shortages on steel demand and scrap supply therefore remains a risk over the outlook period.

US steel production is expected to maintain healthy growth of around 3.2% annually over the outlook period (Figure 3.11). This includes around 10 million tonnes in new EAF-based steelmaking, to be brought online over the next two years. This will support a projected rise in the US' domestic steel demand over the outlook to 2027, as the US$1.2 trillion Bipartisan Infrastructure Framework (BIF) is implemented. This package includes US$550 billion in new federal government investment for roads and bridges, rail, and water and electrical infrastructure. It also marks the biggest investment in US infrastructure since the 1950s. Recent estimates from the American Iron and Steel Association suggest that as much as five million tonnes of new demand for steel is created for every $100 billion in new investment, indicating a significant boost to US steel consumption from the new package over the outlook period.

Indian steel output was around 118 million tonnes in 2021, 18% higher year-on-year. While this partly accounts for the impacts of a (2020) low base effect — when steel output fell 10% year-on-year — the rebound in the nation's manufacturing and construction industries is ongoing, contributing to rising steel demand.

Following rapid expansion in industrial activity in the first half of 2021, growth in India's industrial production slowed to 0.4% year-on-year in December, with weaker production in industries such as mining, manufacturing and utilities. This is due to a number of rising supply side issues, including a severe power crunch — owing to the shortages of coal — as well as semi-conductor shortages and higher input costs.

India is expected to see a significant increase in infrastructure spending in 2022, as part of its $1.5 trillion National Infrastructure Pipeline to 2025. Around US$500 billion will be spent in the next financial year (starting April 1) for projects including 25,000km of new national highway, 400 new trains and 100 cargo terminals. Construction is also forecast to grow by double digits in India's 2022 fiscal year (April 2021 to March 2022), after a fall of 7.3% in its previous financial year.

Over the outlook period, India is projected to grow its steel output by close to 5% annually, and could challenge the EU for position as the world's second largest steel producer by 2027 (Figure 3.11). In December 2021, India's Minister for Steel announced a target to double national steel production capacity to 300Mt by 2030–31 (from current capacity of 144Mt).

The Indian Government intends to support this target with the Production-Linked Incentive (PLI) Scheme it introduced in July 2021.

Total steel production for South East Asian countries, including the Philippines, Indonesia, Malaysia and Thailand, is projected to grow by around 6.8% annually over the outlook period, from 62 million tonnes in 2021 to more than 90 million tonnes by 2027 (Figure 3.11). This will help meet growing domestic demand for steel in these countries, including from government-led infrastructure projects, and the continued development of export-oriented manufacturing capacity.

Low and zero-carbon steel to become more widespread over the outlook

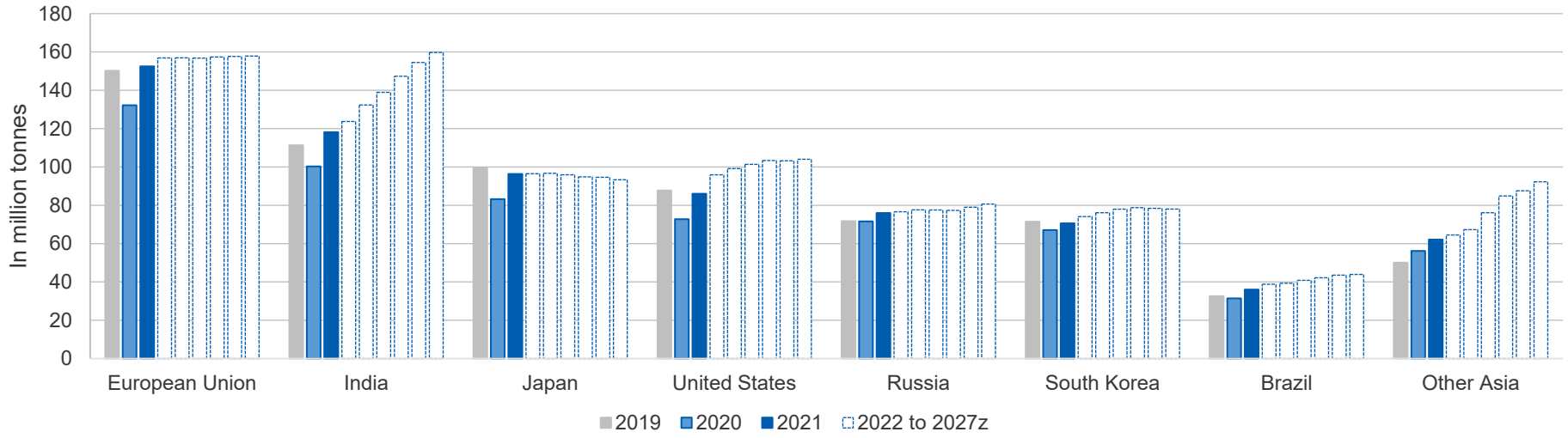
World production of low and zero-carbon steel is expected to increase over the outlook period, as the steel industry continues to respond to the global transition to low carbon emissions.

A number of different technologies and processes are being developed to produce low and zero-carbon steel. This includes the use of renewable energy in Electric Arc Furnace-based making (including the DRI-EAF process, where DRI feedstock is created using green hydrogen); as well as nascent technologies such as Molten Oxide Electrolysis, where (renewable) electricity turns iron ore directly into liquefied metal. Collectively, this evolution is often referred to as 'green steel' (though this term often also incorporates scrap-based steelmaking, recycled steel, and conventional steel with emissions offsets).

Many major steel producers have recently committed to ambitious emissions-related targets. This includes over 6 million tonnes of new DRI-EAF capacity, to be delivered over the next five to ten years for producers such as Swedish-based SSAB, German steelmaker Salzgitter, and the world's largest steel producer, ArcelorMittal.

The rise of these products is expected to take some time, and largely displace more traditional, high-emissions steel, rather than substantially increase total global steel production in the aggregate.

Figure 3.11: Annual steel production (exc. China)



Notes: **z** projection

Source: World Steel Association (2022); Department of Industry, Science, Energy and Resources (2022)

Table 3.1: World steel consumption and production

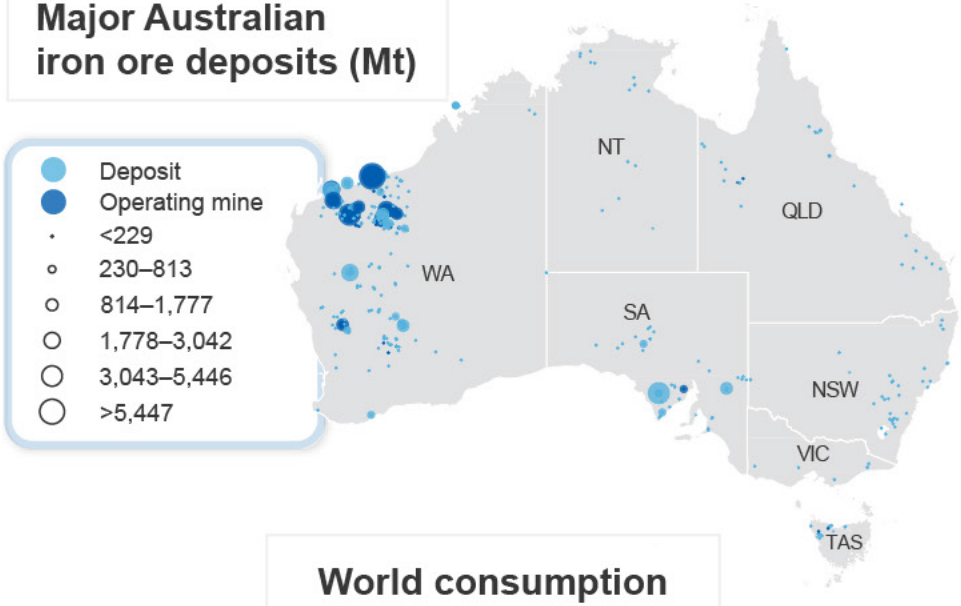
	Million tonnes							
Crude steel consumption	**2021**	**2022[f]**	**2023[f]**	**2024[z]**	**2025[z]**	**2026[z]**	**2027[z]**	**CAGR[r]**
China	1,026	1,029	1,032	1,027	1,021	1,013	1,011	-0.2
European Union	150	156	161	166	171	172	174	2.6
United States	94	106	114	118	122	126	128	5.3
India	99	104	113	122	132	141	142	6.3
Japan	56	57	59	61	61	62	62	1.8
South Korea	51	53	54	55	55	56	56	1.7
Russia	49	50	52	54	55	56	57	2.5
Brazil	25	27	30	32	34	35	35	5.9
World steel consumption	1,959	2,004	2,028	2,050	2,072	2,089	2,106	1.2
Crude steel production	**2021**	**2022[f]**	**2023[f]**	**2024[z]**	**2025[z]**	**2026[z]**	**2027[z]**	**CAGR[r]**
China	1,033	1,040	1,042	1,038	1,033	1,031	1,030	-0.1
European Union	153	157	157	157	157	158	158	0.6
India	118	124	132	139	147	155	160	5.2
Japan	96	96	97	96	95	95	93	-0.5
United States	86	96	99	101	103	103	104	3.2
Russia	76	77	78	78	77	79	81	1.0
South Korea	71	74	76	78	79	78	78	1.7
Brazil	36	39	39	41	42	44	44	3.3
World steel production	1,951	1,993	2,019	2,044	2,064	2,081	2,097	1.2

Notes: **e** Estimate; **f** Forecast; **r** Compound annual growth rate; **z** Projection

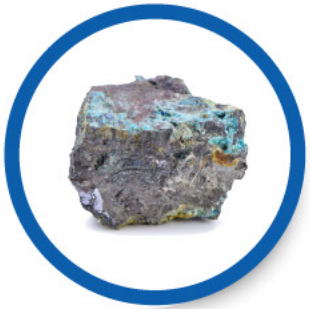
Source: World Steel Association (2022); Department of Industry, Science, Energy and Resources (2022)

26 Fe 55.845 Iron Ore

Major Australian iron ore deposits (Mt)



Iron ore



- Iron is the most abundent element on earth, forming much of the **planet's core**
- Iron ore deposits were originally **formed by algae**
- Humans have been working with iron for at least **5,000 years**
- Iron was central to the **industrial revolution**

World consumption

56% China

9% India

5% EU

5% Japan

3% South Korea

22% Rest of the world

Australia's iron ore

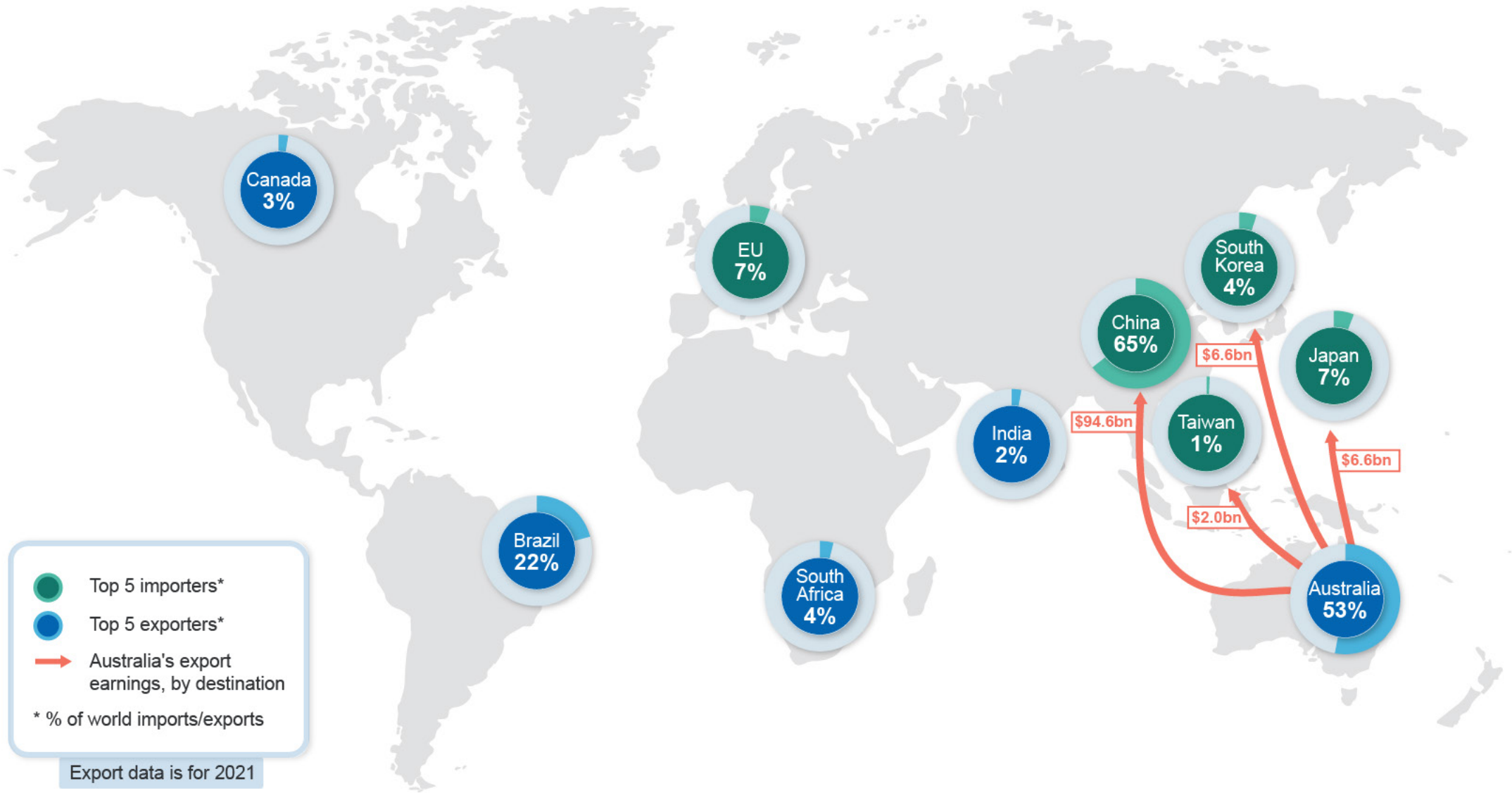
World's no.1 for iron ore **resources**

Largest iron ore producer in the world

Exports earned **$153 billion** in 2020-2021

26 Fe Iron Ore

Trade map | March 2022



4.1 Summary

- After falling more than 60% through the second half of 2021, iron ore prices have rebounded in early 2022 (to around US$140 per tonne by mid-March). This reflects an improvement in China's steel output in recent months, growing expectations of a more accommodative policy stance in China this year, and current supply concerns due to the Russian invasion of Ukraine.
- Australian export volumes are projected to grow steadily over the outlook period, from 897 million tonnes in 2021–22 to 1,044 million tonnes by 2026–27. This reflects the ramp up in production of several new and replacement mines in Western Australia.
- Australia's iron ore export earnings (in real terms) are projected to ease over the outlook period, from $135 billion in 2021–22 to $105 billion in 2022–23, and falling to $74 billion by 2026–27.

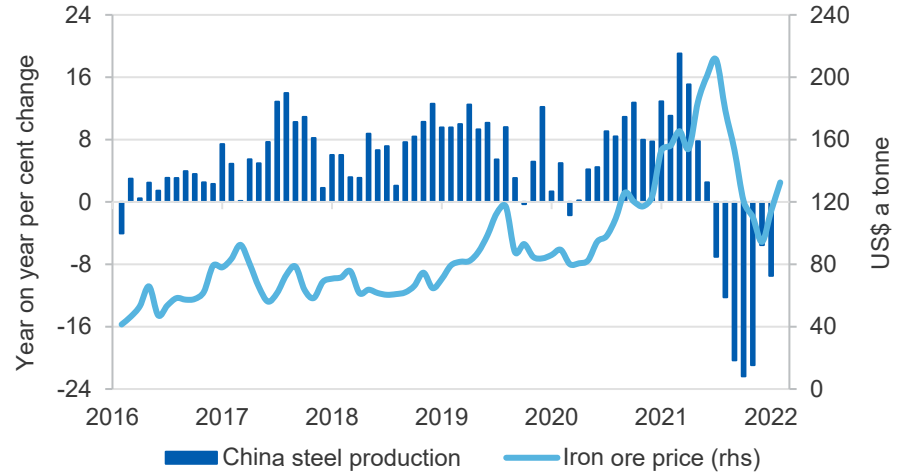
4.2 Prices

Iron ore prices partly recover the considerable falls of second half of 2021

Iron ore prices have fluctuated considerably over the past 18 months. Following record highs during the first half of 2021 (US$230 a tonne), the benchmark iron ore spot price (62% Fe fines CFR Qingdao) fell to a low of US$80 a tonne by mid-November. However, in February 2022, the 62% spot price averaged around $125 per tonne, 60% off the lows reached late last year.

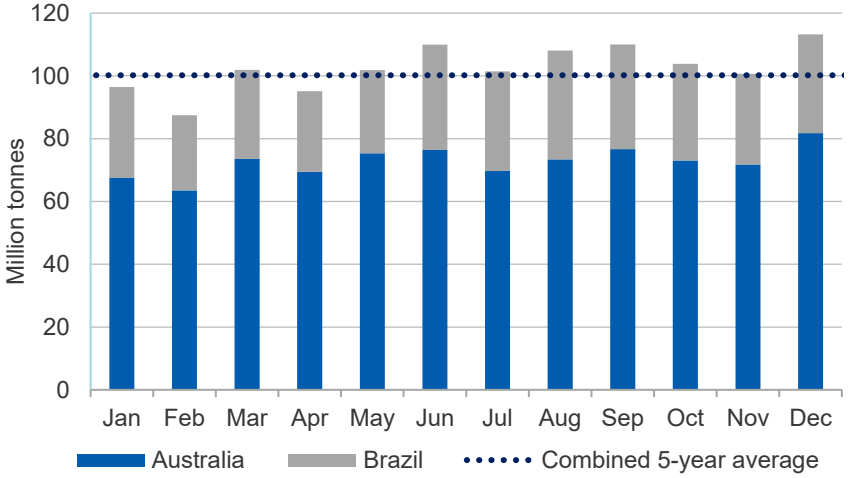
The large fall in iron ore prices in the second half of 2021 reflected China's efforts to curb its steel production, as well as its subdued demand for steel due to weaker construction activity (see *Steel* chapter) (Figure 4.1). As the world's largest consumer of iron ore — with China importing around 65% of global seaborne iron ore supply in 2021 — weaker demand from China's steel industry had a significant and negative impact on global iron ore demand over the period. Recovering exports from Australia and Brazil — following a weather-affected March 2021 quarter — also helped to replenish tight seaborne iron ore supplies and put downward pressure on prices (Figure 4.2).

Figure 4.1: Iron ore price and China steel production, monthly



Notes: China import Iron ore fines 62% Fe spot (CFR Tianjin port)
Source: Bloomberg (2022) China import prices; World Steel Association (2022)

Figure 4.2: Monthly iron ore exports 2021, Australia and Brazil



Source: ABS (2022); Brazilian customs data (2022)

The stabilisation of prices in more recent months reflects a partial recovery of China's steel production, which has come despite annual winter steel curbs and pollution controls in place for much of the March quarter 2022. China's steel production in January 2022 was around 82 million tonnes, 18% higher than the low reached in November last year.

Weather disruptions also impacted Brazilian supply in December and January. Heavy rains in the state of Minas Gerais reduced output from Vale's Southern and South-Eastern systems, as well as CSN's Casa de Pedra mine. While production recovered by mid-January, further rainfall — and particularly its impact on tailings dams in these systems — remains a key risk for the first half of 2022.

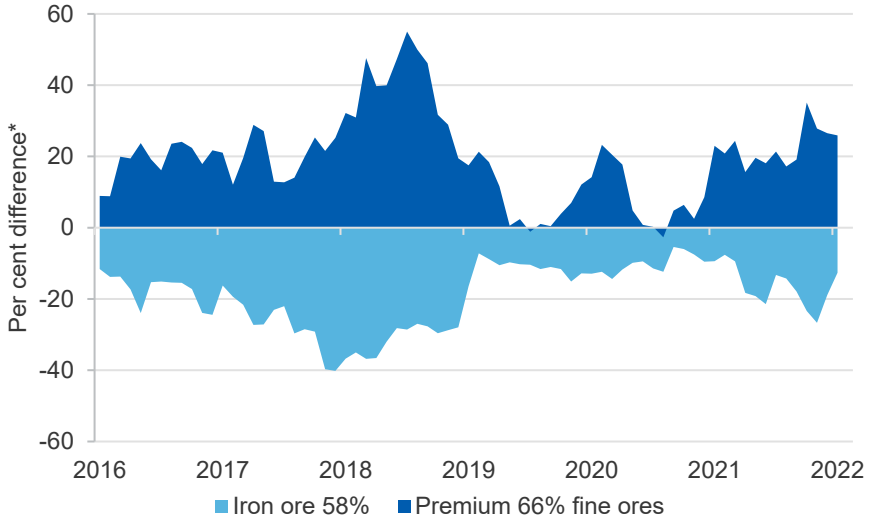
The combination of emissions-related curbs and historically elevated metallurgical coal prices (see *Metallurgical Coal* chapter) also saw the premium for higher grades of iron ore (65% Fe content and above) reach multi-year highs throughout 2021 (See Figure 4.3). These grades typically require less metallurgical coal to be used in blast furnace steelmaking, and create reduced emission levels (for a given level of output), allowing mills to maximise output while still adhering to pollution controls. With winter production curbs in place through the March 2022 quarter for Hebei — China's largest steel-producing province — this has seen a persistence of the 66% premium in early 2022.

More expansionary policy in China to buoy iron ore demand in 2022

China is expected to engage in more expansionary fiscal and monetary policies this year, following a relatively tight stance through 2021. This is expected to bolster steel and iron ore demand in 2022.

China's Central Government has announced an emphasis on infrastructure spending in 2022, with financing for over 100 mega projects to be frontloaded in the first half of the year (See *Steel* chapter). The Government has been taking further steps to stabilise its residential property sector, another major consumer of steel. This includes ensuring the completion of existing residential projects, with many state-owned developers taking over distressed assets and purchasing new land.

Figure 4.3: Iron ore price spread between grades



Notes: *Difference to benchmark of 62% iron fines CFR
Source: Bloomberg (2022); China import prices

China's so-called 'Three Red Lines' policy has also been loosened, with funds in escrow now able to be used by developers to finish projects. The People's Bank of China has also made cuts to both the Bank Reserve Ratio Requirement (RRR) and the benchmark mortgage rate in recent months, signalling a potential upswing in China's credit impulse.

Collectively, these actions are expected to see a lift in total construction activity in 2022, particularly from the June quarter.

In response to recent high prices, China's Central Government has also announced an intention to clamp down on speculative and excessive hoarding behaviour in iron ore markets in 2022. This will include greater inspection of domestic exchanges and major ports, and stronger reporting requirements around iron ore market information.

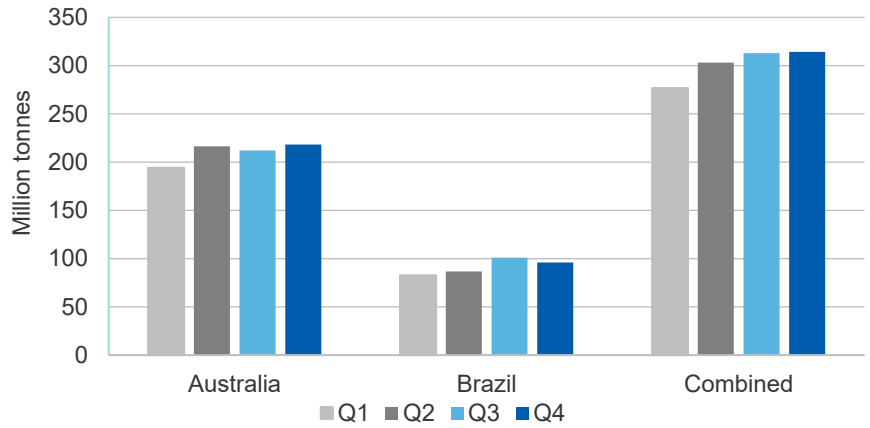
Over the outlook period, China has announced a desire to further consolidate its steel industry, which would help to strengthen its market position and negotiating power in global markets.

Iron ore prices vulnerable to supply shocks in 2022

Combined exports volumes for the world's two largest iron ore producers — Australia and Brazil — reached close to 318 million tonnes in the December 2021 quarter. This was 5.3% higher than the five-year (quarterly) average, and the best result for the December quarter since 2017. Due to a relatively dry start to the year in the Pilbara region, Australia's strong export volumes have continued into 2022, with total iron ore volume for the month of January of 74 million tonnes, 9.6% higher year-on-year, and the largest export tonnage on record for the month of January.

However, the potential for seasonal rainfall to impact global iron ore supply remains a key risk in the first half of 2022. The March quarter of each calendar year is typically the most impacted by weather, with average iron ore export volumes in Australia around 8% lower than the annual (quarterly) average (Figure 4.4). This phenomenon also impacts Brazilian supply, with average export volumes in the March and June quarters typically around 10% and 5% lower respectively than the full year quarterly average.

Figure 4.4: Average iron ore export volumes, 2016 to 2021



Notes: Average is for period 2016 to 2021
Source: ABS (2022); Brazilian customs data (2022)

Australian producers have continued to be impacted by labour supply shortages in recent months. This includes issues at existing operations, as well as the tie-in of replacement capacity. With an ongoing rebound in China's steel output so far in 2022, these labour shortages raise the risk of global supply shortfalls in the near term.

The current Russian invasion of Ukraine also has the potential to tighten seaborne iron ore markets in 2022. Combined exports for both countries in 2021 were estimated to be around 70 million tonnes (equivalent to around one month's export volumes for Australia), with major export destinations including China, the EU and Asia. With Russia and Ukraine also accounting for a significant share of global steel supply (see *Steel* chapter), increased exports from other major steel producers to fill this shortfall could further boost global iron ore demand in coming months.

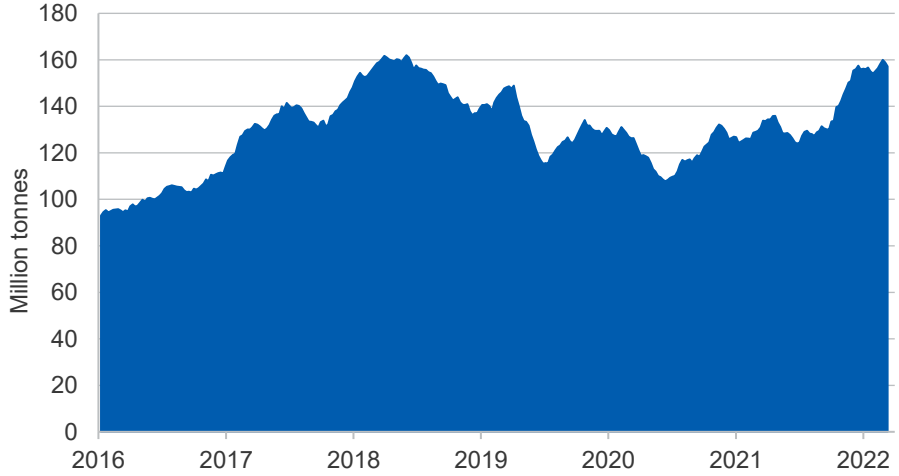
Chinese portside iron ore inventories were around 160 million tonnes by the middle of March, well above the five-year average and just off multi-year highs (Figure 4.5). This accumulation initially reflected reduced portside sales due to the significant drop off in steel output in the second half of 2021. However, the lower price for iron ore in the December quarter 2021 also saw increased stockpiling by portside traders, in preparation for the ramp up in steel production anticipated from the end of the March quarter 2022. High portside inventories will provide some buffer for steel mills to restock iron ore supply in 2022, reducing the risk of a tightening in the seaborne iron ore market similar to that seen in the first half of 2021.

Stronger prices in 2022 to fade over the outlook period

The boost in new infrastructure investment and easier credit conditions in China this year is expected to provide further support to prices for the rest of 2022. The spot price for 62% Fe iron ore fines (FOB) for calendar 2022 is now forecast to average US$110 per tonne for 2022.

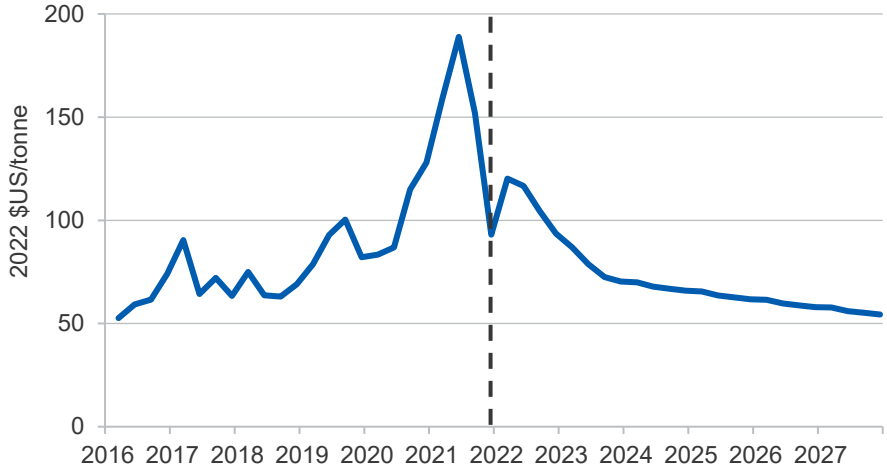
Downside risks to this outlook include continued weakness in China's residential property market. Throughout 2021, China made attempts to address surging property prices and high debt in the sector, which led to lower construction activity going into the start of 2022. With property

Figure 4.5: China's weekly iron ore port stocks



Notes: Benchmark used is 62% iron fines CFR
Source: Bloomberg (2022)

Figure 4.6: Iron ore price outlook, quarterly



Notes: China import iron ore fines 62% Fe spot (FOB)
Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022)

construction a major end-user of steel (around 30% of China's total demand), continued weakness in this sector would have significant implications for the country's total demand for iron ore.

Over the outlook to 2027, iron ore prices are projected to decline to lower long-run levels. This decline will come as a result of more modest growth in blast-furnace steelmaking (compared with the past decade) from major producers such as the EU, US and China, as the world undergoes a transition to a low emissions environment. This softer demand growth will also take place alongside growing supply from Australia, Brazil and Africa, and is expected to dampen prices over the outlook period to 2027.

From a forecast average price of around US$110 per tonne (62% Fe fines, FOB) in 2022, the real benchmark iron ore price is then projected to average US$80 per tonne in 2023. Over the outlook to 2027, real benchmark iron ore prices are projected to decline by around 15% a year, to reach US$55 per tonne in 2027 (Figure 4.6).

4.3 World trade

Global iron ore supply to continue improving in 2022

Total shipments for the world's four largest iron ore exporters — Australia, Brazil, South Africa and Canada — were estimated to be 1.35 billion tonnes in 2021. This was 1.6% higher compared with 2020 and 1.2% higher than 2018, the last full year of unaffected global seaborne supply prior to the 2019 Brumadinho tailings dam collapse in Brazil.

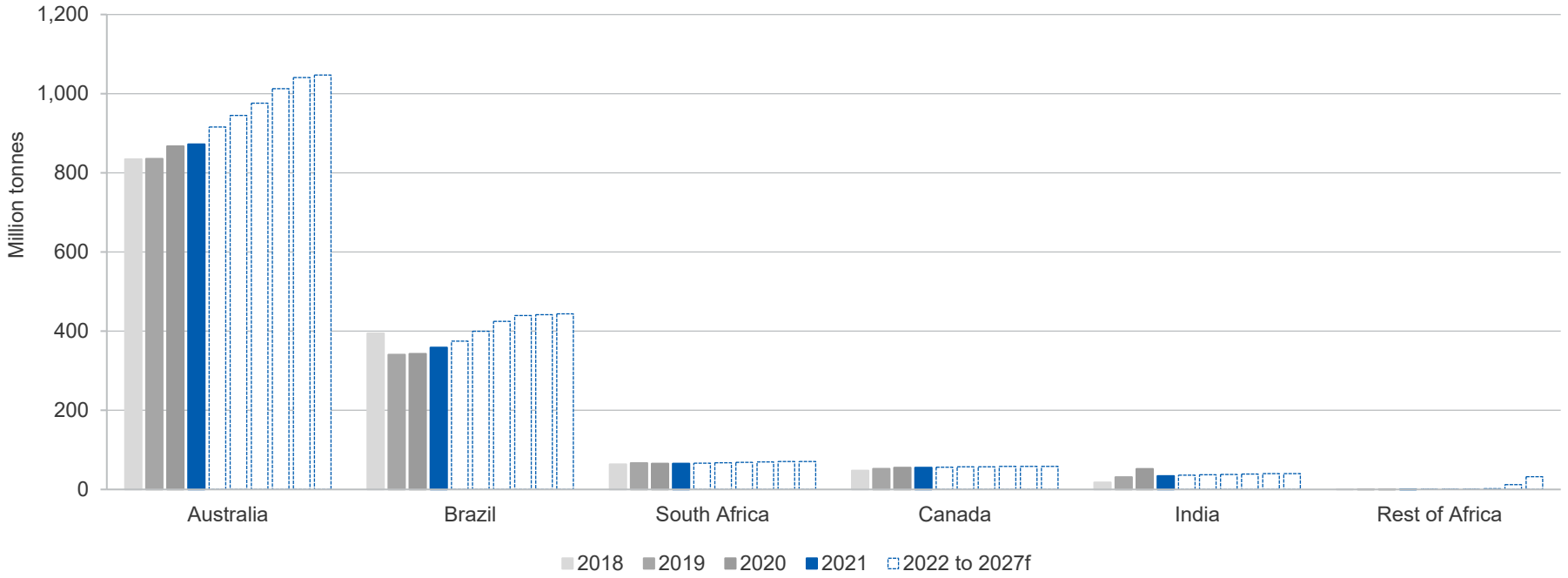
The total volume of iron ore exported from Australia in 2021 was 872 million tonnes. This was 0.6% higher compared with 2020. The modest improvement reflected a recovery in production in Western Australia in the latter part of the year, following the dissipation of acute weather disruptions seen in the March 2021 quarter. Export volumes also continued to improve throughout 2021, despite ongoing maintenance work at the ports of Dampier and Hedland, and pandemic-related delays for major producers in bringing replacement supply online in 2021 (see *Australia* section).

Australian iron ore shipments are expected to rise considerably in 2022, as replacement and new mine supply comes online for major Australian producers. Total Australian exports are forecast to reach 919 million tonnes in 2022, an increase of over 5.0% year-on-year. Over the outlook period, Australia's iron ore exports are projected to rise at an average annual rate of 3.1%, to reach 1.05 billion tonnes by 2027 (Figure 4.7).

Total shipments of iron ore from Brazil — the world's second largest exporter behind Australia — were 359 million tonnes in 2021. While this was 4.7% higher than 2020, it remained 9.0% (or 36 million tonnes) below Brazil's record for export tonnage set in 2018.

Brazil's largest producer, Vale, had total production of 316 million tonnes in 2021, an increase of 5.1% compared with 2020. This followed the resumption of its Serra Leste mine (part of Vale's 240 million tonne per year Northern System), as well as efficiency improvements in its South-eastern and Southern systems. However, annual production for Vale in 2021 remained around 20% below its pre-Brumandinho capacity production of 400 million tonnes per annum.

Figure 4.7: Outlook for global iron ore exports



Source: World Steel Association (2022); Department of Industry, Science, Energy and Resources (2022)

For 2022, Vale has set guidance at 320 to 335 million tonnes. This target reflects a new strategy, outlined late last year by the company, aimed at prioritising value over volume, and lowering supply of some of its high-silica, low margin product. The move is part of Vale's aim to reduce Scope 3 emissions by 15% by 2035, and is expected to lead to lower production of 12-15 million tonnes in 2022.

Vale continues to aim for a return to 400 million tonnes annual capacity within the next few years. This includes bringing its Serra Sul 120 project — with 20 million tonnes of additional capacity — into production by 2024. The plans also include development of a new dedicated iron ore port for its Northern system that could provide up to 560 million tonnes of annual export capacity, with construction expected to get underway in mid-2022, and operations to start by 2025.

Total Brazilian exports are forecast to reach 375 million tonnes in 2022, a rise of around 4.5% compared with 2021. Over the outlook period, Brazil's total iron ore export volumes are projected to grow by around 3.6% annually, to reach around 440 million tonnes by 2027 (Figure 4.7).

Combined exports from other major producers South Africa, Canada and India are forecast to reach 159 million tonnes in 2022. This will contribute to projected world exports (excluding Australia and Brazil) of 417 million tonnes in 2022, 1.2% higher than the previous year. However, the current Russian invasion of Ukraine carries the potential to tighten seaborne iron ore supply in the near term, with combined exports from these two countries of around 72 million tonnes in 2021 (or around 6 million tonnes per month). Over the outlook period, world iron ore exports (exc. Australia and Brazil) are projected to grow by around 0.5% annually, to reach around 460 million tonnes by 2027.

New iron ore mines in Africa to come online later in the outlook

In March this year, the China Iron and Steel Association announced a new plan to diversify the country's iron ore supply chain (of which Australia currently accounts for over 60% of the nation's iron ore imports). The plan includes boosting domestic output by 100 million tonnes (to 370 Mt) by 2025; increasing steel scrap consumption by 70 million tonnes (to 300Mt) over the same period; and increasing equity output from overseas mines (from 120 million tonnes in 2020) to 220 Mt by 2025.

China is investigating a number of possible iron ore mines in Africa. The most notable prospect is the proposed Simandou iron ore mine, located in Guinea. The project has been increasingly emphasised as a key element in China's future supply chains, with potential full production capacity of 200 million tonnes per year (around 15-20% of output currently produced in the Pilbara region of Western Australia) of 65% grade ore.

However, there are significant risks for this development. The project requires long term and significant investment in mining-related and transport infrastructure to get minerals to market, including the development of a new port and 650 kilometres of new railway. While construction of this infrastructure began early in 2021 — with an intended completion date of 2024 — recent political events in the country could delay the project's timeframes. Following a coup that took place against President Alpha Condé late last year, in early March the Guinean Government ordered a full halt of the project and has proposed a further review of the infrastructure plans in 2022.

The Nimba iron ore project in Guinea has also come up for further review announced by the neighbouring Liberian Government in late 2021. The project is aiming to produce 30 million tonnes a year of high grade ore in Guinea, but also requires the construction of extensive port and rail infrastructure, primarily in Liberia. Construction is forecast to begin in 2023 and cost around US$3 billion (including US$600 million for rail and port development). However, this new government review in 2022 risks delaying this schedule.

New prospects also continue to be developed in Cameroon, the Democratic Republic of the Congo, Mauritania and Gabon. This includes Gabon's Belinga iron ore project, for which Fortescue Metals Group recently signed a 36 month exclusivity agreement (for exploration). Belinga is believed to be one of the largest undeveloped Direct Shipping Ore (DSO) deposits in the world, capable of producing 30 million tonnes per

year. However, the project would also require new port and railroad infrastructure to be built in order to mine and export the iron ore.

The tightness in global iron ore markets seen in recent years is expected to ease over the outlook, with growth in exports from both Australia and Brazil over the next few years. New iron ore supply from Africa is also projected to start from the latter half of the outlook period (Figure 4.7). However, Australia's market share is expected to hold up to 2027. On the demand side, while traditional major steel producers are expected to see slower growth in steel output (particularly blast-furnace production) over the outlook to 2027, new production capacity across South and South East Asia, and South America is expected to see healthy growth in global steel production and iron ore consumption over the period.

4.4 Australia

Iron ore export earnings set calendar year record in 2021

Australia's total iron ore export earnings reached $153 billion in 2021. This was $37 billion (or 32%) higher than the previous calendar-year record set in 2020. The achievement primarily reflects an elevated price for iron ore sustained throughout the year, with the average unit export price in 2021 of $178 per tonne, around 30% higher compared with 2020.

Australia exported 872 million tonnes of iron ore in 2021, 0.6% higher than in 2020. This followed severe wet weather experienced throughout the first half of the year, maintenance work undertaken at Port Hedland and Dampier, and pandemic-related delays for the major producers in bringing replacement supply online in 2021.

Iron ore exports to China reached close to $126 billion in 2021, representing 82% of Australia's total iron ore export earnings. By value, Australia's exports to China in 2021 were 33% higher year-on-year, while volume (720 million tonnes) was around 2.8% higher.

Rio Tinto shipped 322 million tonnes of iron ore in 2021. This was slightly below their 2021 guidance (325 to 340 million tonnes), and 3% lower than 2020. The company indicates the result was due to above-average rainfall in the first half of the year, and cultural heritage management. The company has also identified delays in its efforts to bring 90 million tonnes of replacement capacity online during 2021. This was largely due to COVID-19 restrictions, labour shortages and supply chain disruptions.

Despite these issues, the ramp up of tie-in replacement capacity is expected in 2022. Rio Tinto's West Angelas project (30 million tonnes per annum capacity) and Mesas B, C and D project (25 million tonnes per annum) achieved first ore in June and August 2021, respectively. And the company's third brownfield replacement project, Western Turner Syncline Phase 2 (32 million tonnes per annum), achieved first ore in October 2021. Rio Tinto also projects its greenfield project Gudai Darri (43 million tonnes per annum) to start producing from the June 2022 quarter. Rio Tinto has provided 2022 guidance of 320 to 335 million tonnes.

BHP's total iron ore production was 129 million tonnes for the first six months of the 2021–22 financial year (and around 257 million tonnes for the 2021 calendar year). This was around 1% higher than for the same period in 2020. The increase came despite major maintenance undertaken during the second half of the year at Port Hedland, as well as railway labour shortages related to COVID-19 border restrictions. Despite the issues, BHP has retained 2021–22 guidance at 249 to 259 million tonnes. This will include a ramp up of its South Flank project, which achieved first ore in May 2021, and is expected to reach full production of 80 million tonnes per year over the next few years. In September 2021, BHP also received regulatory approval to lift capacity at its Port Hedland operations (from 290 million tonnes per annum) to 330 million tonnes per annum.

Fortescue's total iron ore exports were around 93 million tonnes in the second half of 2021 (and around 185 million tonnes for the 2021 calendar year). This half year result was 3% higher than the same period in 2020, and set a new record for total volume shipped in a six month period. This has come as Fortescue's newly developed Eliwana project ramps up, with an eventual production capacity of 30 million tonnes per year. Fortescue is continuing to develop its 22 million tonne per annum Iron Bridge Magnetite Project, with first output scheduled for December 2022. This new project

will deliver high grade 67% Fe magnetite concentrate. Fortescue has set 2021–22 fiscal year production guidance at 180 to 185 million tonnes.

In February 2022, the Western Australian Government endorsed a development plan to increase Port Hedland's export capacity to 660 million tonnes of iron ore per year (previously 495 million tonnes per annum). This includes a substantial increase in allocation for BHP, Fortescue and Roy Hill. The WA Government expects final approvals by mid-2022.

With increasing production volumes and continued strength in prices, Australia's iron ore export earnings are forecast to be $135 billion in 2021–22. Prices for iron ore are expected to continue to ease from the second half of 2022, leading to lower earnings over the outlook. Total export earnings for iron ore is forecast to be $105 billion (in real terms) in 2022–23, before falling to $74 billion by 2026–27 (Figure 4.8).

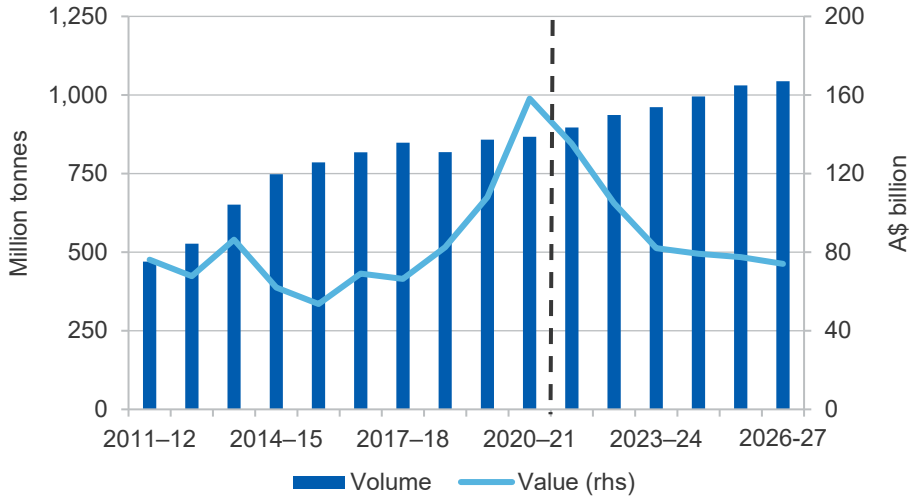
Iron ore exploration expenditure is growing as prices lift

A total of $131 million was spent on iron ore exploration in the December quarter 2021 (Figure 4.9). This was a fall of 25% compared with the previous quarter, but 19% higher than the same quarter in 2020. For the calendar year 2021, expenditure was $558 million, more than 40% higher than the previous year. Exploration has been elevated in recent quarters as iron ore prices have reached historical highs in the first half of 2021.

Revisions

Forecast export earnings for 2021–22 (in nominal terms) have been revised upwards from $118 billion in the December 2021 *Resources and Energy Quarterly* to $135 billion in this edition. This reflects stronger prices in 2022, due to a projected easing in China's credit conditions and increased fiscal spending by Beijing. Export earnings have also been revised up (by around $23 billion) for 2022–23 to $108 billion, reflecting continued price strength through 2022. Compared with the March 2021 *Resources and Energy Quarterly*, forecast Australian earnings in 2025–26 (in nominal terms) have been revised down by 25% to $86 billion. This reflects a downward revision in projected export volumes and lower prices in the latter half of the outlook period.

Figure 4.8: Australia's iron ore export volumes and values



Source: ABS (2022) International Trade, Australia, 5368.0; Department of Industry, Science, Energy and Resources (2022)

Figure 4.9: Australian iron ore exploration expenditure

Source: ABS (2022) Mineral and Petroleum Exploration, Catalogue 8412

Table 4.1: World trade in iron ore

	Million tonnes							
	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
World trade	1,642	1,710	1,772	1,826	1,884	1,926	1,954	2.9
Iron ore imports								
China	1,088	1,091	1,092	1,083	1,077	1,073	1,068	-0.3
Japan	116	116	116	115	114	113	112	-0.5
European Union	113	117	117	118	119	119	118	0.8
South Korea	76	80	82	84	84	84	84	1.6
Rest of Asia[a]	97	98	101	111	122	124	129	4.9
Iron ore exports								
Australia	872	919	951	976	1,012	1,041	1,047	3.1
Brazil	359	375	400	425	440	442	444	3.6
South Africa	65	66	67	68	69	70	70	1.2
Canada	55	56	57	57	58	58	58	0.9
India	34	36	37	38	39	40	40	2.7

Notes: **a** Excludes China, Japan, South Korea, Taiwan and India; **f** Forecast; **r** Compound annual growth rate; **z** Projection
Source: World Steel Association (2022); International Trade Centre (2021); Department of Industry, Science, Energy and Resources (2022)

Table 4.2: Iron ore outlook

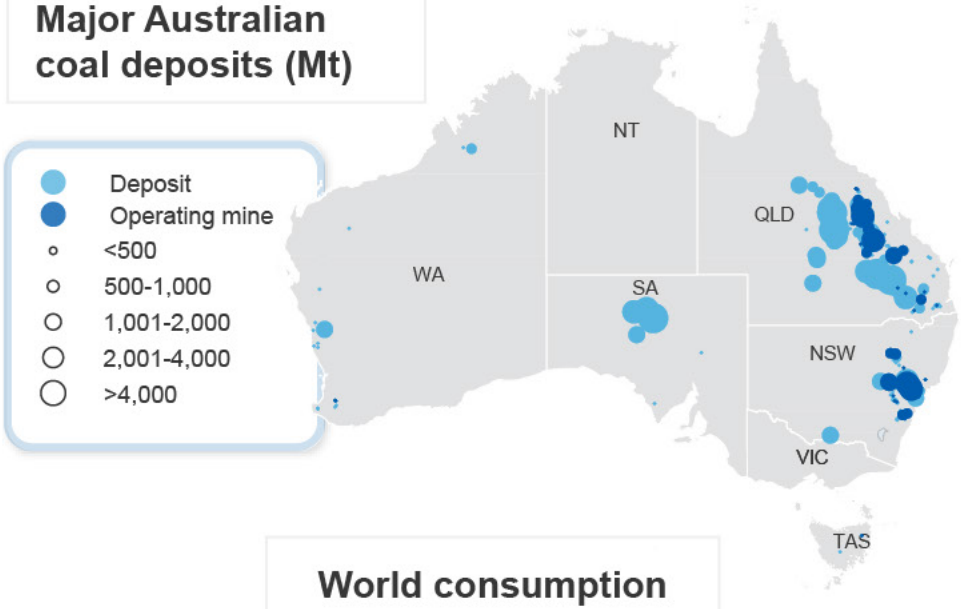
World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Prices [a]									
– nominal	US$/t	143	109	79	71	68	66	63	-13
– real [b]	US$/t	148	109	77	68	63	59	56	-15
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production									
– Steel [e]	Mt	5.67	5.92	5.98	5.98	5.98	5.98	5.98	0.9
– Iron ore	Mt	906	941	970	997	1,033	1,068	1,081	3.0
Exports									
Steel [e]	Mt	0.80	0.88	0.90	0.88	0.86	0.80	0.82	0.4
– nominal value	A$m	773	884	932	932	932	893	932	3.2
– real value [g]	A$m	794	883	909	892	871	815	830	0.7
Iron ore	Mt	867	897	936	961	996	1,031	1,044	3.1
– nominal value	A$m	152,975	135,119	108,223	86,816	85,994	86,218	84,495	-9.4
– real value [g]	A$m	158,144	135,119	104,947	82,003	79,214	77,484	74,083	-12

Notes: **b** fob Australian basis; **c** Spot price, 62% iron content basis; **d** In 2021 US dollars; **e** In 2021–22 Australian dollars; **f** forecast; **h** Crude steel equivalent; Crude steel is defined as the first solid state of production after melting. In ABS Australian Harmonized Export Commodity Classification, crude steel equivalent includes most items from 7206 to 7307, excluding ferrous waste and scrap and ferroalloys; **i** In 2020–21 Australian dollars; **r** Compound annual growth rate; **s** estimate; **z** Projection
Source: ABS (2021) International Trade in Goods and Services, Australia, 5368.0; Bloomberg (2021) Metal Bulletin; World Steel Association (2021); AME Group (2021); Company Reports; Department of Industry, Science, Energy and Resources (2022)

Metallurgical coal

6 C Carbon 12.011

Major Australian coal deposits (Mt)



Metallurgical coal

- Metallurgical coal is primarily used **to make steel**
- Contains **more carbon and less ash & moisture** than thermal coal
- 1x tonne of steel made in a blast furnace **uses 780kg of met coal**
- Electric arc furnaces don't use met coal as a **raw material**

World consumption

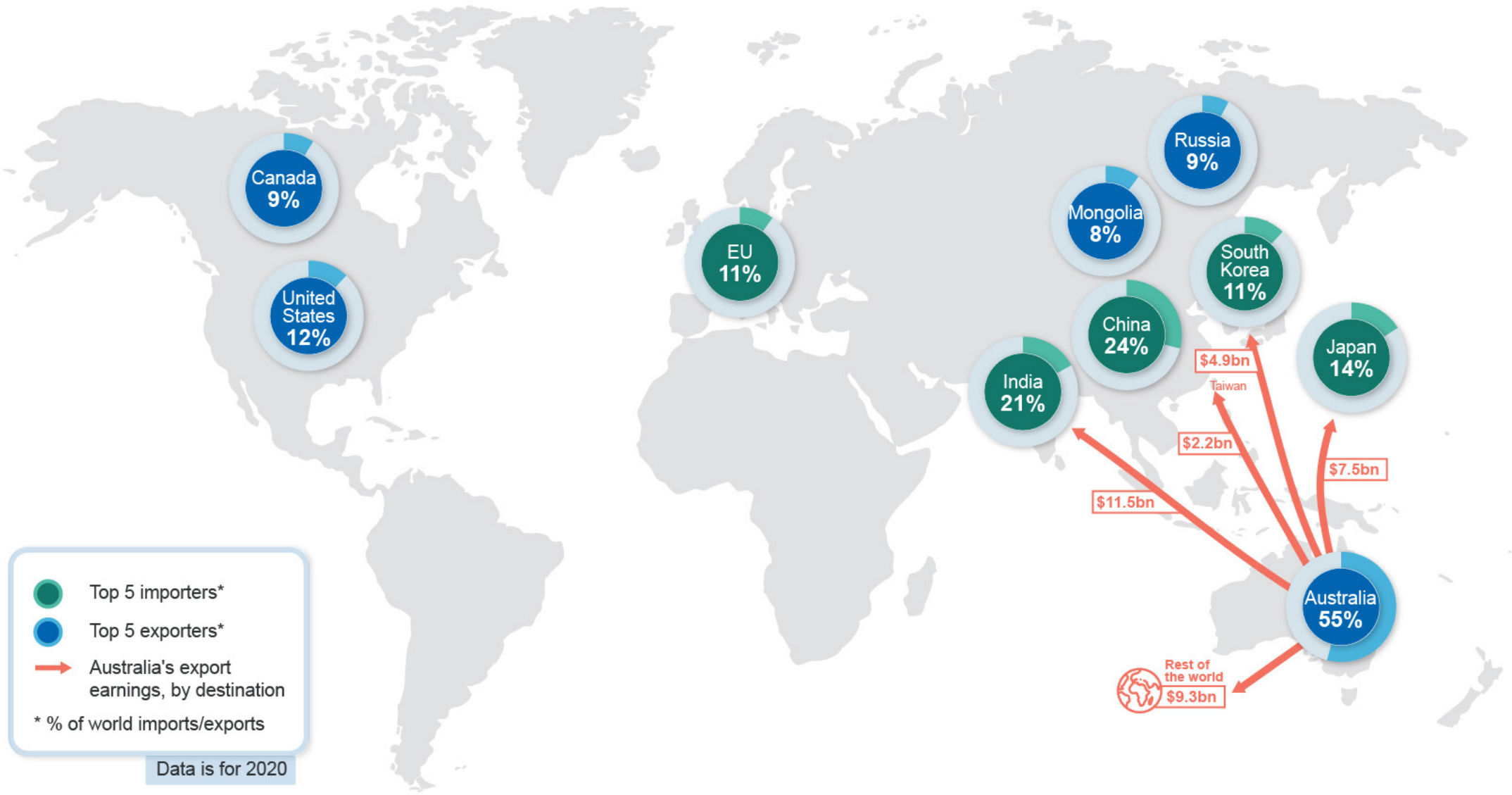
- **59%** China
- **10%** India
- **7%** Russia
- **5%** EU28
- **5%** Japan
- **4%** South Korea

Australia's metallurgical coal

- **World's no.1** **metallurgical coal** exporter
- **170m tonnes** of **metallurgical coal** exported each year
- **Almost all** of Australia's met coal is **exported**

Metallurgical coal

Trade map | March 2022



5.1 Summary

- Metallurgical coal prices hit historic highs as the year turned, and surged again following the Russian invasion of Ukraine. The Australian premium hard coking coal price is forecast to average over US$300 a tonne in 2022, but is expected to fall by almost half as supply conditions return to normal in 2023. Prices are ultimately expected to reach US$133 a tonne by 2027 (in real terms).
- Australia's exports are forecast to rise from 171 million tonnes in 2020–21 to 184 million tonnes by 2026–27. The result reflects increased production in NSW and Queensland.
- Australia's metallurgical coal export values are forecast to track with price movements, rebounding from $24 billion in 2020–21 to peak above $60 billion in 2021–22, before falling back to $26 billion by 2026–27.

5.2 World trade

After reaching record highs in October, metallurgical coal prices fell back slightly in late 2021 before surging again in January and February 2022. The recent lift reflects supply issues due to weather disruptions in Australia and the Russian invasion of Ukraine. Australia has faced both heavy rainfall (which affected production and transport in Queensland), and a sharp rise in COVID-19 cases, which disrupted workforces at several coal operations.

Russia faced bottleneck issues in 2021, with production consistently exceeding transport capacity. The invasion of Ukraine adds significant new uncertainty, with coal shipping potentially disrupted and sanctions limiting Russian access to crucial imports of machinery and equipment.

Further disruptions remain in prospect for Australia, with floods in New South Wales and Queensland likely to affect mining and transport. The March-April period also often correlates with high cyclone activity in the oceans off Queensland and heavy rainfall in the Bowen Basin. It is expected that tight global trade conditions will continue to affect metallurgical coal, with most issues being on the supply side.

Metallurgical coal demand remains relatively contained. Chinese imports edged down late in 2021 as steel production was placed under more constraints. Lunar New Year holidays and the Winter Olympics appear to have further moderated Chinese demand in February, but prospects are growing for a recovery in March and April.

Demand elsewhere remains similarly flat. This may be due to recent record prices and supply difficulties, which have encouraged caution among potential buyers. This caution leaves significant room for demand to lift as steelmaking increases, with the result that global markets will likely remain tight — and prices above US$150 a tonne — for the next 2-3 years. However, prices are expected to trend down slowly, approaching their historical average over the second half of the outlook period.

On balance, world metallurgical coal trade is forecast to increase from 314 million tonnes in 2020 to 343 million tonnes in 2027. The bulk of growth in trade is expected early in the outlook period, as steelmaking picks up and economies around the world recover from the effects of the COVID-19 pandemic. However this recovery faces greater risks following the invasion of Ukraine.

5.3 World imports

Chinese metallurgical coal imports are trending down

Chinese imports of metallurgical coal fell in 2021, as curbs on steelmaking reduced blast furnace requirements. Steelmaking and Chinese industry demand also remain subject to uncertainties caused by the country's ongoing zero-COVID policy. The entire of Jilin province was placed under lockdown in March 2022, as was the city of Shenzhen, which holds extensive tech and industry hubs. At the time of writing almost 40 million people are under lockdown, with potential for lockdowns to expand into other population centres, transport networks and industrial zones.

Previous fiscal stimulus packages have targeted the Chinese steel industry, and any renewed stimulus could push up steel usage again, potentially lifting metallurgical coal prices in turn. The recent announcement that the steel industry's peak emissions target would move

from 2025 to 2030 also points to higher potential steel output. However, domestic coal production in China also rose solidly in January and February. If sustained, this could keep pace with steel production.

Informal import restrictions against Australia continue to complicate the picture within China, where domestic prices have reached over US$600 a tonne. In January the Chinese Government released around 5.6 million tonnes of Australian metallurgical coal previously held in Hong Kong warehouses. The release of stored coal does not imply any change in overall Chinese policy, which is assumed to be maintained over the outlook.

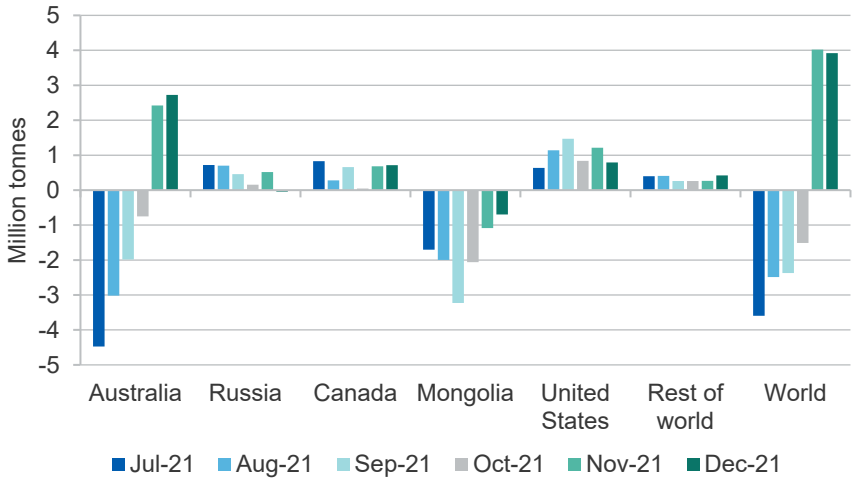
Chinese metallurgical coal imports eased over much of 2021 (Figure 5.1), constrained by steel production caps and by the Winter Olympics. Imports are expected to hold at just under 50 million tonnes annually through the outlook period, with steel production peaking and domestic coal production largely keeping pace with domestic demand.

India's metallurgical coal imports are recovering

Indian steel production showed strong signs of growth in the second half of 2021, but was checked somewhat by high metallurgical coal prices and supply problems. Australia accounted for almost three-quarters of metallurgical coal imports to India over 2021, while import shares from Canada and the US slumped to 3% and 5%. Recent heavy rainfall and COVID-19 issues in Australia thus create particular risks for India in an environment where most non-Australian supply is monopolised by China. Expansions in rail capacity between Russia and India are expected to broaden Indian import sources over the longer term, but the prospects for this have become less certain following the invasion of Ukraine.

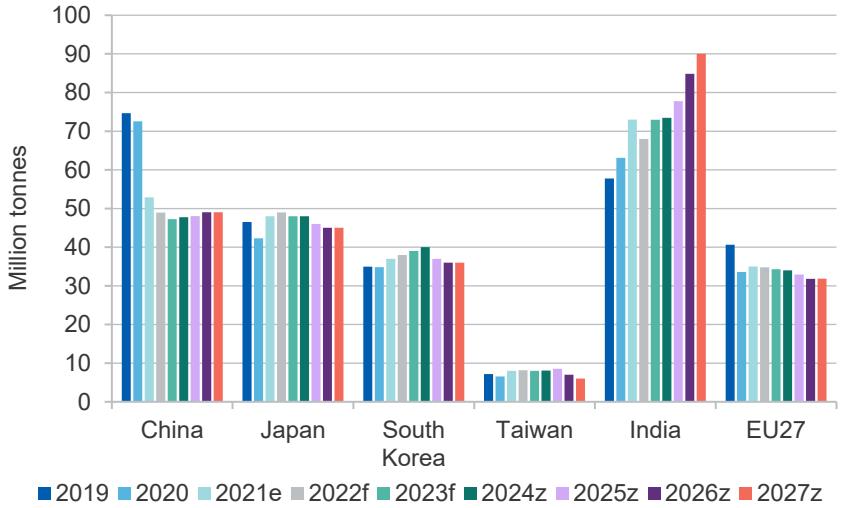
India's metallurgical coal needs are likely to grow during the outlook period. Indian steelmakers have announced projects worth a total of US$11 billion over the next five years (though final investment decisions are yet to be made in many cases). Metallurgical coal imports, already the largest in the world, are expected to grow in tandem, increasing from 63 million tonnes in 2020 to 90 million tonnes by 2027 (Figure 5.2).

Figure 5.1: China's metallurgical coal imports, year-on-year change



Notes: China customs released combined January/February data.
Source: Bloomberg (2022); China customs (2022)

Figure 5.2: Metallurgical coal imports



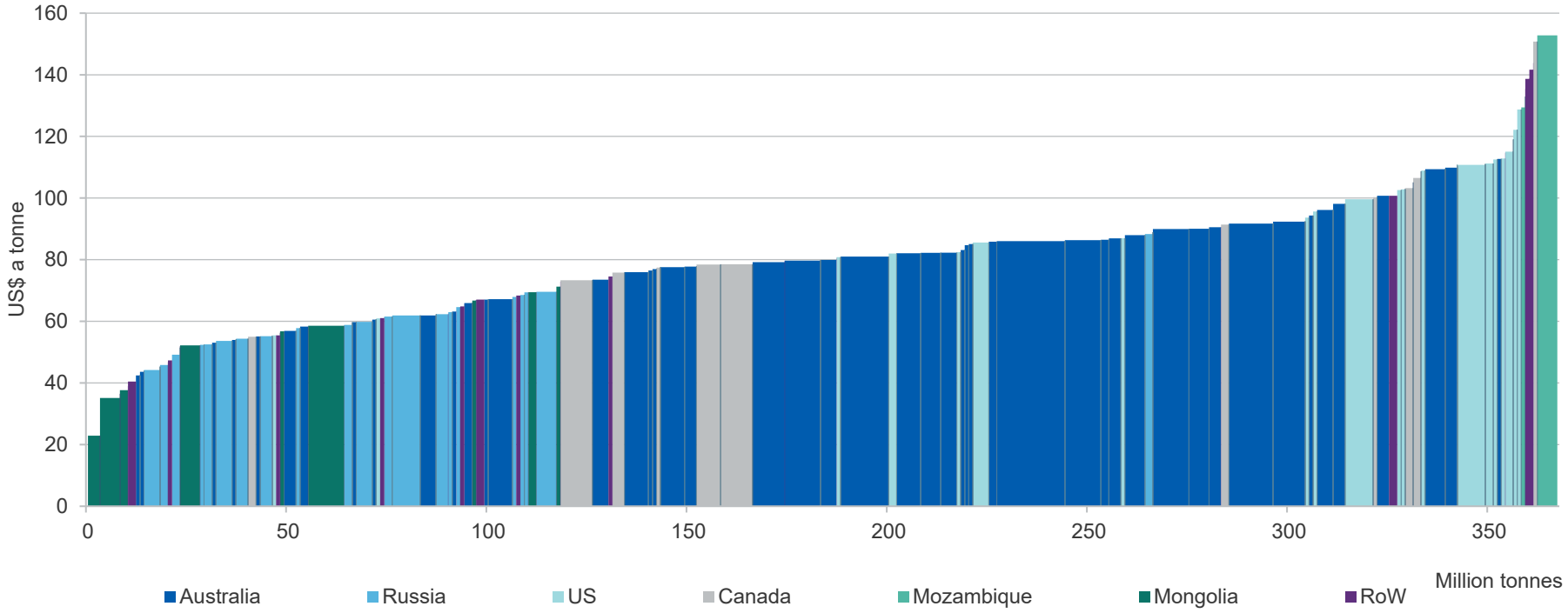
Notes: **f** Forecast.
Source: IHS (2022); Department of Industry, Science, Energy and Resources (2022)

Japanese and South Korean imports are picking up faster

Japanese steelmaking is rising following a significant decline in 2020, with manufacturing conditions and consumer white goods sales increasing. Metallurgical coal imports are expected to have risen from 42 million tonnes to 48 million tonnes in 2021, with a marginal increase to 49 million tonnes expected for 2022. In the second half of the outlook period, import needs are expected to ease, as some Japanese steel plants reach the end of their useful operating life, and steelmaking shifts offshore.

Steelmaking in South Korea was relatively less affected by the COVID-19 pandemic, with the result that metallurgical coal imports were largely steady in 2020 and 2021. South Korean metallurgical coal imports are forecast to lift slowly over the outlook period, peaking at 40 million tonnes in 2024 and then subsequently easing slightly as efficiency improves and industrial use peaks.

Figure 5.3: Metallurgical coal (including hard coking, PCI and semi-soft) global cost curve, FOB



Notes: FOB is Free on Board. RoW is rest of world.
Source: AME Group (2021); Department of Industry, Science, Energy and Resources (2022)

5.4 World exports

COVID-19 impacts are hampering US efforts to capitalise on strong prices

Metallurgical coal production in the US was virtually flat in the December quarter 2021, edging up by less than 250,000 tonnes to remain under 14 million tonnes. Metallurgical coal producers continue to face labour shortages linked to the COVID-19 pandemic, which undermined attempts by US producers to raise output and capitalise on supply disruptions elsewhere.

The effects of COVID-19-related labour shortages have also spread to transportation and port infrastructure in recent months. While much of this has affected rail transportation, CSX's large Curtis Bay export terminal also experienced recent outages, with shipments facing disruptions in early 2022.

Over the longer term, US supply remains subject to high production costs (Figure 5.3) and high transport costs due to the inland location of coal reserves. The recent surge in prices should support profitability in the short-term, but labour shortages may inhibit companies' ability to capitalise. High costs and prior mine closures mean the US is not seen as a strong growth prospect in the longer term, with exports unlikely to match their 2019 peak at any point over the next five years (Figure 5.4).

Mongolia's exports have stopped falling, as COVID-19 impacts peak

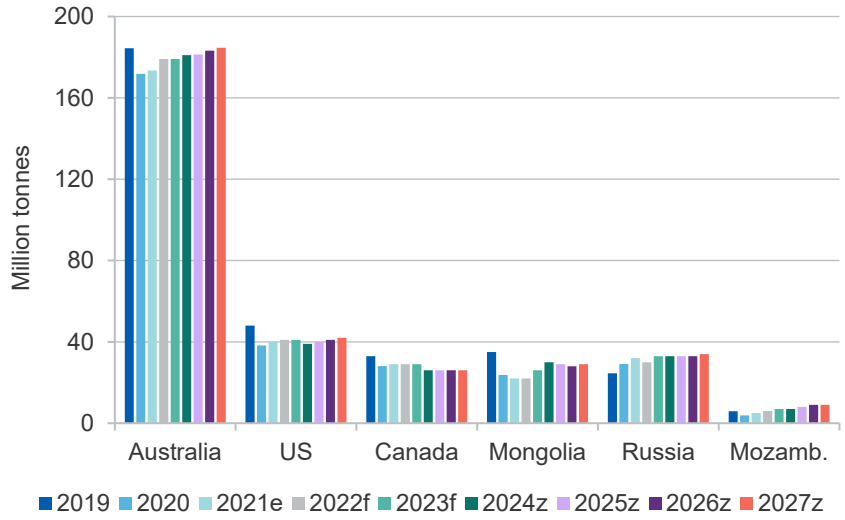
Mongolian exports have steadied after a sharp fall during 2020, when trade was disrupted by Chinese efforts to contain the COVID-19 pandemic. Chinese investment has supported new and expanded infrastructure connections, including a new railway between Mongolia and China. It is expected that this expanded capacity will come fully online during the outlook period, lifting Mongolian exports and reducing some pressure on the Chinese market. Exports are expected to increase from 22 million tonnes in 2022 to 29 million tonnes by 2027.

Russia's exports are recovering, supported by new infrastructure

In 2021, Russian exports exceeded their 2020 level by more than 10%, largely due to a 50% lift in exports to China. However, Chinese demand has led to growing strain on Russian shipping infrastructure to the Asian market. In response to bottlenecks, a large quantity of rail capacity is being considered for upgrade, with some already under development. A significant quantity of new capacity is scheduled to come online between 2022 and 2024. However, the Russian invasion of Ukraine has led to sanctions which are likely to restrict access to imported machinery and equipment crucial to the expansion.

The full implications of the invasion of Ukraine are not yet clear, but the situation has already forced some Russian coal trains to divert to Poland, with resulting delays and potential reduction in landborne supply. Neither Russia nor Ukraine are globally significant metallurgical coal consumers, so any effects are likely to impact mainly on the supply side, representing an upside risk for prices. Sanctions targeting Russia also have potential to expand, with unpredictable effects on steelmaking in the EU and on metallurgical coal supply from Russia. The overall effect on prices is likely to be mixed, but with greater risks on the upside.

Figure 5.4: Metallurgical coal exports



Notes: **e** estimate **f** forecast
Source: IHS (2022); Department of Industry, Science, Energy and Resources (2022)

With recent infrastructure maintenance largely completed, and bottlenecks set to ease, Russian exports are forecast to recover from a 2020 low of 29 million tonnes to 32 million tonnes in 2021. However, further growth is likely to be stymied by economic instability and a lack of access to imported machinery following the invasion of Ukraine (Figure 5.4). Russian coal is highly suited to north Asian markets, being low cost and unusually low in sulphur. Key demand sources in the region (including China) have demonstrated less intention to target Russia with sanctions and other trade restrictions. However, a long-term shift away from Russian coal may occur even in the absence of formal state sanctions.

Exports from Canada are set to rise as a new mine ramps up

Canadian metallurgical coal exports are expected to lift slightly in 2022, supported by the restart of Canada Coal's Grand Cache mine (which has historically produced about 2 million tonnes of coal annually). The mine was shut down in 2020 following the outbreak of the COVID-19 pandemic, and while the restart may take some time (given the eighteen month period of care and maintenance), it is expected to be finished by end 2022 or early 2023, with most new output feeding the Chinese market.

The return of production at Grand Cache, and generally strong conditions for Canadian exporters, are expected to see exports lift from 28 million tonnes in 2020 to 29 million tonnes by 2023 (Figure 5.4). Beyond this, exports are set to edge down marginally as existing mines deplete, with no other large or high quality deposits now in prospect in Canada.

Mozambique's exports will take time to recover

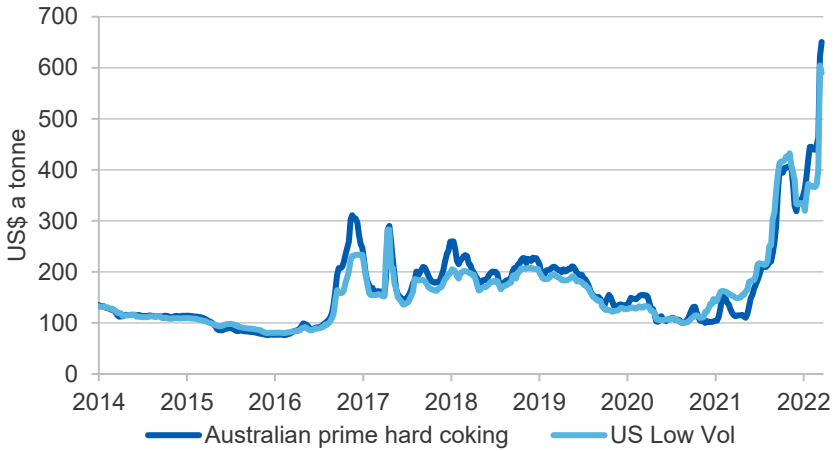
Mozambique's exports fell sharply to 4 million tonnes in 2020, as low prices severely affected the country's relatively high cost producers. Exports are forecast to recover to 7 million tonnes by 2023 and 9 million tonnes by 2027. This growth is expected to be supported by Vale's Moatize mine — where work has finished on a preparation plant upgrade — and by upgrades to the Nacala logistics corridor rail line and port. Higher output at the Moatize site may be temporarily affected by seasonal heavy rainfall, but growth to at least 8 million tonnes of metallurgical coal (annually) is expected at the site over the longer term.

5.5 Prices

Metallurgical coal prices are expected to ease gradually

Metallurgical coal prices have been volatile over recent quarters (Figure 5.5), rising sharply in the September quarter and then falling rapidly in November on lower Chinese steel production. Prices subsequently surged back in January 2022, as global steelmaking showed further signs of recovery and new supply disruptions began to emerge.

Figure 5.5: Metallurgical coal prices – Australian Prime Hard vs US Low Vol, FOB



Source: IHS (2022). Low vol = low volatile coking coal.

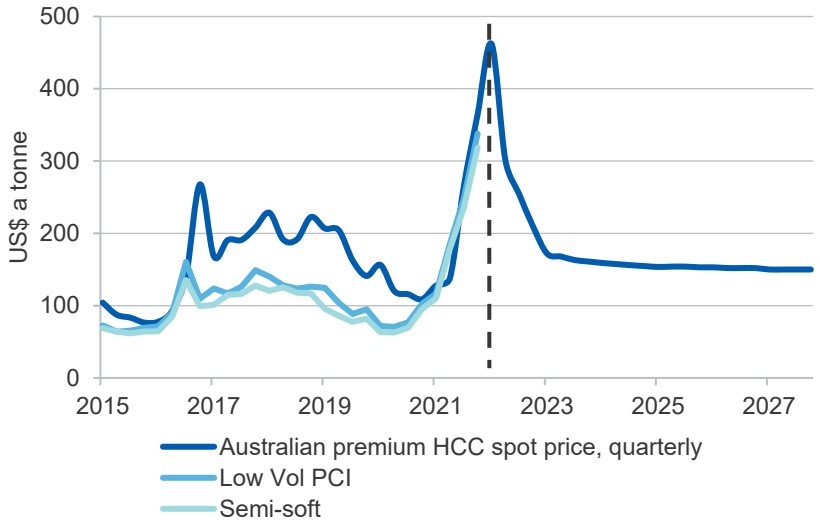
A series of weather disruptions affecting coal mines in Mongolia and China resulted in upward price movements in late 2021, with the largest effect following weeks of heavy rains in September and October. While weather disruptions in central Asia have now partly abated, prices had little time to correct before heavy rains and mudslides crippled various coal infrastructure in Canada. Subsequent to that, heavy rainfall linked to La Niña weather conditions disrupted Australian supply, with exports now subject to damaging weather events for four consecutive months.

Non-weather supply disruptions have also picked up early in 2022, with infrastructure bottlenecks constraining output in Russia, and COVID

impacts starting to affect output from Australia. On top of this, the Russian invasion of Ukraine sent prices to new records in March.

It is expected that disruptions will ease on some fronts over the remainder of 2022, allowing prices to start correcting. Over the outlook period, hard coking coal prices are expected to ease back from a war-affected peak of around US$460 a tonne in the March quarter 2022, to reach US$172 a tonne by the March quarter 2023. Prices are then expected to stabilise at around US$150 a tonne towards the end of the outlook period (Figure 5.6).

Figure 5.6: Australian metallurgical coal spot price, quarterly



Source: Platts (2022); Department of Industry, Science, Energy and Resources (2022)

Despite the downwards trend, risks remain weighted to prices remaining high for longer. Factors that could hold prices high include further developments in the war against Ukraine, changes in Chinese government policy, the ongoing La Niña weather event and associated weather disruptions (which often peak in Australia each March quarter), and new developments in the COVID-19 pandemic. Risks remain mostly on the supply side, with low inventories likely to exacerbate the impact of any further supply disruptions in 2022.

5.6 Australia

Metallurgical coal export earnings have risen despite supply issues

As previously noted, disruptions to Australian output have accounted for much of the recent lift in metallurgical coal prices. These disruptions included the ongoing La Niña event and recent floods in New South Wales and Queensland. Production has also been affected by the rapid growth of COVID-19 cases. This rise has led to unpredictable worker absences in mines across Queensland, though the recent decline in new COVID cases may help to contain further effects.

Metallurgical coal exports appear to be gradually recovering, with volumes lifting by 3% in December 2021. This left export volumes for 2021 broadly the same as in 2020, though the underlying supply chains have reorganised. India is now the top destination for Australian coal (accounting for almost a third of all exports in December), with significant growth also recorded in exports to South Korea, Brazil, Taiwan and Vietnam. These supply chains are expected to remain in place over the outlook period, leaving Australian suppliers with a more diverse market in the wake of informal import restrictions by the Chinese Government.

BHP has reduced its guidance for metallurgical coal output for 2022 (from 39-44 million tonnes to 38-41 million tonnes), as a result of 'significant La Niña related wet weather impacts during the December 2021 quarter coupled with COVID-19 related labour constraints'. These factors are expected to ease over the rest of the year, but are not expected to disappear entirely. Output from BHP is likely to be firmed by the successful completion of a complex longwall move at the company's Broadmeadow site. Maintenance at BHP's Caval Ridge plant was also successfully concluded in the December quarter 2021, clearing the way for stronger output at the site from 2022.

Production at South32's Dendrobium mine in 2022 is likely to fall temporarily, with the company noting that 'Illawarra Metallurgical Coal saleable production decreased by 23% (or 951kt) to 3.1Mt in H1 FY22 as we completed an extended longwall move at the Dendrobium mine in Q2 FY22. Metallurgical coal production declined 15% to 2.8Mt, while energy

coal declined by 55% to 0.4Mt. Other projects, including Appin, are also planning longwall moves, though overall production guidance remains relatively solid.

Glencore has announced that metallurgical coal production across Australia reached an estimated 9.1 million tonnes in 2021: around 20% higher than in 2020.

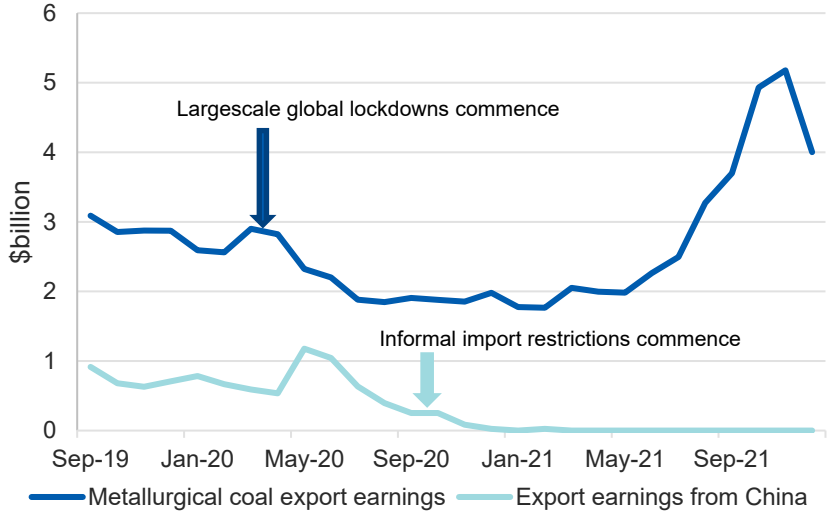
With COVID cases stabilising and producers adjusting to them, the primary risk to Australian production is now weather disruptions, with cyclones often peaking off the Queensland coast during March-April. Floods in New South Wales and Queensland are also leading to uncertainties over supply, though the Bowen Basin, where floods have been particularly significant, is primarily a producing region for thermal coal.

Over the longer term, renewed stimulus measures around the world are expected to offset some of the risk associated with potential further waves of the COVID-19 pandemic, though the timing of this remains unclear (see *Macro economy chapter*). Changes in consumption patterns (as countries seek to reduce carbon emissions) could have unpredictable effects on both supply and demand, with greater risks on the demand side.

On balance, Australian export earnings are expected to remain well above pre-COVID levels through much of the outlook period (Figures 5.8 and 5.9), despite some short-term constraints on volumes. Higher demand from India is expected to support Australian exports over the outlook period, though buyers in Japan, South Korea and Taiwan have also expressed interest in increased Australian supply.

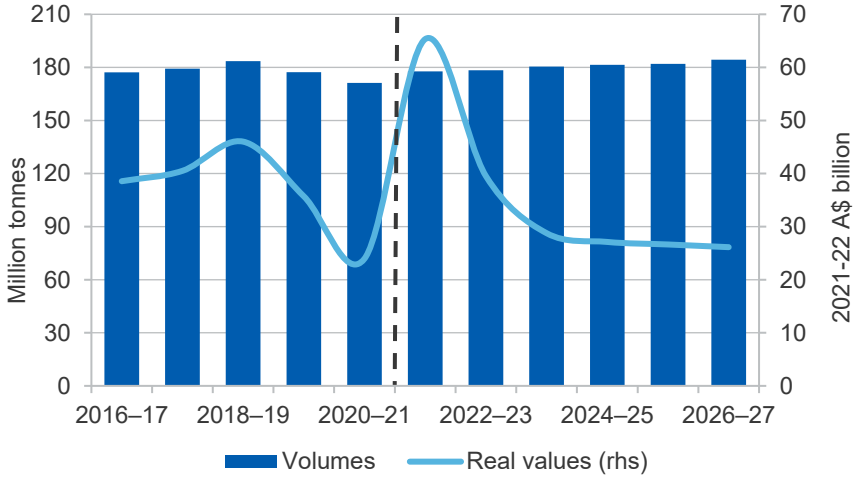
Metallurgical coal export earnings were $24 billion in 2020–21 (Figure 5.8). Prices are set to deliver a large windfall to metallurgical coal producers in 2021–22, with export values forecast to rise to over $60 billion, a new record level. A decline to a still-high $26 billion (in real terms) is expected by 2026–27, as seasonal and short-term supply issues pass and supply and demand come into balance.

Figure 5.7: Australia's metallurgical coal export values, monthly



Source: ABS (2022) International Trade, Australia 5454.0

Figure 5.8: Australia's metallurgical coal exports

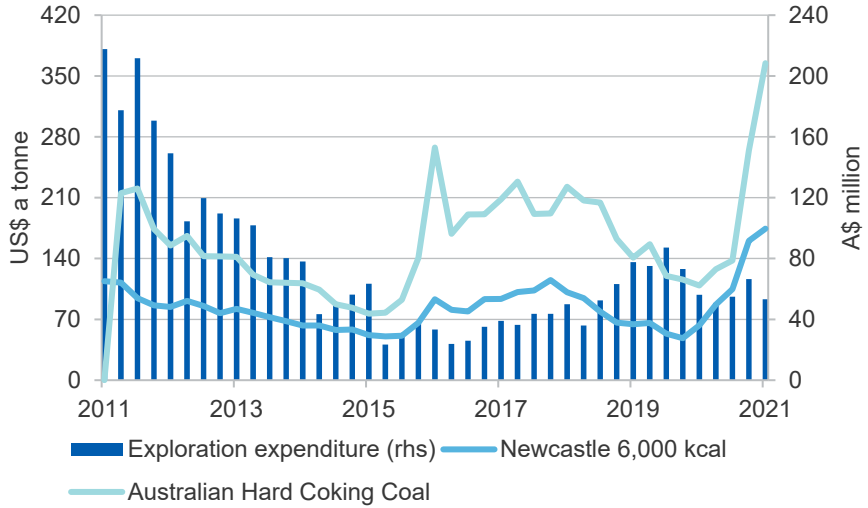


Source: ABS (2022) International Trade, Australia 5454.0; Department of Industry, Science, Energy and Resources (2022)

Coal exploration expenditure has declined

Australia's coal exploration expenditure decreased to $53 million in the December quarter, to be 9% off the level recorded in December 2020. Prices have risen markedly for Australian coal in recent months, but thermal coal in particular remains subject to significant policy and financial uncertainty. Price increases may improve rates of exploration over coming quarters, particularly for metallurgical coal (Figure 5.9).

Figure 5.9: Australian coal exploration expenditure and prices



Source: ABS (2022); IHS (2022); Platts (2022)

Revisions to the outlook for Australian metallurgical coal exports

The forecast for export earnings has been revised up by $10 billion (nominal terms) in 2021–22, but slightly reduced in 2022–23, reflecting the impact of unusually severe weather disruptions and the Russian invasion of Ukraine. The forecast for earnings in 2025–26 has been lowered by around $4 billion from the March 2021 *Resources and Energy Quarterly*. This reflects lower estimates for mine production in some areas, and a recent greater frequency of disruptive weather events, which have been factored in to the long-term forecast.

Table 5.1: World trade in metallurgical coal

	Unit	2021[s]	2022[f]	2023[z]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
World trade	Mt	323	321	330	331	334	338	343	1.0
Metallurgical coal imports									
China	Mt	53	49	47	48	48	49	49	-1.3
India	Mt	73	68	73	73	78	85	90	3.6
Japan	Mt	48	49	48	48	46	45	45	-1.1
European Union	Mt	35	35	34	34	33	32	32	-1.6
South Korea	Mt	37	38	39	40	37	36	36	-0.5
Metallurgical coal exports									
Australia	Mt	167	179	179	181	181	183	185	1.7
United States	Mt	40	41	41	39	40	41	42	0.8
Canada	Mt	29	29	29	26	26	26	26	-1.8
Russia	Mt	32	30	33	33	33	33	34	1.0
Mongolia	Mt	22	22	26	30	29	28	29	4.7
Mozambique	Mt	5	6	7	7	8	9	9	10.3

Notes: **f** Forecast; **s** Estimate; **z** Proection.

Source: IEA (2022) Coal Information; IHS (2022); Department of Industry, Science, Energy and Resources (2022)

Table 5.2: Metallurgical coal outlook

World	Unit	2021[s]	2022[f]	2023[z]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Contract prices[e]									
– nominal	US$/t	194	319	170	157	154	152	150	-4.2
– real[d]	US$/t	201	319	166	149	142	138	133	-6.7
Spot prices[g]									
– nominal	US$/t	224	307	166	157	154	152	150	-6.4
– real[d]	US$/t	231	307	162	149	142	138	133	-8.9
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[z]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production[s]	Mt	171	185	184	186	187	187	190	1.8
Export volume	Mt	171	171	178	180	181	182	184	1.2
– nominal value	A$m	23,187	65,330	40,757	30,457	29,436	29,641	29,804	4.3
– real value[i]	A$m	23,970	65,330	39,523	28,769	27,116	26,638	26,131	1.4

Notes: **d** In 2022 US dollars. **e** Contract price assessment for high-quality hard coking coal. **i** In 2021–22 Australian dollars. **f** Forecast. **z** Proection. **g** Hard coking coal fob Australia east coast ports. **s** Estimate.

Source: ABS (2022) International Trade in Goods and Services, Australia, 5368.0; Department of Industry, Innovation and Science (2022); Platts (2022)

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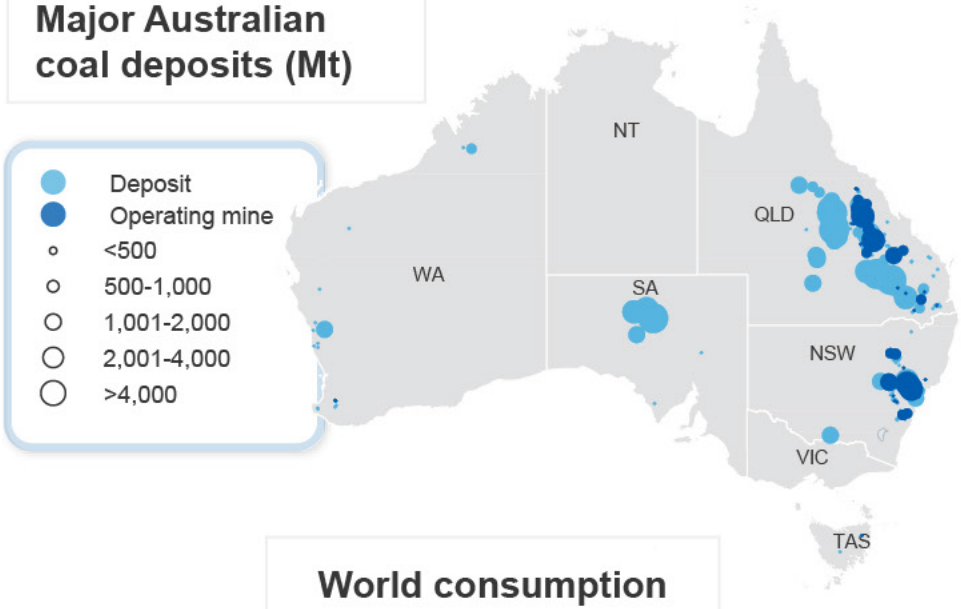
Thermal coal

Major Australian coal deposits (Mt)



Thermal coal

- Thermal coal is primarily used in **electricity generation**
- Coal supplies **over one-third** of global electricity generation
- Mines are open cut or underground depending on the **geology of the deposit**
- **Coal formation** began 290-360 million years ago

World consumption

55% China

14% India

8% United States

3% South Africa

3% Indonesia

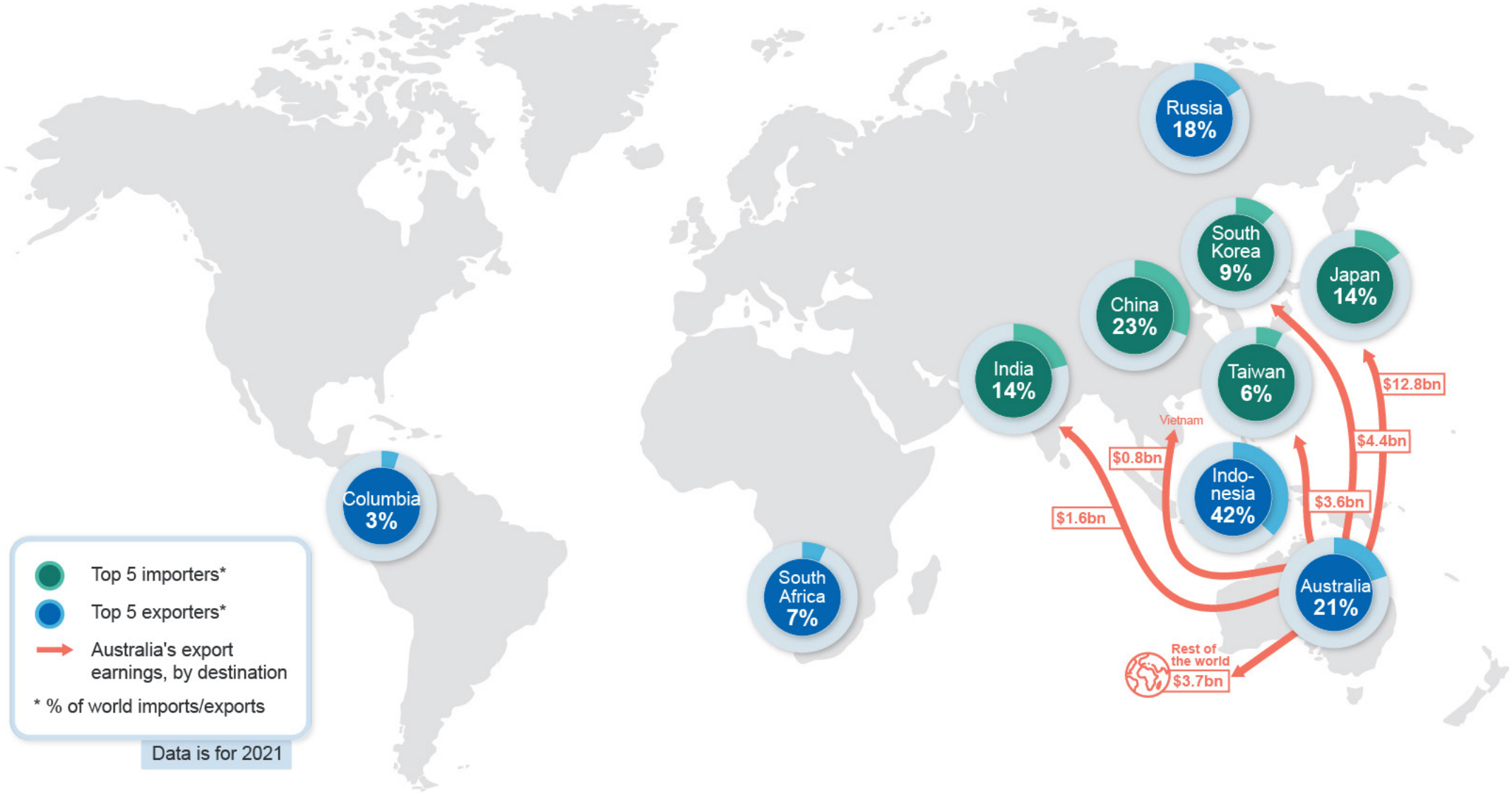
2% Japan

Australia's thermal coal

- **World's 2nd** largest **thermal coal** exporter
- **World's 4th** **largest black coal** resources
- **75-80%** of thermal coal **is exported**

Thermal coal

Trade map | March 2022



6.1 Summary

- Global thermal coal spot prices have spiked, as increasing Chinese demand coincides with weather disruptions, supply impacts from COVID-19 outages, and the fallout from the Russian invasion of Ukraine. As more normal conditions return, the Newcastle benchmark price is forecast to ease from a peak of US$184 a tonne in 2022 to around US$60 a tonne by 2027 (in real terms).
- Australian thermal coal exports declined from 213 million tonnes in 2019–20 to 192 million tonnes in 2020–21, but are expected to recover back to a 204–207 million tonne range over the forecast period.
- Surging prices are expected to push export values to a peak of $45 billion in 2021–22, with a gradual (price-driven) easing to a more typical level of around $15 billion (in real terms) by 2026–27.

6.2 World trade

Thermal coal markets are undergoing a complex transition. Prices have surged in recent months as demand outpaced supply, which remains disrupted among a range of major exporters. The long-term shift in demand sources away from OECD nations and towards Asia is accelerating, forcing markets to adjust. The global drive towards low-carbon energy sources and a sharp decline in the coal plant construction pipeline has changed incentives for investors and miners, deterring long term investment in coal despite the recent surge in prices.

The shift in coal demand away from OECD countries has gathered pace on a range on fronts. In the US, coal generation is declining at an accelerating rate amidst growing domestic competition from gas generation. Coal generation (currently around 210 GW) is expected to fall by more than 70GW over the outlook period, and by more than 130 GW by the early 2030s. More than 65 GW of coal plant retirements have already been announced.

Thermal coal imports to European nations are expected to decline particularly rapidly in the second half of the outlook period as coal plant retirements gather pace. Emissions levies and other government policies have accelerated a pre-existing decline in coal use, leading numerous coal plants to close ahead of schedule.

Imports to Austria, Belgium and Sweden have fallen to virtually zero following the recent closure of the last power stations in each country. Denmark, Finland, Italy and Spain are expected to reduce imports to zero by the late 2020s, while the UK is on track to close its last coal power station in 2024. Germany closed 6GW of coal power in 2021, and current policy is likely to drive closure of another 2.5GW of coal power in the first half of the outlook period, with more to follow as the Government seeks to close all coal power by 2038.

In the short-term however, the Russian invasion of Ukraine is expected to delay some coal plant closures. Germany has closed nearly all of its domestic nuclear generation, making up the loss with imported Russian gas. The need to secure its energy supply is expected to lead to scheduled coal plant closures being delayed, and could even lead to some closed plants being temporarily re-opened.

However, broader conditions across the OECD remain difficult for coal, and these conditions are increasingly being mirrored among proximate countries subject to similar finance and investment pressures. In Egypt, construction of the massive (6.6 GW) Hamrawein coal plant has been placed on permanent hiatus, with coal imports now largely driven by the cement sector, which is seeking alternative power sources. In Israel, four of the six units of the Orot Rabin coal plant are scheduled to shut down in 2022, with the remaining two units expected to be substituted by gas generation from 2025. The Rutenberg coal plant is also on track to be replaced by gas generation from 2025. Coal imports to Israel are expected to fall to virtually zero by the end of the outlook period.

Turkey may prove to be an exception, with coal import demand likely to rise following completion of the Hunutlu coal plant in 2022. However, finance and investor pressure has resulted in delay and the potential cancellation of other potential coal plants, though the Turkish government has no official policy to phase out coal generation in the country. Coal imports to Turkey are expected to peak just beyond the outlook period.

Imports to Asia are expected to offset much of the decline elsewhere over the outlook period. The year 2030 looks to be a significant turning point, representing a coal power phase-out date for many OECD countries, but a peak demand date for a number of nations across Asia. The underpinning transition of energy sources across much of the world could lead to significant volatility in coal trade and coal prices in the interim.

High coal prices have not thus far prompted significant supply-side investment. The lack of investment in supply will make it harder for coal prices to correct, which may in turn reduce the competitiveness of coal and accelerate its structural decline. However, high coal prices should provide strong profits to existing coal producers and exporters, in turn benefiting regions which rely on them.

In volume terms, seaborne imports are estimated to have increased by 3% in 2021, with COVID-19 disruptions peaking late in the year. Thermal coal demand is expected to edge lower over the outlook period, with supply expected to largely track with demand after 2022 (Figure 6.1).

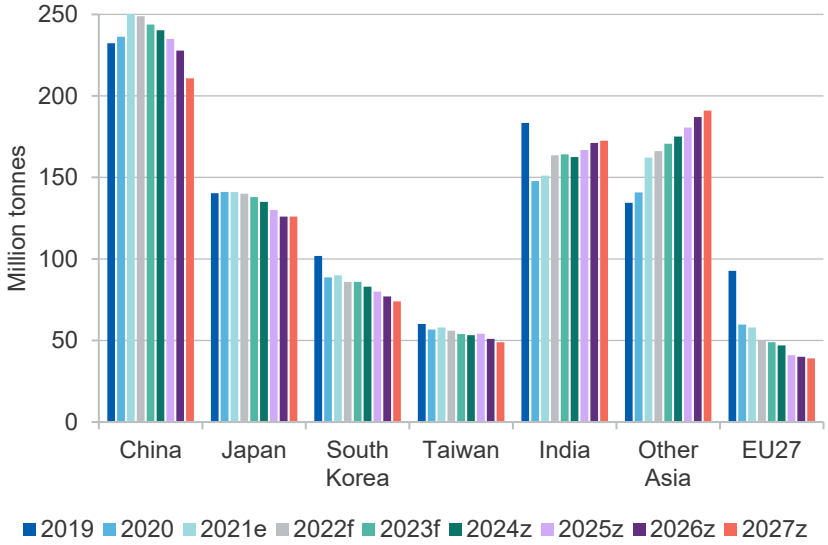
6.3 World imports

China's import price premium remains high as import restrictions persist

China's dominant share of global coal demand is expected to grow further over the coming years, with other South-East Asian countries cancelling a significant quantity of planned coal plant constructions at the COP26 conference. Subsequent agreements over the outlook period may lead to further reductions, though these would increasingly involve early closures of existing plants rather than cancellation of new ones.

Coal use in China is likely to remain strong, with the Government recently removing energy intensity goals from its energy targets. However, China also continues to seek ways to reduce its dependency on coal imports. This could come about through rising domestic production (China maintains a stronger investment climate for coal than many countries, and recorded solid growth in domestic output in January and February 2022). Recent measures also include expansion of 'coal by wire' proposals, which seek to convert a greater share of coal into electricity at mine sites, enabling more efficient transmission through power grids. 'Blue skies' policies and commitments to attain net zero emissions by 2060 are also likely to drive more diversity into electricity markets, with efforts underway to substitute previously proposed coal expansions for nuclear- and LNG-fired power.

Figure 6.1: Thermal coal imports



Note: **f** Forecast; **z** Projection

Source: IHS (2022); IEA (2022) Coal Market Report; Department of Industry, Science, Energy and Resources (2022)

Some Chinese provinces have made additional commitments towards net zero targets. Hong Kong is converting its Lamma and Castle Peak coal plants to gas-fired plants, and may complete this process during (or shortly after) the outlook period. Coal imports to Hong Kong are expected to fall during the outlook period, ceasing entirely by the mid-2030s.

As 2021 turned, the Chinese Government permitted some Australian coal previously held in storage to enter its domestic supply chains. However, no cessation of present informal import restrictions is assumed during the

outlook period. With strong pressure now being applied to increase domestic coal output, Chinese imports are expected to decline from around 260 million tonnes in 2021 to 211 million tonnes by 2027. The Chinese Government remains committed to an emissions peak before 2030.

India's coal imports are expected to grow each year of the outlook period

Indian coal demand is expected to rise steadily over the outlook. However, the likely rate of growth has been revised down, with some coal plant proposals being recently shelved. Imports have picked up in recent months (Figure 6.2), and are expected to grow further over the outlook period — but at a lower rate than previously forecast.

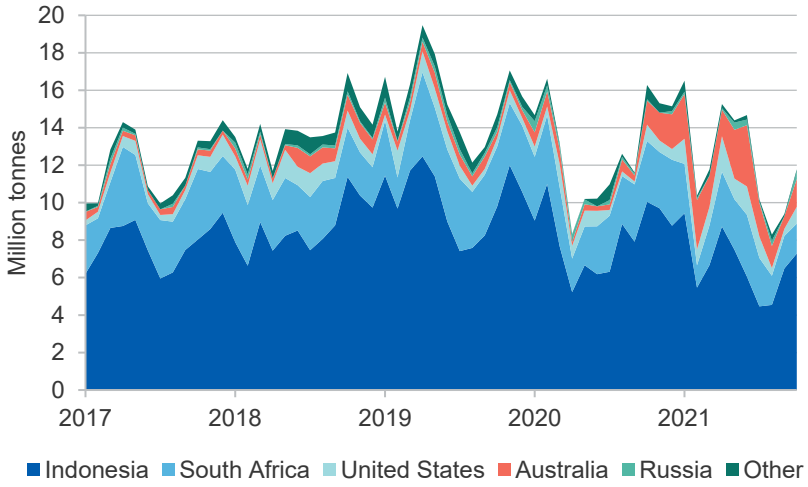
Part of the expected slowdown in import growth is a result of significant efforts by the Indian Government to expand domestic coal production. The Indian Government ran a series of auctions for coal blocks in 2021, with more than half of the 38 blocks being sold by the end of the year. Should work at the sites proceed on schedule, it is likely that new mines would begin to enter the domestic market from the mid-2020s.

Imports to India are projected to grow by around 20 million tonnes to 173 million tonnes by 2027, with growth slowing by the end of the outlook.

Japan's imports are expected to hold up for the next five years

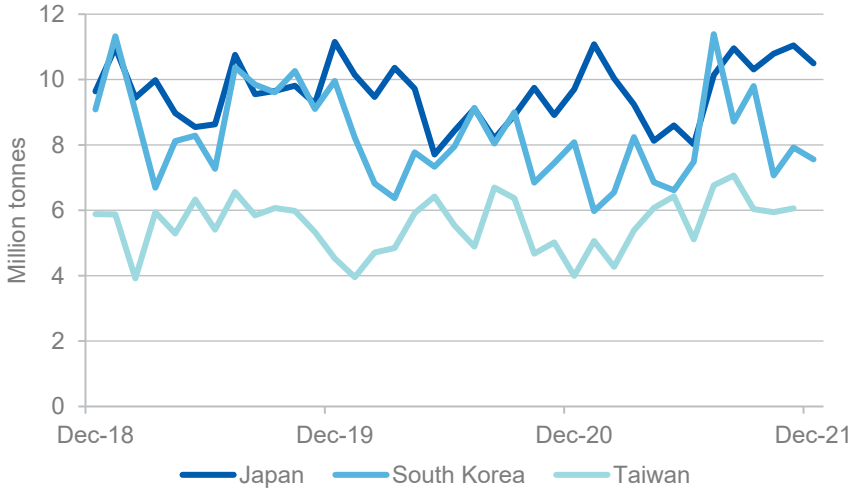
The Japanese government has committed to net zero emissions by 2050. This commitment is likely to lead to modest pressure on coal imports towards the end of the outlook period, though the country retains 14 coal plants under development. Japan has committed US$70 billion over the next five years to assist regional countries accelerate their commitments to 'net zero', but this is not expected to affect its own import growth over the outlook period. Japan is also attempting to expand carbon capture and storage technology, which may enable a longer use of coal power consistent with net zero commitments.

Figure 6.2: India's thermal coal imports, monthly



Source: IHS (2022)

Figure 6.3: Japan, South Korea and Taiwan's thermal coal imports



Source: IHS (2022)

Japanese coal imports have levelled out in recent quarters (Figure 6.3) and are expected to ease slightly through the outlook period, with planned closures and new coal-fired power plant constructions largely offsetting each other. The slight shift down is expected to accelerate gradually over time as low-carbon energy generation picks up.

Reconnection of further nuclear plants represents a significant variable in the coal import outlook; the pace of connections remained relatively slow over 2021 due to additional safety requirements and political opposition. A continuation of this trend may help to support coal use through most, or all, of the outlook period.

South Korean coal imports will face growing pressure

In October 2021, the South Korean Government released a draft plan to reduce coal fired generation from around 42% of electricity generation (in 2018) to 22% (by 2030) and zero (by 2050). This builds on the existing Basic Energy Plan, which seeks to shut about half of the nation's 60 coal fired plants by 2034. Around half of this reduction in capacity is expected to be offset by new coal plants already under development. However, the greater efficiency of these plants should reduce import requirements over the course of the outlook period, with the scale of reduction picking up in the late 2020s.

Pressure may also come from South Korean gas plants. These plants have faced difficulty in recent years, due to being locked in to long-term high priced contracts for gas supply. By the second half of the outlook period, it is likely that these contracts will begin to reset, intensifying price competition with coal. Nuclear energy is not expected to expand its capacity significantly over the outlook period. However, the conclusion of scheduled maintenance at several nuclear plants in 2022 and 2023 may reduce some pressure on coal imports, as nuclear power is highly price competitive in South Korea.

Taiwan's imports are expected to start declining slowly

Taiwan has announced that it will cancel all coal plant construction, and reduce the coal share of its power generation from around 45% to 30% by 2025. The Taiwanese Government has also abandoned previous plans to upgrade its coal fleet — much of which was built 30-40 years ago — and to convert coal plants to use gas.

While Taiwan was excluded from participation in the COP26 summit, it has announced a recent Climate Change Response Act, which commits to carbon neutrality by 2050. Given the age of Taiwan's coal fleet, it is expected that coal imports will start to decline modestly during the outlook period, ahead of other countries in the region. However, this may be complicated by plans to downscale nuclear generation in Taiwan, which will add to the scale and difficulty of the energy transition required.

South East and South Asia imports are set to grow

Nations in South East and South Asia (excluding India) collectively import about 150 million tonnes of thermal coal each year. This sum is expected to rise over the next five years (Figure 6.4), with recent cuts in planned coal-fired power generation capacity not expected to have a measurable impact until the second half of the outlook period.

Malaysia has large and modern coal-fired power plants, which have managed to out compete gas-fired generation. These plants consolidated their advantage during the COVID-19 pandemic, as gas production was forced to cut back. Coal imports are expected to hold up and even grow slightly over the outlook period, peaking around 2030.

The Philippines is expected to require more coal over the outlook period, with significant coal fired capacity still under construction. Steady import growth is expected in every year of the outlook period. Around 10 coal plants face early closure risks, but the country retains a significant pipeline of coal constructions, and coal consumption is expected to peak (at double its current level) around 2030.

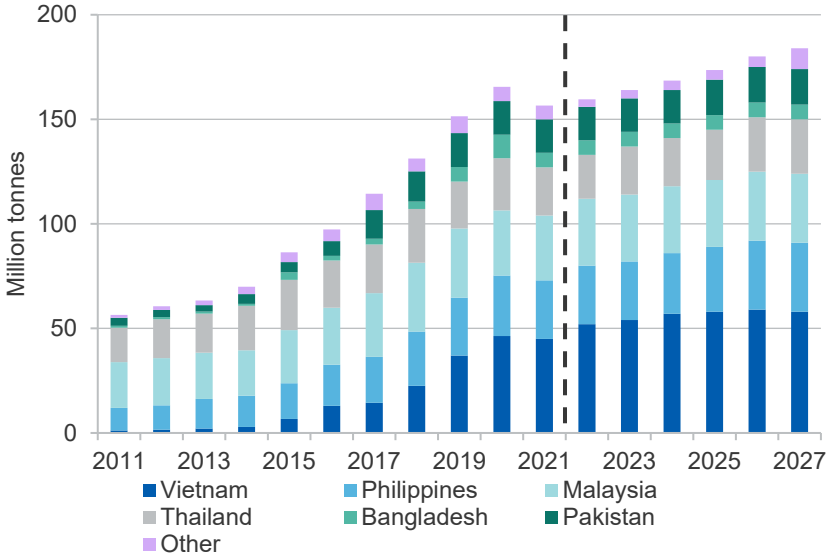
Coal imports to Thailand are rising in line with growing demand from the country's industrial sector, which has been led by rapid expansion in cement production. However, coal plant construction has largely come to a halt, with proposed plants cancelled in the Krabi and South Songkhla provinces. Coal power phase-outs are expected to start reducing imports

of coal by the end of the outlook period, with Thailand's latest Power Development Plan aiming to bring coal's share of power generation down by half (to 10%) by 2030.

Bangladesh has scaled back its coal plant proposals, with coal plant constructions pared down to 5 over the next 5 years. Like other countries in the region, Bangladesh is likely to see coal use peak close to 2030, with imports growing in the interim, albeit from a modest base.

The Pakistani Government has announced that no further coal plants will be developed, but how this declaration will apply to coal plants already approved (with some already construction) is not yet clear. Most coal plants under construction are expected to utilise domestic reserves, with only one proposed coal plant mooted to draw heavily on imports. Pakistani imports may, however, be supported by rising industrial activity.

Figure 6.4: South and South East Asia thermal coal imports



Source: IEA (2022) Coal Information; Department of Industry, Science, Energy and Resources (2022); IHS (2022)

Vietnam has scaled up coal imports over the last 10 years, as power demand lifts across the country. This demand has generally been met through imports from Indonesia, as Vietnamese deposits are mostly located under areas with dense population or intense rural activity, making access difficult.

Vietnam has introduced a range of environmental targets aimed at reducing carbon emissions, with the country targeting more deployment of renewable power firmed by gas. Coal plant constructions are expected to continue, though at a slower pace in the second half of the outlook period. Some coal plant constructions have fallen behind schedule due to constraints on global coal financing. However, power shortages are expected to add pressure, ensuring that the constructions continue. More than 7 GW of coal plants are expected to be built over the outlook period. Coal import growth is expected to continue, with some slowing from the mid-2020s and a peak around 2030.

6.4 World exports

Global supply chains have reorganised in the wake of Chinese informal import restrictions, with Australian product being fully redirected to other markets including India, Japan, South Korea, and Taiwan.

Indonesia, Russia and Australia remain dominant in global coal exports, with the former two nations being increasingly drawn to the Chinese market, filling the gap left by Australian supply.

Indonesia's exports are rising despite temporary disruptions

The Indonesian government temporarily banned coal exports in January 2022. This was done in response to supply shortages at domestic power plants, which had raised fears of possible blackouts. The decision coincided with rapid price rises, but the subsequent cessation of the ban has seen little correction. It thus appears that the overall market dynamic (of inadequate and disrupted global supply) remains largely unaltered by decisions in Indonesia. However, recent efforts by the Indonesian Government to contain exports could represent an ongoing upside risk to prices, as the country continues to require more coal for domestic use.

The rise in domestic coal use in Indonesia over time is likely to be significant. The country retains a large pipeline of proposed coal plants which, if fully constructed, would almost double domestic coal use from the current annual level of around 130 million metric tonnes.

Despite this, Indonesia has significant capacity to increase its exports. The country has large (albeit low quality) untapped deposits in the Kalimantan and Sumatra regions. Most of these deposits are easily accessible and close to infrastructure and ports. Commitments from the Indonesian Government at COP26 (which include scrapping future coal plant construction and potentially closing 5.5GW of existing coal plants) could also provide more space for exports. Exports picked up solidly in 2021, and are expected to hold steady over the rest of the outlook period, with production growth being diverted to meet rising domestic needs.

Russia's exports face an uncertain time following the invasion of Ukraine

Russian coal faces an uncertain outlook despite some recent recovery from weather disruptions and accidents in 2021. Russian coal is of high quality, but the placement of reserves in Southern Siberia makes it complex and costly to extract and ship. While Russian port capacity has expanded in recent years (from 36 million tonnes to 50 million tonnes annually), further growth in capacity is likely to be stymied by the invasion of Ukraine and the consequent sanctions, which have cut Russia off from imported equipment and reduced its purchasing power.

Demand-side impacts of the Russian invasion of Ukraine remain unclear. Some Russian rail shipments have been diverted to Poland, potentially delaying their transit or pushing them into the seaborne market. But overall trade is likely to continue given Russia's importance (supplying around 60 per cent of Europe's thermal coal imports). Coal has not yet been explicitly sanctioned, but the closure of ports to Russian vessels and a series of financial restrictions may affect shipment and trading indirectly. An expansion of sanctions from Europe could drive Russian coal to the Chinese market, likely with a price penalty. In the longer term, the high quality of Russian coal should provide a competitive advantage even as the global coal market shrinks from the mid-2020s.

Colombian exports are not expected to recover fully

Colombian exporters face particular difficulty in an environment of falling use among OECD nations, which has primarily affected the Atlantic market. Columbian producers have sought to expand into the Asian market in response, but falls in the closer Atlantic market are not expected to be fully substituted.

Significant mines, including La Jagua and Calenturitas, have been taken offline following falls in regional demand, and are not expected to return to full operation in the foreseeable future. The country's large Cerrejón and Drummond mines remain in operation, but the former continues to face disruptions — most recently to its export route — as a result of protests from indigenous communities and mine workers.

Exports fell sharply in 2020 (from 70 million tonnes to 29 million tonnes), and recovery is likely to prove difficult. A loss of traditional markets, and permanent closure of some mine sites, will likely prevent Columbian exports from ever returning to their pre-pandemic levels.

US exports have picked up, but long-term cost challenges remain

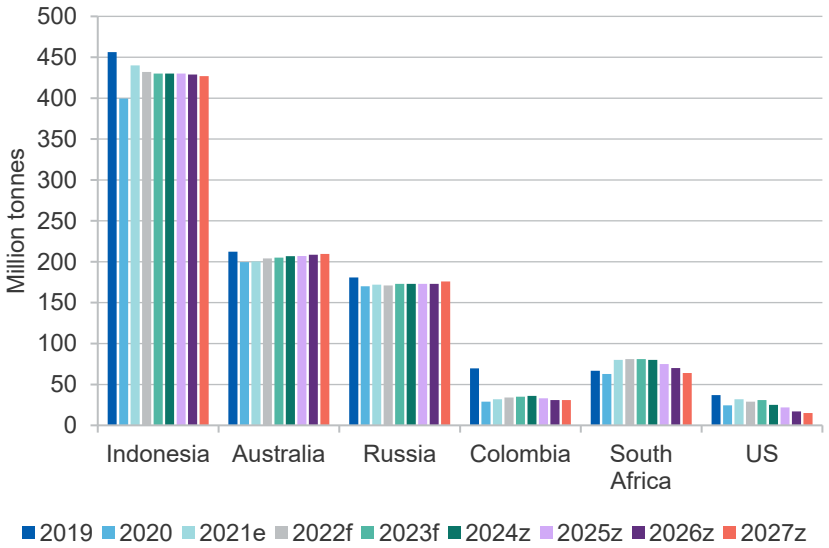
US coal exports face competitiveness issues due to long transportation distances (notably between Montana and export terminals in Vancouver, which requires rail shipment across the Canadian border). US coal also tends to be high in sulphur, requiring potential buyers to blend it or use it for industrial purposes. The Atlantic market, which is the main destination for most US coal, has faced steep demand falls in recent years.

Despite these challenges, strong rises in coal prices have improved the prospects for US coal producers, leading to some recent growth in output. Domestic demand and exports both rose following the recent surge in gas prices, and higher export volumes are expected to mostly hold up over the first half of the outlook period, with some easing in the second half.

In the longer term, the high-cost and marginal status of many US mines will likely oblige some producers to withdraw from the market as prices become weaker. Given the broader global trends, it is likely that mines

pushed out of the export market will close for good rather than remain in suspension. Falling domestic demand may also trigger further bankruptcies in the US coal sector, which has already faced significant closures and market exits over the past five years.

Figure 6.5: Thermal coal exports



Notes: **e** estimate **f** Forecast **z** Projection.

Source: IHS (2022); IEA (2022) Coal Information; ABS (2022); Department of Industry, Science, Energy and Resources (2022)

Conditions are likely to be slightly stronger for some smaller thermal coal exporting countries. South African exports, which are generally of high quality, are expected to hold up at current levels until after 2025. Exports from Canada are expected to lift from about 4 million tonnes annually to 6 million tonnes from the middle of the outlook period, supported by a ramp-up of output at the Vista mine, which began production in 2019. Longer term, Canadian exports are likely to decline in line with the Government's COP-26 pledge to ban thermal coal exports by 2030.

6.5 Prices

Prices are expected to stay volatile and high

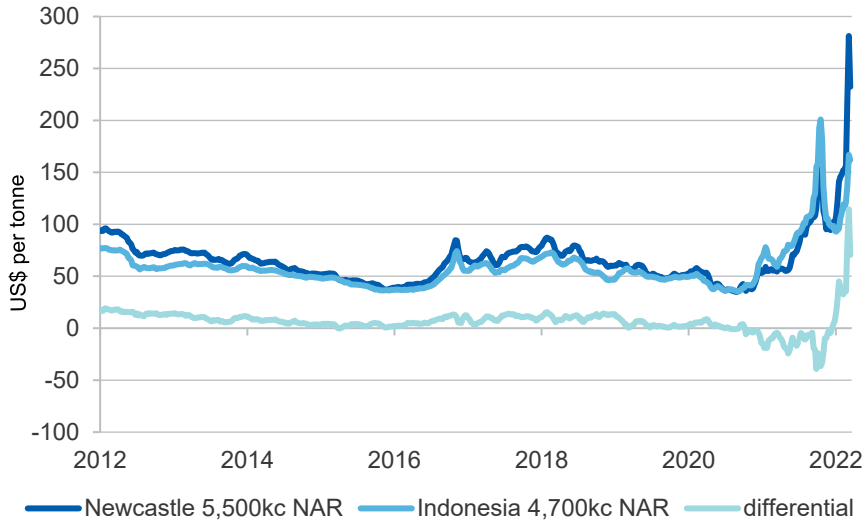
Thermal coal prices surged in January 2022, lifting by almost a third from (already high) December levels. Prices have been consistently elevated in recent months as rising demand ran up against successive disruptions to seaborne supply (Figure 6.6). These disruptions included labour shortages and slow loading at ports as a result of the COVID-19 pandemic. Difficult weather conditions (including intense wet weather in north-eastern Australia) have affected Australian supply in particular. Chinese informal import restrictions against Australia have added to the length and complexity of coal freight, adding especially to Chinese domestic prices.

A temporary export freeze by the Indonesian government, imposed in January 2022, provided a temporary lift to prices. However, the Russian invasion of Ukraine has had a more serious impact, and is expected to see thermal coal prices for Newcastle 6,000kcal product surge to US$247 a tonne in the March quarter 2022.

As conditions gradually return to normal, prices are forecast at US$128 a tonne in the March quarter 2023, ultimately easing to US$60 by the end of the outlook period (in real terms). However, prices are likely to experience significant fluctuations along the way.

Price risks remain in both directions, but with a weighting to the upside. Short-term risks include further weather disruptions and a potential severing of coal shipments from Russia to Europe. Longer term risks include further potential outbreaks and new mutations of the COVID-19 pandemic, as well as uncertainties over the direction of Chinese government policy and its impact on global coal markets. Commitments by most nations to cut coal-fired power generation over time are likely to affect thermal coal prices in unpredictable ways over the projection period and beyond, with the potential impacts of global energy transition growing through the outlook period.

Figure 6.6: Thermal coal prices — Australian vs Indonesian



Source: IHS (2022). NAR = Net as received.

6.6 Australia

Australian thermal coal exporters face volatile conditions in 2022

Australian coal producers have faced increased uncertainty since the outbreak of the COVID-19 pandemic, and this is expected to persist. However, the recent surge in coal prices (Figure 6.7) has provided important benefits to coal producers, adding to revenue at the start of a potentially unstable 2022.

Rapid export redirection and surging prices swiftly offset the impact of China's informal import restrictions. Ultimately, restrictions have led to a more diverse coal export market and some insulation for Australian producers against further changes in Chinese Government policy.

Australian thermal coal exports finished 2021 on a relatively strong note, with volumes up by around 5% in December, and above 17 million tonnes. Values were over $3 billion in the month. Volumes over 2021 were virtually unchanged from 2020, but earnings surged in line with growth in prices.

Volumes in 2022 face a more complex picture as floods have disrupted mines in New South Wales and Queensland, and led to a declaration of force majeure at the Port Kembla Coal Terminal. The current La Niña is likely past its peak, but could still foster unpredictable weather events over the first half of 2022.

Construction of a new $60 million ship loader at the RG Tanna coal terminal in Queensland should provide some support to volumes over the longer term. The construction comes as part of a general upgrade of the port. Design activity linked to the new loader is set to begin in March 2022, with completion expected by mid-2024.

Coal provided to the Eraring power station has potential to be redirected to export markets upon its announced closure in 2025, though coal used in the station is typically of lower grade than most exported coal. The power station draws supply from the Hunter Valley Coal Chain, where mines have ready access to export infrastructure.

Market uncertainties still persist, however, with proposed coal projects facing longer and more costly legal challenges over recent years. These legal challenges have been particularly significant in the Hunter Valley region, where attempts to mark out land for coal mining have been met with counter-claims from the region's agriculture and tourism industries.

Faced with global and local pressures, some proposed thermal coal projects have been withdrawn or abandoned. These include mines at Bylong Valley, and New Acland, which continues to face legal challenges. The owners of New Acland have now closed the site and reduced its workforce to around twenty in response to the depletion of accessible resources. Shenhua's Watermark project has also been cancelled, with the NSW Government compensating the company $100 million in exchange for forfeiting development rights at the site.

Partly offsetting this will be the ramp-up in output from Bravus' newly opened Carmichael mine in Queensland, where all approvals have been granted and expansions in output are proceeding.

Australian Pacific Coal's Dartbrook mine, which holds around 370 million tonnes of marketable reserves, has also been granted a five-year operating extension after years of legal disputes. The decision reverses a halt imposed by the NSW Independent Planning Commission in 2019.

Although global thermal coal conditions are likely to grow tougher towards the end of the outlook period, Australian coal retains key advantages over rival coal exporters. Australia retains many of the highest quality thermal coal reserves in the world, and an average export quality well above most competitors. Australian coal producers have geographic proximity to the Asian markets which account for virtually all future growth in coal demand. Coal miners in Australia also have strong infrastructure and high safety standards which make them a lower risk for global buyers.

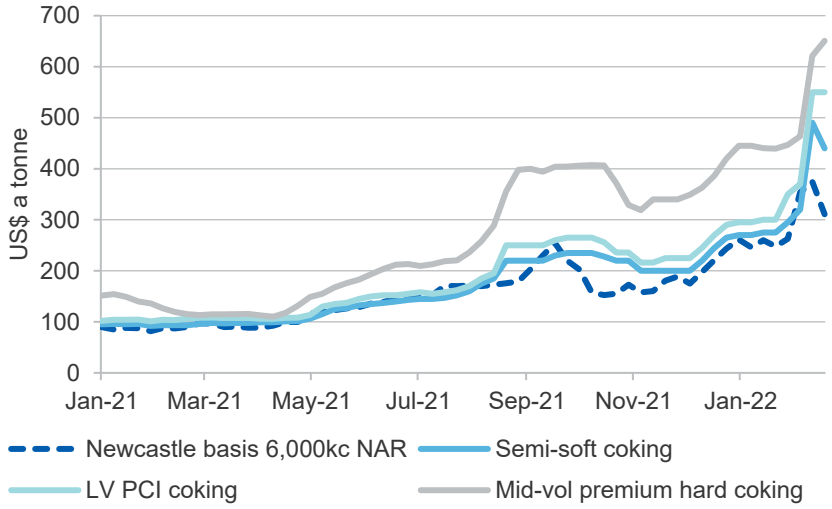
It is expected that reductions and expansions of mine output will remain broadly in balance over the outlook period, keeping export volumes mostly steady (Figure 6.8). However, prices will likely remain subject to significant volatility, with huge growth apparent following the Russian invasion of Ukraine. This is expected to see export values rise from $16 billion in 2020–21 to over $40 billion in 2021–22, before an easing to $36 billion in 2022–23 (in real terms). As market conditions return to balance and prices shift back towards historical averages, export revenue is expected to ease further, to around US$15 billion by 2026–27. However, potential price surges remain a prospect and could add significantly to export earnings at various points in time.

Volatility in prices and uncertainties around global coal markets are expected to persist through the outlook and beyond, but Australia's natural advantages should provide a measure of stability to coal producers.

Revisions to the outlook for Australian thermal coal exports

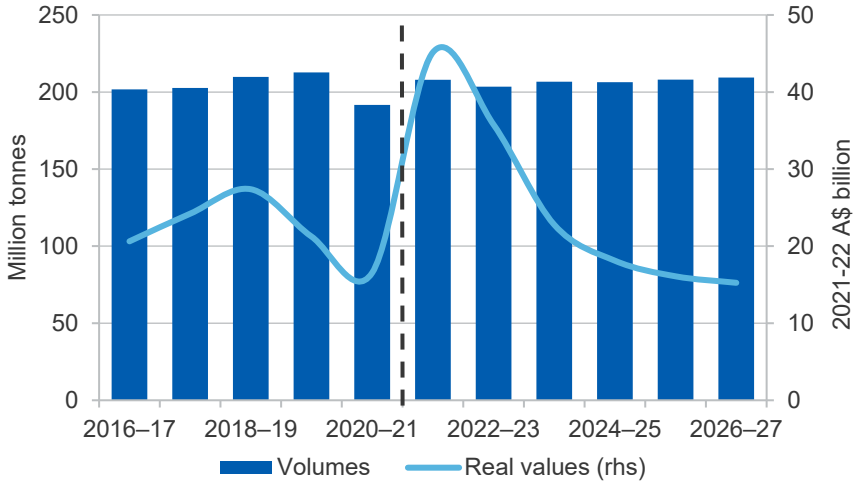
The forecast for export earnings has been revised up by $9 billion (nominal terms) in 2021–22 and 2022–23, reflecting the impact of unusually severe weather disruptions and the Russian invasion of Ukraine. The forecast for earnings in 2025–26 remains largely unaltered from that of the March 2021 *Resources and Energy Quarterly*.

Figure 6.7: Prices for thermal and low-grade coking coals



Source: IHS Markit (2022)

Figure 6.8: Australia's thermal coal exports



Source: ABS (2022); Department of Industry, Science, Energy and Resources (2022)

Table 6.1: World trade in thermal coal

	Unit	2021[s]	2022[f]	2023[z]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
World trade	Mt	1,059	1,024	1,018	1,015	1,012	1,003	990	-1.1
Thermal coal imports									
Asia	Mt	865	861	857	849	847	840	823	-0.8
China	Mt	262	249	244	240	235	228	211	-3.6
India	Mt	151	164	164	163	167	171	173	2.2
Japan	Mt	141	140	138	135	130	126	126	-1.9
South Korea	Mt	90	86	86	83	80	77	74	-3.2
Thermal coal exports									
Indonesia	Mt	440	432	430	430	430	429	427	-0.5
Australia	Mt	199	204	205	207	207	209	209	0.9
Russia	Mt	172	171	173	173	173	173	176	0.4
Colombia	Mt	32	34	35	36	33	31	31	-0.5
South Africa	Mt	80	81	81	80	75	70	64	-3.7
United States	Mt	32	29	31	25	22	17	15	-11.9

Notes: **s** Estimate **z** Forecast **r** Projection

Source: International Energy Agency (2022); IHS Markit (2022); Department of Industry, Science, Energy and Resources (2022)

Table 6.2: Thermal coal outlook

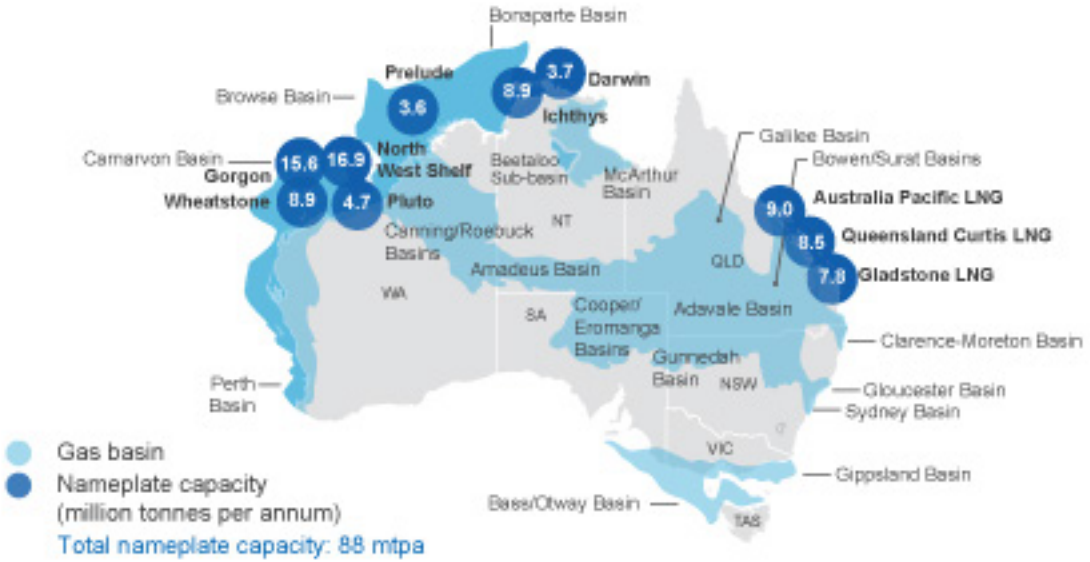
World	Unit	2021[s]	2022[f]	2023[z]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Contract prices[b]									
– nominal	US$/t	110	145	104	91	82	77	75	-6.1
– real[c]	US$/t	114	145	102	86	76	70	67	-8.5
Spot prices[d]									
– nominal	US$/t	132	184	109	86	76	72	70	-10.1
– real[e]	US$/t	136	184	106	81	70	65	61	-12.4
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[z]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production	Mt	228	256	256	257	257	254	256	1.9
Export volume	Mt	192	206	204	207	206	208	209	1.5
– nominal value	A$m	16,009	45,143	36,891	24,122	19,663	17,897	17,387	1.4
– real value[h]	A$m	16,550	45,143	35,774	22,784	18,113	16,084	15,244	-1.4

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 6000 kcal net as received; **e** In 2022 US dollars; **f** Forecast; **h** In 2021–22 Australian dollars; **s** estimate

Source: ABS (2022) International Trade in Goods and Services, Australia, Cat. No. 5368.0; IHS (2022); NSW Coal Services (2022); Queensland Department of Natural Resources and Mines (2022); Company Reports; Department of Industry, Science, Energy and Resources (2022)

Gas

Australia's LNG projects and gas basins



Gas facts

- LNG is produced by **cooling natural gas to -161°C**
- **LNG shrinks** to 1/600th the volume of natural gas
- **LNG accounted for 12%** of global gas demand in 2020
- **Over 70%** of global LNG demand came from Asia in 2021

Global gas use by sector

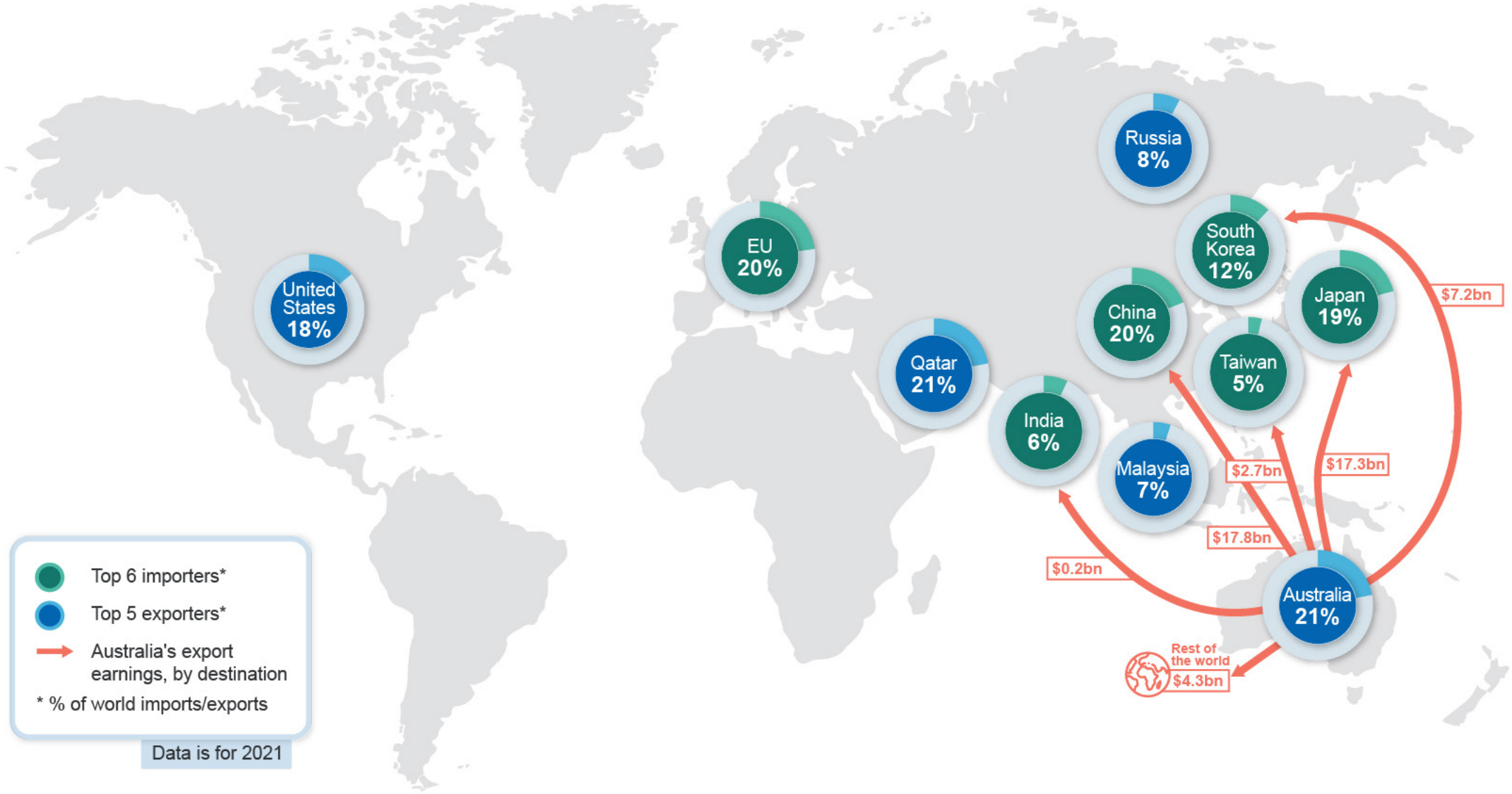
- **20%** Industry
- **19%** Transport
- **22%** Residential
- **40%** Electricity

Australia's LNG

- **81m tonnes** exported in 2021, valued at **$50bn**
- Total LNG nameplate capacity is **88m tonnes** per annum
- Around **3/4** sold on **long-term contracts**

LNG

Trade map | March 2022



7.1 Summary

- Asian LNG spot prices and oil-linked contract prices are expected to remain high throughout 2022 and 2023, before declining back to more typical levels in the latter half of the outlook.
- Australian export volumes are forecast to increase to 82 million tonnes in 2021–22, as technical issues offset higher capacity utilisation at other plants. Volumes should then fluctuate between 79 and 81 million tonnes over the outlook.
- Australia's LNG exports earnings are forecast to rise from $30 billion in 2020–21 to $70 billion in 2021–22, and $82 billion in 2022–23 as oil-price linked contract prices surge. Export earnings are forecast return to around $52 billion by the end of the outlook period.
- Analysis in this chapter is based on a base case scenario of the impacts of Russia's invasion of Ukraine. For more information, please see Box 8.1 for a scenario-based analysis.

7.2 World trade

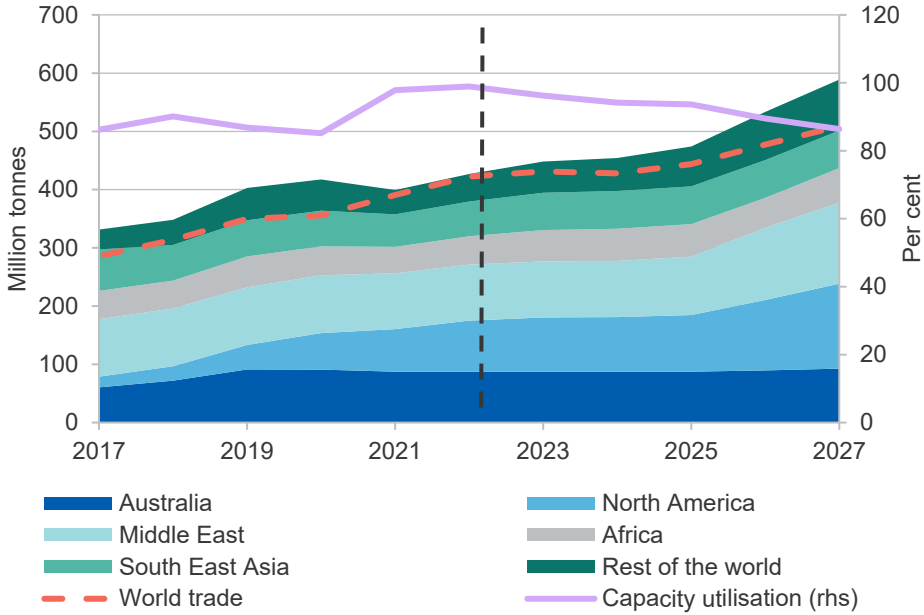
LNG market expected to be tight through to 2025

Global LNG trade reached 391 million tonnes in 2021, an increase of 9.8%, as the global economy showed a strong recovery from the COVID-19 pandemic. A number of extreme weather events raised demand, as the Northern Hemisphere built inventories after a bitter winter, followed by a hot Asian summer and sustained droughts in South America (that affected hydro generation). Asia remained the key driver of import growth, with growth of 9% in 2021, largely driven by Chinese demand. While elevated spot prices weighed on consumption in some emerging Asian economies, overall Asian demand remained high.

Export growth was dominated by North America, which accounted for over 60% of all supply growth in 2021. There has been mixed export performance from other regions; exports from the Asia-Pacific have largely been flat, and the Middle East has seen only moderate growth.

Global LNG trade is expected to increase in 2022, growing by about 4.3% a year. The slower growth rate is due to moderating demand from Asia

Figure 7.1: LNG demand and world supply capacity



Source: Nexant (2022) World Gas Model; Department of Industry, Science, Energy and Resources (2022)

and the reversal of demand from South America as hydro generation resumes. Between 2023 and 2027, trade is assumed to expand at a slower rate, as the post COVID-19 economic rebound effect fades, with growth projected at an average annual rate of 4.6%.

Overall, the market is expected to be tight through to 2025, as demand growth is evenly matched by supply growth, sans any extreme weather events (Figure 7.1). From 2026, a number of sizeable projects are expected to come online in both the US and Qatar, which is expected to result in the market being over-supplied.

World imports

China the world's largest LNG importer in 2021

China imported 80 million tonnes of LNG in 2021, an increase of 20% from 2020, making it the world's largest importer, a title it is expected to hold throughout the forecast period as strong growth in demand continues. China was the largest buyer of spot and short-term LNG in 2021.

China's LNG imports were higher in the December quarter 2021, up 4.6% year-on-year, as consumption recovered from a marked slowdown in the September quarter, when high gas prices led to demand destruction in some sectors. Coal shortages and a cold start to winter boosted consumption in the December quarter.

In 2021, Australia accounted for the largest share of China's LNG imports, at around 39%, down slightly on 2020 in percentage terms, but up in terms of absolute volumes (Figure 7.2). Throughout 2021, China has sought to diversify its LNG sources, signing new supply contracts with the US and Qatar, and seeking other suppliers on the spot market.

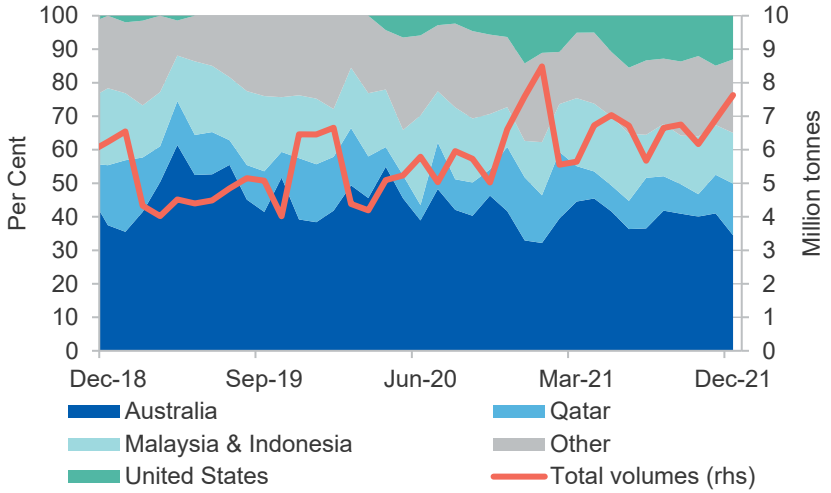
Gas demand growth is expected to moderate in 2022, as extreme weather events normalise and economic growth slows. In addition, there is expected to be a ramp-up of pipeline gas imports as the Power of Siberia pipeline between Russia and China takes increased volumes. China is expected to import 86 million tonnes of LNG in 2022, a slower rate of growth but still the largest import increase globally.

China's demand for gas is expected to increase by around 41% in total over the outlook period — driven by the industrial and residential sectors and ongoing coal-to-gas switching. The Chinese Government's 14th Five Year Plan indicates that gas will play an important role in the energy transition to meet its 'carbon-neutral by 2060' pledge. Whilst growth is expected across all supply sources — domestic production, pipeline imports and LNG imports — it is likely that the pace of growth of domestic production and pipeline imports will outstrip LNG. LNG demand growth is expected to average 5% between 2022 and 2027.

Japanese LNG demand to slow in pursuit of net-zero

Japan imported 73.9 million tonnes of LNG in 2021 — marginally lower year-on-year. LNG demand in Japan generally remains on a downward trend, with Japan losing its position as the top global LNG importer to China during 2021 (Figure 7.3).

Figure 7.2: China's gas supply by source



Source: Bloomberg (2022); National Bureau of Statistics of China (2022) General Administration of Customs

Following the announcement of a net zero by 2050 target in October 2020, the Japanese Government approved the 6th Strategic Energy Plan in October 2021, which details provisional power generation mix targets for 2030. The draft plan incorporates a pivot towards nuclear and renewables generation, with the share of gas proposed to decline from 37% to 20%.

Japan's LNG imports are forecast to decline further to 72 million tonnes in 2022, as the country moves toward the implementation of its energy plan. LNG imports are expected to fall to 70 million tonnes by 2027.

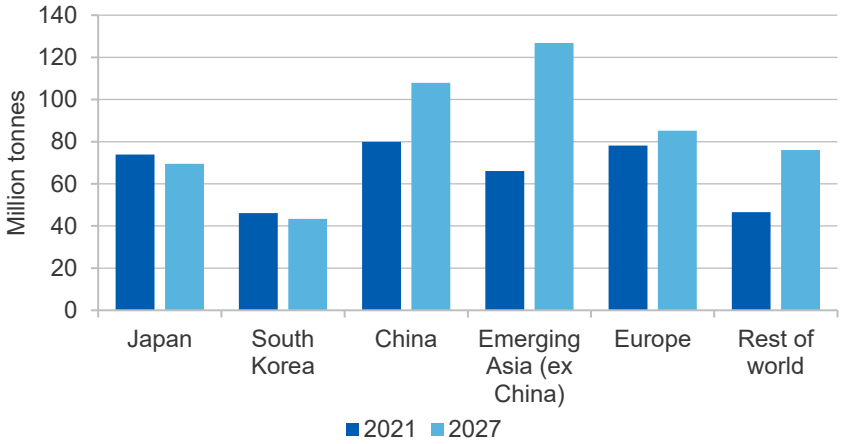
South Korea's LNG demand to increase late in outlook period

South Korea's LNG usage recovered to record levels in 2021, at 46 million tonnes, up 13% year-on-year. Growth has been driven by the ongoing economic recovery and the continued trend of coal-to-gas switching.

Growth in LNG imports is expected to be relatively modest, or even negative, in 2022 and 2023. This follows new nuclear and coal capacity putting downward pressure on LNG usage in the power sector, and more moderate weather is expected, lowering demand from the highs of 2021.

Following the announcement of a 'net zero by 2050' target in late 2020, the South Korean Government has released a number of detailed strategies — including the 14th Natural Gas Plan — which outline the country's move to net-zero through an increase in renewables and a move away from both nuclear and coal-fired power generation and highlighting gas as a transition fuel. These policies are expected to directly support LNG imports through to 2034, with LNG imports expected to show strong growth from 2024 through to the end of the outlook period.

Figure 7.3: World LNG import forecasts



Notes: Emerging Asia includes India.
Source: Nexant (2022) World Gas Model; Department of Industry, Science, Energy and Resources (2022)

Taiwan's LNG demand dependent on new import terminals

Taiwan imported 19.6 million tonnes of LNG in 2021. Gas-fired power generation is expected to continue to grow through the outlook period, as the government pursues a policy which would see all nuclear power phased out by 2025. Gas is expected to make up 50% of the electricity mix by 2025, up from 35% in 2020, although this is highly dependent on infrastructure constraints.

Taiwanese LNG imports are forecasto to be fairly stable at 18million tonnes a year until 2024. Taiwan's existing LNG import terminals are both operating at full capacity. The government has announced three new import terminals are now in the project pipeline, which are expected to come online between 2024 and 2026. Taiwan is expected to import around 22 million tonnes by 2027.

Indian LNG demand remains volatile and price sensitive

India's LNG imports were 8.6% lower in 2021 than 2020, with demand noticeably impacted by the high spot prices later in the year. Indian LNG buyers are highly price sensitive, and cut LNG imports as spot prices reached record highs. There was evidence of switching from gas to liquid fuels as prices rose, in both the refining sector and in power generation.

Looking forward, India's LNG demand growth depends on a number of factors. In the near term, domestic gas output will continue to surge, which provides a significantly cheaper source than current LNG prices. Demand for LNG is expected to rise strongly in 2022, after a weak 2021. Demand is likely to continue to grow out to 2027, averaging 6% annual growth. High prices for LNG remain the key downside risk to India's LNG demand growth, and any escalation in prices may result in demand destruction.

European imports down as cargoes diverted to Asia

European LNG imports were down 4% year-on-year, to 78 million tonnes, in 2021, despite the backdrop of an energy crisis that saw coal fired generation increase 11% on the previous year. A number of factors contributed to Europe's energy crisis in 2021, on both the supply and demand sides. Energy demand has surged, as the economy recovers from

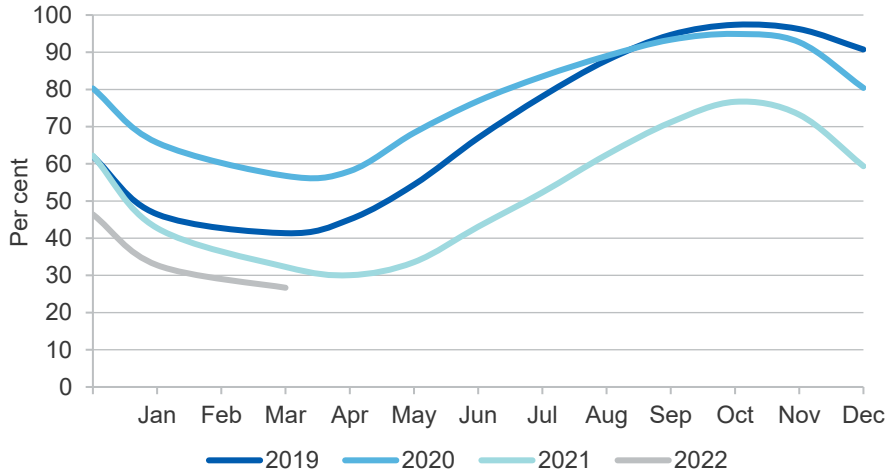
the COVID-19 pandemic amidst a relaxing of restrictions. Extreme weather events — including a colder-than-average winter in 2020–21 — have further added to demand. On the supply side, lower than expected renewable generation has coincided with supply disruptions, including lower Russian pipeline gas flows and low domestic production in Europe. As a result, European gas prices have soared, with average TTF prices increasing over 400% year-on-year.

For the first three quarters of 2021, there was a significant decline in LNG imports, down 17% year-on-year, even as demand soared. As Asian economies, especially Japan, Korea and China, endeavoured to replenish gas stockpiles over 2021, there was increased competition for spot LNG cargoes, and Europe was routinely priced out. However, in the December quarter 2021, Europe's LNG imports rose by 40% year-on-year, as a mild winter and well-stocked inventories slowed demand in Asia and allowed more cargoes to divert to Europe. The US was the largest supplier into Europe over 2021, and accounted for 40% of the increase in supplies in the December quarter, followed by Qatar and Egypt. Import terminals have been operating near capacity in the first 2 months of the March quarter.

LNG demand is likely to remain elevated in 2022, despite declining gas consumption overall. Regardless of the extent of the conflict between Russia and the Ukraine, Europe will need to restock their heavily depleted storage. At the time of writing, European storage was only 26% full, 38 percentage points below the 5 year average (Figure 7.4). There will also be increasing pressure to diversify gas supplies, as they seek firmer guarantees of energy security amidst declining domestic production. Historically, Europe has been heavily reliant on Russia for supplies of gas, with Russia supplying 32% of its gas imports in 2021. However, with the Nord Stream 2 pipeline unlikely to progress in the current environment due to the German government halting the certification process, there will be further pressure to shore up supplies from other sources.

Against this backdrop, LNG imports into Europe are expected to remain higher than 2020 levels until at least 2023, when they are likely to start declining in line with overall gas demand. Towards the end of the outlook, LNG imports are likely to increase as domestic production declines.

Figure 7.4: European gas storage levels



Source: Bloomberg (2022)

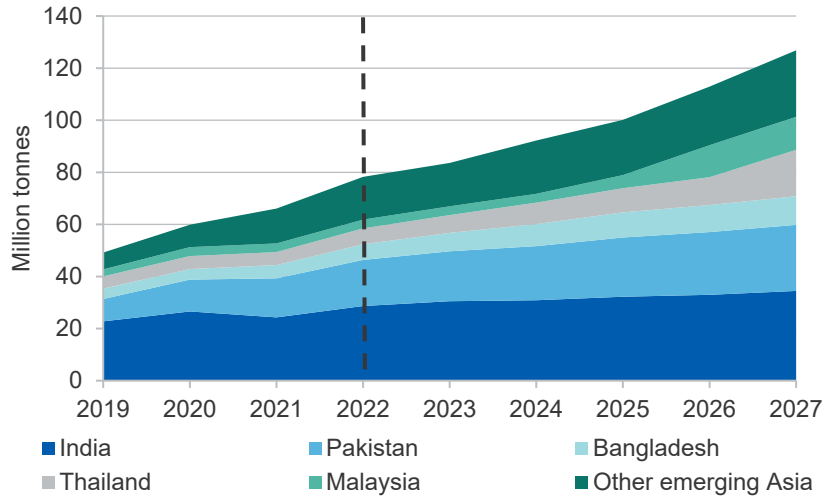
Emerging Asia to significantly increase LNG imports

Other South and South-East Asian economies were a major source of demand growth in 2021. Unlike India, both Bangladesh and Pakistan's LNG imports have been resilient to high prices and COVID-19 disruptions this year. Pakistan's LNG imports are estimated to have grown by 14% in 2021, compensating for domestic gas decline and growing industrial demand in the wake of the recovery from the COVID-19 pandemic. Bangladesh's LNG imports are estimated to have grown by 22% in 2021, led by the industrial and energy sectors. In the short term, re-gasification capacity is hindering further growth, however, both nations have set plans to add further capacity.

Over the outlook period, imports by emerging Asian economies are expected to increase, due to declining domestic gas production, the expansion of gas-fired power generation and new LNG infrastructure developments. Individually, these nations are relatively small importers of LNG, but collectively are expected to account for a noticeably larger share

of global LNG demand. The region (including India) is forecast to import 78 million tonnes of LNG in 2022; 18% higher than 2021 (Figure 7.5).

Figure 7.5: Emerging Asia LNG imports



Source: Nexant (2022) World Gas Model; Department of Industry, Science, Energy and Resources (2022)

7.3 World exports

Outlook for investment in new supply looks promising

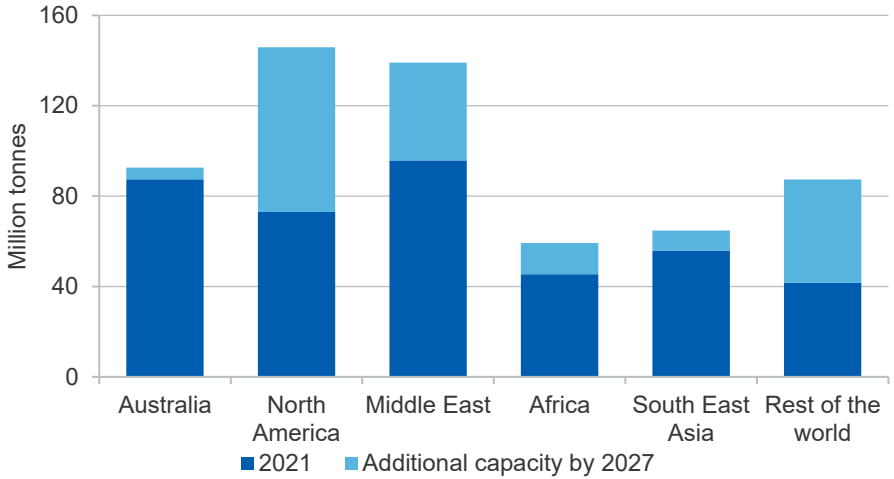
After minimal investment in 2020, 2021 saw some improvement in the investment outlook for LNG, with 51 mtpa (million tonnes per annum) of new capacity sanctioned. A FID was made on Qatar Petroleum's 33 mtpa North Field East project, worth US$29 billion and potentially the world's largest LNG project by capacity. Woodside made a FID on the $16.5 billion Scarborough and Pluto Train 2 project in late November.

There is a significant pipeline of projects expected to make FID in 2022, including Qatar's North Field South project and Plaquemines and Corpus Christi Stage 3 in the US. Up to 55 million tonnes of capacity could be sanctioned in 2022.

At the end of 2021, nominal global LNG capacity was at 457 mtpa.

Nominal global LNG capacity could be as high 618 mtpa by 2027, however, this is highly dependent on a conducive investment environment (Figure 7.6). A majority of capacity will come online after 2025.

Figure 7.6: Global LNG supply capacity forecasts



Source: Nexant (2022) World Gas Model; Department of Industry, Science, Energy and Resources (2022)

US expected to be the largest LNG exporter

The US drove the increase in global LNG supply in 2021, contributing over 60% of the global increase. US LNG exports increased 49% year-on-year to 75 Mt in 2021, on the back of already sizeable growth in 2020. The rapid increase in exports has been encouraged by the large price differences between the domestic Henry Hub prices and the spot prices in European and Asian markets. However, the increasing export volumes have put upward pressure on Henry Hub prices in the latter half of 2021.

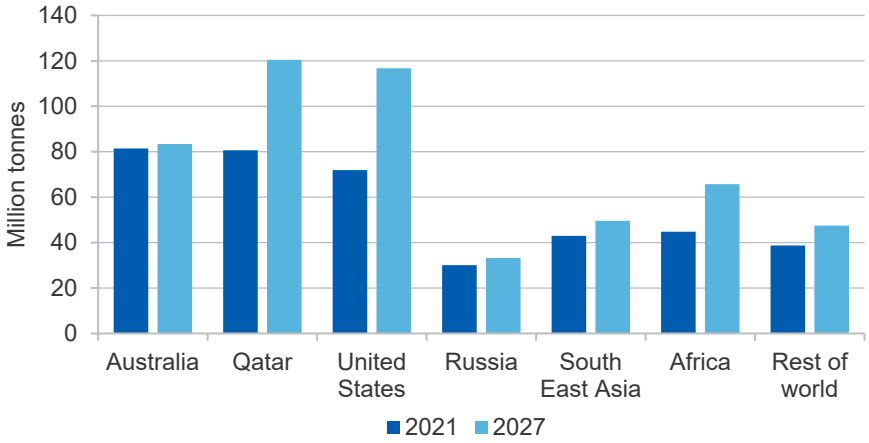
US supplied 59% to the spot market in 2021, making it the largest supplier of spot cargoes. The US benefits from its location on the Atlantic basin and being able to be a flexible provider into both Asian and European markets.

The US is expected to be the world's largest LNG exporter in 2022, a position it is expected to hold throughout the outlook period. In the last

month of 2021, the US was the largest exporter. The EIA has nominal US LNG export capacity at 73 mtpa in November 2021, and is expecting that to grow to 87 mtpa by the end of 2022. Sabine Pass Train 6 produced its first cargo of LNG in December 2021 and Calcasieu Pass is also ramping up in early 2022.

Beyond 2022, the US has a significant pipeline of LNG projects coming online, including the 24 mtpa which is currently under construction, and a number of projects in Pre-FID stage. US exports are forecast to reach 80 Mt in 2022, and grow 65% through to 2027.

Figure 7.7: Outlook for global LNG exports



Source: Nexant (2022) World Gas Model; Department of Industry, Science, Energy and Resources (2022)

Qatar exporting at maximum capacity until North Field East comes online

Qatar exported above nameplate capacity in 2021, exporting around 81 Mt of LNG, stable on 2020 volumes. Amidst the energy crisis and strong global demand for LNG, the Qatari Government has stated that the nation is operating at maximum capacity and is unable to raise exports to boost global supply.

Significant investments have been made to expand Qatar's LNG capacity over the forecast period, most notably the $US29 billion North Field East project — scheduled for completion in late 2025. This project could lift Qatar's export capacity from 79 million tonnes to about 110 million tonnes.

The North Field South project – the second phase of the North Field development – is expected to reach FID in the first half of 2022, with first production targeted for 2027. If this project goes ahead, Qatar's nameplate capacity would be 126 mtpa by the end of the forecast period.

Qatar's annual LNG exports are forecast to be relatively steady at about 80 million tonnes between 2022 and 2025. Output then rises as North Field East ramps up and hits full capacity some time in 2027 (Figure 7.7).

7.4 Prices

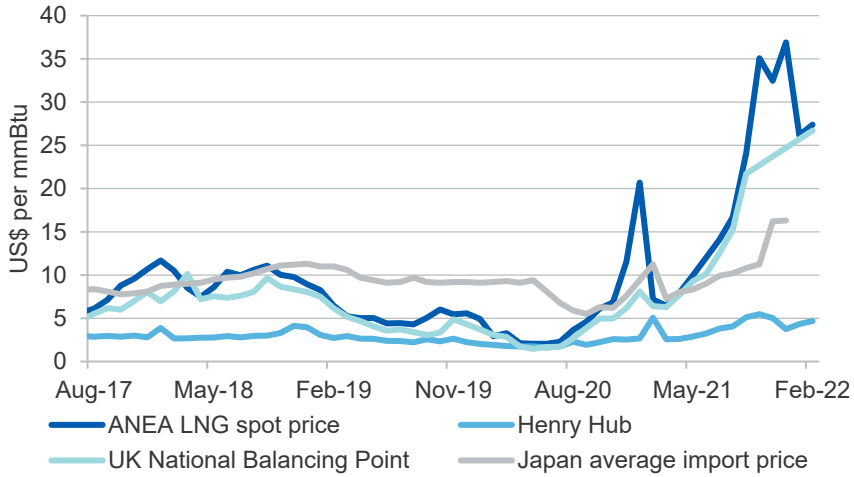
LNG spot prices have continued to show extreme volatility

Asian LNG spot prices were highly volatile throughout 2021 (Figure 7.8). Low inventories left the market vulnerable to supply problems and stronger than expected demand. After averaging US$9.95 a mmBtu in May, the price rose steadily to average US$36.9 a mmBtu in December. On 22 December, prices spiked to reach US$44.98 a mmBtu, the highest price on record, as the Northern Hemisphere winter deepened.

The steady increase in North East Asian spot prices in 2020 was driven by a number of factors, including the 'energy crisis' that has been occurring throughout Europe and parts of Asia, and a rebound in economic activity from the COVID-19 pandemic. A colder-than-average Northern Hemisphere winter of 2020–21 left both Asia and Europe with heavily depleted gas storage levels, leading to increased competition in the spot market as both major importing regions sought to complement contracted cargoes. Against this backdrop, in Europe lower renewable generation, lower levels of domestic gas supply and interruptions to Russian pipeline supply have all pushed TTF and NBP prices to extremely high levels. The Asian LNG spot price has tracked closely to the TTF price over this period, as arbitrage plays kicked in. Against this backdrop, there were also significant supply disruptions to the global LNG market, which peaked in May-June 2021.

North-East Asian spot prices are expected to average US$31.0 a mmBtu in the March quarter 2021. Prices initially came down off the highs of late 2021 as the Northern Hemisphere experienced a more moderate winter and supply steadily increased, before rebounding on the escalation of the Russia-Ukraine conflict. Prices reached US$54.4 a mmBtu on 8 March – the highest price on record. Prices are expected to remain elevated significantly above the long-run averages through to 2025, with tight supply as Europe diversifies and demand continues to grow in Asia. As significant volumes of supply come online in 2025, prices are expected to ease, settling back to about US$14 a mmBtu for 2026 and 2027, picking up each year in line with Northern Hemisphere winter (Figure 7.9).

Figure 7.8: Global gas and LNG prices, monthly



Notes: ANEA is the Argus Northeast Asia spot price. LNG prices are DES (Delivered Ex Ship), which include shipping and insurance.

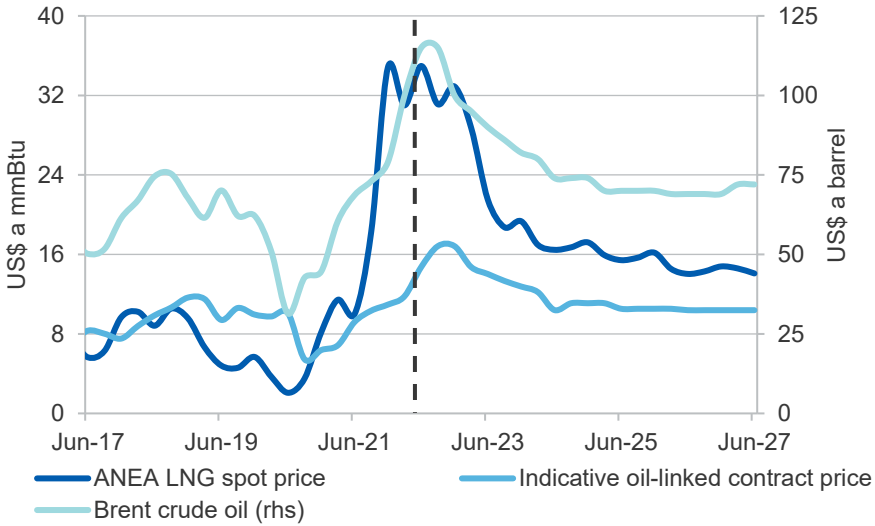
Source: Argus (2022); Bloomberg (2022)

Oil-linked prices forecast to remain high for some time

Almost 70% of the LNG traded in Asia is sold via long-term contracts which link the price of LNG to the price of oil (commonly the Japanese customs-cleared crude price), typically with a lag of around three to six months — depending on contractual arrangements.

Oil prices were elevated in late 2021, averaging US$80 a barrel in the December quarter. Given the lag of 3-6 months, these prices will flow through to contracts in the second half of 2021–22, raising export values.

Figure 7.9: ANEA LNG spot and contract prices, quarterly



Notes: ANEA is the Argus Northeast Asia spot price. LNG prices are DES (Delivered Ex Ship), which include shipping and insurance. The long-term oil-linked contract price is indicative, and is estimated at 14% of the 3-month lagged JCC oil price plus shipping.

Source: Argus (2022); Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022)

Contract prices are anticipated to have increased further in the March quarter 2022, reflecting ongoing oil price gains. In the first three months of 2022, oil prices were sitting consistently above US$80 a barrel, and sitting above US$100 a barrel for significant periods in March. In the March quarter 2022, oil prices are expected to average about US$100 a barrel and average US$108 a barrel over 2022 (see *Oil chapter*).

Over the outlook period, oil-linked contract LNG prices are expected to peak in 2023, before falling as oil prices settle. Oil prices are forecast to settle at around US$74 a barrel from 2024, and remain there for the remainder of the outlook period.

7.5 Australia

Australia's LNG export volumes at record highs

Australia's LNG export volumes reached a record high in 2021, at 81.2 million tonnes, up 4.1% on 2020. This is an average capacity utilisation of 93%. The strong result comes off the back of the resolution of technical issues from 2020 at Gorgon and Prelude, as well as suppliers responding to higher prices.

In the December quarter 2021, Australia's LNG exports were the highest quarterly result on record, totalling 21.5 million tonnes, up 1% quarter-on-quarter and 4.7% year-on-year, a significant result given volumes were once again impacted by unplanned maintenance at both Gorgon and Prelude. Overall, capacity utilisation in the December quarter was 99%, with 6 plants operating above 105% of nameplate capacity.

Following a strong September quarter, Gorgon faced some unplanned maintenance in the December and March quarters, with a gas leak shutting down Train 1 in mid-November, and subsequent investigations taking Trains 2 and 3 offline. Production in the December quarter was still up 1.3% quarter-on-quarter, and up 46% year-on-year.

At the time of writing, Prelude is undergoing a complete shut-down while investigations and repairs are conducted, following an electrical fire in early December that resulted in the vessel being evacuated. Production is expected to resume in late March. Production in the December quarter was down 55% on the September quarter 2021.

Australia's export earnings recovering off the back of strong oil prices

In the December quarter 2021, Australia's LNG export earnings increased to $18.4 billion, up 30% quarter-on-quarter and 150% year-on-year (compared to the December quarter 2020). Export earnings were supported by both high LNG spot prices, averaging US$34.8 a mmBtu in the December quarter (See *Prices* section) and recovering oil prices.

Around 80% of Australian LNG is sold via long-term contracts that link the price of LNG to the price of oil with a lag of around three to six months, depending on contractual arrangements. LNG contract prices in the December quarter reflect Brent oil prices from the June (US$69 a barrel) and September (US$80 a barrel) quarters, which are considerably higher than corresponding quarters in 2020.

LNG export volumes to peak in 2021-22, until new capacity comes online

Export volumes are expected to recover in 2021–22 to exceed pre-COVID-19 levels, off the back of strong performance in the first half of the financial year and on-going incentives from high prices. However, several of Australia's LNG facilities are facing field decline – most notably Darwin and the North-West Shelf, which will result in declining export volumes in the outlook period.

The Bayu-Undan field, which supplies Darwin LNG, is in decline. Santos announced a FID for an infill drilling program in early 2021. Production commenced in late July 2021, with initial outcomes better than expected. This program will likely extend output at the Darwin LNG facility until 2023. Santos announced a FID for Barossa, which will backfill Darwin, on 30 March 2021, and is expecting initial gas production in the first half of 2025. There is likely to be a 12 or more month lag between the depletion of Bayu-Undan and first gas from Barossa.

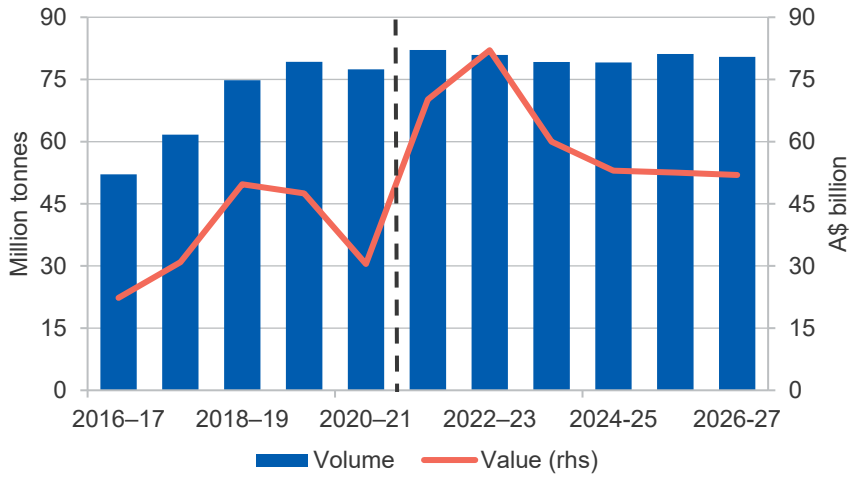
According to Woodside, capacity utilisation at the North West Shelf (NWS) is expected to decline in 2022, as reserves at existing fields are depleted. NWS has secured short-term infill from Pluto (for the period 2022–2025) and Waitsia (for the period 2023–2028), which both have shorter lead times.

Beach Energy will also process 3.45 million tonnes of LNG through the NWS facility over a 5 year period, commencing in 2023. However, large scale backfill projects are required for the longer term. Browse is earmarked as backfill to the NWS, but FID for this project has been deferred until at least 2023, citing weak market conditions.

Woodside announced a FID on the Scarborough and Pluto Train 2 project on 22 November 2021.The Scarborough to Pluto LNG expansion — where a second gas processing train would be constructed, adding capacity of 5 mtpa — is the only substantial expansion to Australia's LNG capacity in

the investment pipeline. At $16.5 billion, this is the largest investment in Australia's upstream LNG capacity in over a decade. First gas is expected by 2026, with LNG export capacity ramping up quickly over 2026–27.

Figure 7.10: Australia's LNG exports



Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

After a strong first half, LNG exports are forecast to rebound to around 82.1 million tonnes in 2021–22. Export volumes are expected to slowly decline to just under 80 million tonnes in 2025, as backfill projects fail to meet the short fall. Export volumes will boost in 2026, as the Scarborough/Pluto project comes online.

Higher prices expected to lift Australia's LNG export earnings

Australia's LNG export earnings fell sharply in 2020–21, down to $30 billion from $48 billion in 2019–20 (Figure 7.10). The majority of this decline was due to weak contract prices, particularly in the September and December quarters of 2020. In 2021, export earnings showed strong signs of recovery, up 37% to $49.7 billion.

LNG export earnings are forecast to increase to $70 billion in 2021–22 and $82 billion in 2022-23. Oil-linked contract prices are expected to be higher than pre-COVID-19 levels, and earnings will also be boosted by high Asian LNG spot prices. Over the remainder of the outlook period, export values are expected to decline to $52 billion, as oil and gas prices return to longer term averages.

Revisions to the outlook

Australia's nominal LNG export earnings have been revised up by $7.3 billion in 2021–22, and by $26.8 billion in 2022–23, from the December 2021 report, reflecting higher assumed LNG spot prices and oil-linked contract prices.

Australia's nominal LNG export earnings for 2025-26 have been revised up by $2.7 billion from the March 2021 REQ, due to higher spot and oil linked contract prices.

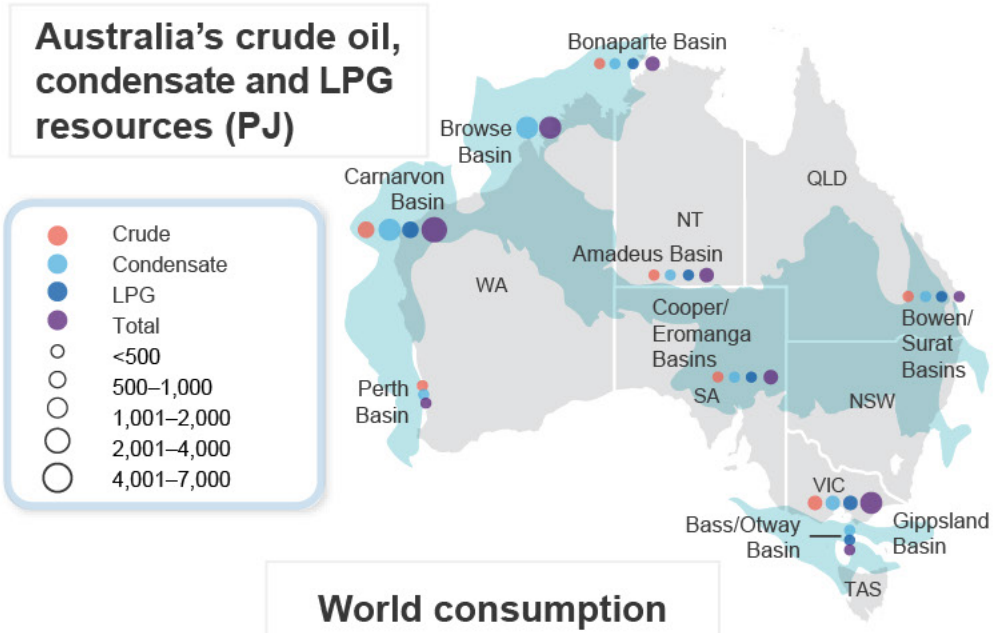
Table 7.1: Gas outlook

World	Unit	2021	2022[f]	2023[f]	2024[f]	2025[z]	2026[z]	2027[z]	CAGR[r]
JCC oil price[a]									
– nominal	US$/bbl	68.7	107.5	88.3	74.0	70.0	69.0	72.0	0.8
– real[h]	US$/bbl	71.1	107.5	86.0	70.3	64.8	62.5	63.7	-1.8
Asian LNG spot price[g]									
– nominal	US$/MMbtu	18.3	32.5	22.1	16.8	15.8	14.4	14.0	-4.3
– real[h]	US$/MMbtu	18.9	32.5	21.5	16.0	14.6	13.0	12.4	-6.8
Gas production[s]	Bcm	4,122	4,220	4,282	4,362	4,451	4,531	4,612	1.9
Gas consumption[s]	Bcm	4,159	4,221	4,282	4,363	4,456	4,540	4,610	1.7
LNG trade[ds]	Mt	390.7	407.7	413.0	417.1	436.7	477.1	511.7	4.6
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[f]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production[b]	Bcm	150	157	157	157	159	160	157	0.7
– Eastern market	Bcm	57	55	54	54	54	57	61	1.1
– Western market	Bcm	81	86	90	88	90	84	76	-1.0
– Northern market[c]	Bcm	14	16	14	15	15	19	20	6.4
LNG export volume[d]	Mt	77	82	81	79	79	81	80	0.6
– nominal value	A$m	30,477	70,155	82,045	59,968	52,993	52,528	51,942	9.3
– real value[e]	A$m	31,507	70,155	79,561	56,643	48,815	47,206	45,541	6.3
LNG export unit value[g]									
– nominal value	A$/GJ	7.5	16.2	19.2	14.3	12.7	12.3	12.2	8.6
– real value[e]	A$/GJ	7.7	16.2	18.6	13.5	11.7	11.0	10.7	5.7
– nominal value	US$/MMBtu	5.9	12.4	15.3	11.6	10.2	9.8	9.7	8.7
– real value[e]	US$/MMBtu	6.1	12.4	14.8	10.9	9.4	8.8	8.5	5.7

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; **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 2021–22 Australian dollars; **f** Forecast; **g** 1 MMBtu is equivalent to 1.055 GJ; **h** In 2022 US dollars; **r** Average annual growth between 2021 and 2027 or 2020–21 and 2026–27; **z** Projection.
Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022); Company reports; Nexant (2022) World Gas Model.

Oil

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



Oil facts

Carnavon basin produces around **2/3 of Australia's crude & condensate**

In last 2 years Brent spot price has ranged from **US$17–US$134 a barrel**

In 2021, around **28%** of refinery feedstock was domestically produced.

World consumption

29% Diesel

26% Gasoline

14% LPG and Ethane

12% Other

6% Fuel oil

6% Aviation turbine fuel

Australia's oil

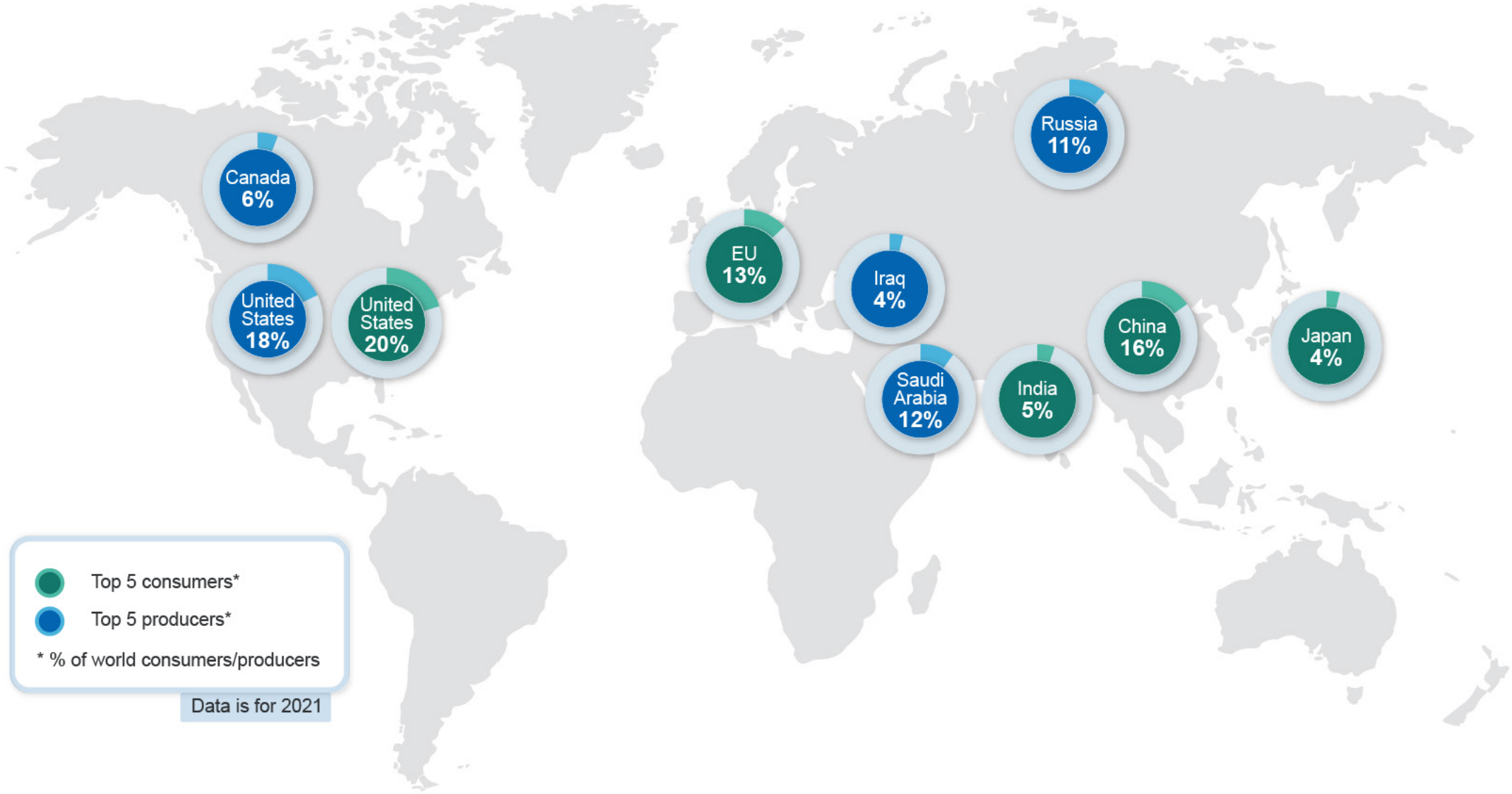
Holds **0.3%** of the world's **oil resources**

In 2020-21 **oil exports** were worth **$7.4bn**

Accounts for **0.5%** of **global production**

Oil

Trade map | March 2022



8.1 Summary

- Significant uncertainty surrounds global oil price forecasts, with Russia's invasion of Ukraine driving global supply concerns in the midst of rising global demand. This chapter includes three price scenarios, with the base case scenario forecasting a Brent crude price averaging US$108 a barrel in 2022, peaking in the middle of the year and then gradually declining.
- Australian crude oil and feedstock exports in 2021–22 are forecast to increase by 1.7% to 281,000 barrels a day. Exports are projected to lift later in the outlook period, as a number of new oil projects come online.
- Soaring oil prices are expected to lift Australian oil export earnings by 86% to $13.8 billion in 2021–22, with earnings then holding steady in 2022–23.

8.2 World consumption

Demand on the path to recovery, led by the petrochemical sector

Global oil consumption in 2021 averaged 98 million barrels a day — this is 6.1% higher than in 2020, but 2.9% lower than in 2019. Consumption has been significantly impacted by the COVID-19 pandemic, with lockdowns and mobility restrictions affecting global industrial activity, commuting and leisure travel for significant periods. As vaccination programs rolled out in 2021 and global economic growth rebounded, oil consumption began to recover. This recovery is set to continue in 2022, with consumption forecast to rise by 2.2% to reach 100 million barrels a day. Demand gains appear to have been dampened in the March quarter by the impacts of Omicron variant outbreak. However, containment measures have been relatively modest compared to those employed during previous waves of COVID-19, potentially curbing the impact on economic activity.

Due to the rate of the transmission of the virus, and a continued rollout of vaccines and subsequent boosters, it is possible that immunity rates could result in minimal COVID-19 mobility restrictions in the second half of the year. However, new COVID-19 variants and subsequent waves will remain a key threat to demand forecasts — particularly for countries such as China, which retain zero-COVID policies.

Demand for transportation fuels continues to recover, with solid growth predicted for 2022 and early 2023. Demand for gasoline and diesel for transportation are forecast to reach pre-pandemic levels this year. While traffic volumes in key markets dropped at the end of 2021 as Omicron cases surged, a rebound in transport use was observed by the beginning of February, as many European Governments ended 'work from home' advice and relaxed other restrictions. At the start of March, road traffic in European cities measured 95% of pre-pandemic levels. It is anticipated that there will be strong growth in road fuel consumption over the second and third quarters, with the return in commuter travel and the Northern Hemisphere summer travel season.

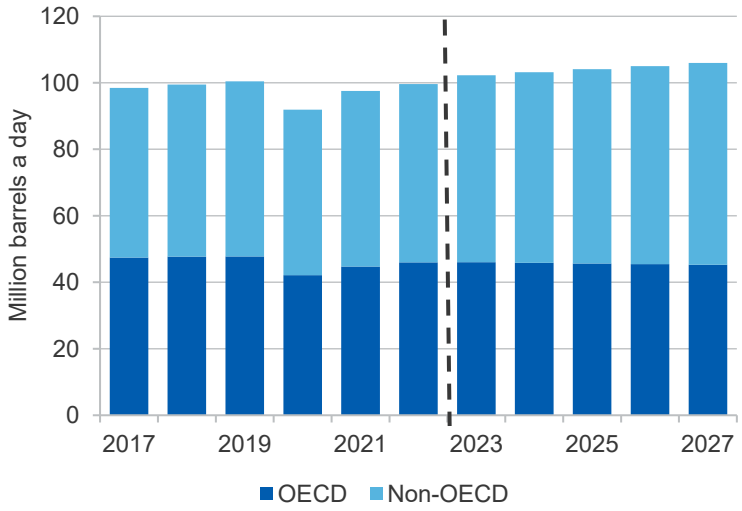
As global airline travel continues to recover, jet fuel consumption is predicted to rise in 2022 and into 2023 — but not to pre-pandemic levels. According to the International Air Transport Association, international passenger demand in 2021 was 76% below 2019 levels, and domestic demand was 28% below 2019 levels. Jet fuel consumption is expected to be led by private travel, with business travel lagging it. At the beginning of March 2022, flight departures in the Eurocontrol area were roughly 74% of the equivalent period in 2019, while passenger numbers in the US measured 88% of 2019 levels. Consumption is expected to return to pre-pandemic levels midway through the outlook period.

In 2021, industrial consumption rebounded strongly, with economic recovery aiding global petrochemical manufacturing. Global consumption of LPG/ethane and naphtha in 2021 were higher than 2019 levels. Demand for petrochemicals is again set to be a key driver of consumption growth in 2022. A surge in natural gas prices (see *gas* chapter) in Europe and Asia in the second half of last year triggered a growing interest in switching from gas to oil for power generation and industrial activities. It is estimated that higher natural gas prices increased demand for oil in Europe by between 250 kb/d and 300 kb/d, compared to typical seasonal

patterns. This trend is likely to support consumption in the March quarter 2022.

While global consumption is forecast to grow this year, Russia's invasion of Ukraine in February 2022 has provided an additional element of uncertainty to near term forecasts. The outlook for consumption in Russia and surrounding nations is now uncertain, as is the overall impact on global economic activity and travel. In 2023, total world oil consumption is forecast to rise by 2.7% to 102 million barrels a day, driven by global aviation demand (Figure 8.1).

Figure 8.1: Oil consumption, OECD and non-OECD



Source: Department of Industry, Science, Energy and Resources (2022); International Energy Agency (2022).

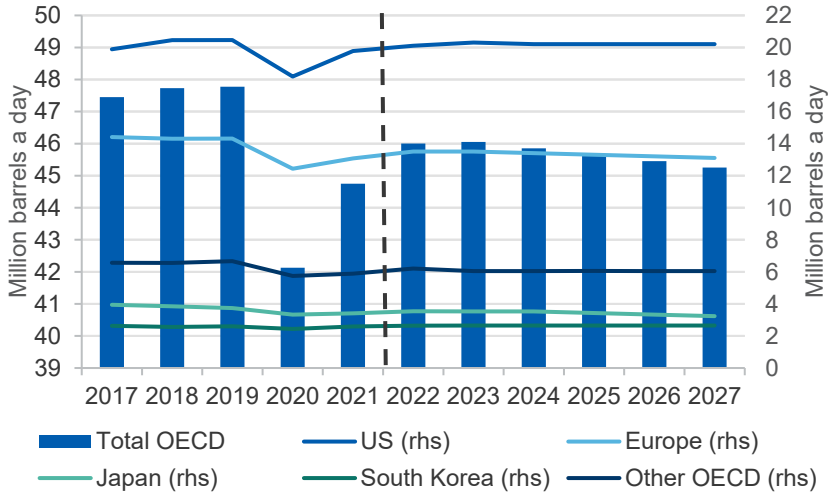
Consumption is projected to reach 104 million barrels a day by 2025, before increasing marginally by 2027. Escalating climate pressures are leading to an acceleration in renewable energy investment and a global shift away from fossil fuels and oil intensive consumption. The global energy transition away from oil intensive activities underpins the slowdown in consumption growth late in the projection period.

Transportation and industrial fuel demand supporting OECD consumption

OECD oil consumption rose by 6.2% in 2021. However, the pandemic caused significant variation across months and regions. Demand is forecast to be 46 million barrels a day in 2022 — a rise of 2.8%. Demand is forecast to decline later in the outlook period, reflecting a drop in transport demand, due to the global energy transition and specifically a higher uptake of electric vehicles (see the *lithium* chapter and Figure 8.2).

In 2021, consumption in the US and OECD Europe rose by 8.8% and 5.2% respectively, largely led by demand for petrochemical manufacturing. Higher natural gas prices have encouraged fuel switching and supported diesel demand in the industrial sector of OECD Europe. Both regions also saw gains in road transportation fuels, largely between May to August, which is the summer vacation travel season. High vaccination rates in these regions mean that widespread lockdowns are unlikely to reappear this year. This, combined with continued growth in economic activity, should support overall consumption growth in both regions in 2022, with industrial and transportation sectors again the key drivers.

Figure 8.1: OECD total consumption, by major nations



Source: Department of Industry, Science, Energy and Resources (2022); International Energy Agency (2022).

In 2022, US consumption is forecast to rise by 1.7% to 20 million barrels a day, led by continued improvement in mobility and accelerated manufacturing activity. Consumption in OECD Europe is forecast to rise 3.3% to 14 million barrels a day, driven by the expected pick up in air traffic.

In 2021, demand in the OECD Asia Pacific region rose by 3.8%, but was hindered by various COVID-19 restrictions and lockdowns. High vaccination rates in major nations — Japan, South Korea and Australia should support continued recovery in transportation, particularly in the aviation sector. Beyond 2022, consumption in the OECD Asia Pacific region is expected to return to around 2019 levels, albeit with declines later in the projection period.

Non-OECD consumption to lead global demand growth in 2022 and 2023

Non-OECD consumption has recovered to match pre-pandemic (2019) levels, averaging 53 million barrels a day in 2021. Consumption is forecast to rise to 54 million barrels a day in 2022.

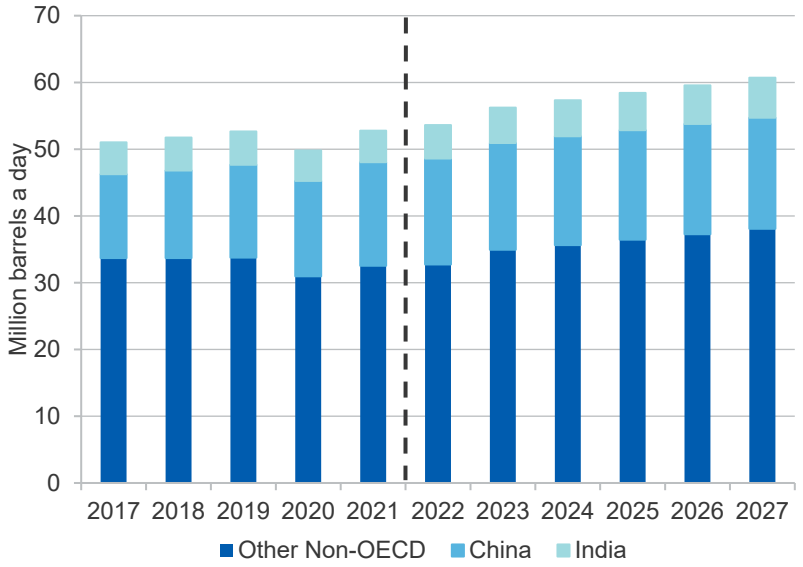
Steady growth in petrochemical feedstock demand, including naphtha and LPG, as well as rebounding mobility, saw Chinese oil consumption grow by 8.6% in 2021. Petrochemical feedstock, gasoline and diesel demand are expected to drive growth again this year. With the emergence of the Omicron variant, at the end of 2021 and into early 2022, strict Government measures were introduced in select Chinese cities in line with the nation's zero-COVID policy. In mid-March, the nation was recording some of the largest daily case numbers since the start of the pandemic. In 2022, Chinese oil consumption is expected to reach 16 million barrels a day, however the evolving COVID outbreaks remain a key risk to consumption forecasts.

Despite weak outcomes in the middle of the year due to the Delta variant outbreak, and some extreme rainfall in November, India's oil demand recovered considerably in 2021 to almost match pre-pandemic levels. In 2022, Indian oil consumption is forecast to reach pre-pandemic levels, averaging 5 million barrels a day. This is expected to be driven by the positive economic outlook and continuing demand by the manufacturing sector.

Since economic growth in non-OECD nations tends to be more oil-intensive than in OECD nations, it is expected that non-OECD nations will drive global oil consumption growth in the short term. However, new virus variants pose a downside risk to growth in these regions: low vaccine coverage could see COVID containment measures implemented.

Non-OECD consumption is projected to continue rising over the outlook period, reaching 56 million barrels a day in 2023, 58 million barrels a day in 2025 and 61 million barrels a day in 2027. China and India will continue to lead consumption growth for non-OECD nations (Figure 8.3).

Figure 8.3: Non-OECD consumption



Source: Department of Industry, Science, Energy and Resources (2022); International Energy Agency (2022)

8.3 World production

Production set to rise, but investment in sector is the key to future growth

While global oil output rose by 1.6% from 2020 levels to average 95 million barrels a day in 2021, inventories remained tight. The supply approach of OPEC+, combined with underperformance from some member nations, and a lagged recovery by some non-OPEC producers, led to falling global inventories, with OECD inventories reaching their lowest levels for seven years.

Global oil production is predicted to rise further in 2022, but the Russian invasion of Ukraine has added to global uncertainty. OPEC+ is expected to continue with monthly increases, but the failure of some member nations to meet targets could dampen growth. Russian production is also now expected to see growth declines – affected by both the active conflict and by sanctions imposed by some importers on Russian oil exports. In light of current prices and the tight global supply situation, some non-OPEC producers, including the US, Canada and Brazil could pump at their highest ever annual levels this year. Global production is forecast to increase by 4.3% to average 99 million barrels a day in 2022.

Production is projected to increase gradually over the rest of the outlook period, as OPEC+ output targets increase and production in non-OPEC+ members recovers. Output is projected to increase to 102 million barrels a day in 2023, and 105 million barrels a day by 2027. However, future production hinges on investment in the sector, which is of particular concern for higher-cost producer nations such as Canada and the US. Investment, combined with the structural adjustment from the transition away from fossil fuels, may weigh on world production later in the projection period.

OPEC+ supply progressively rising, but underperforming stated targets

In July 2021, members of the OPEC+ alliance reached an agreement for a significant winding back of production cuts which occurred from early 2020, when global oil inventories surged and prices plummeted. The group agreed to increase production every month — commencing in August 2021 — by an additional 400,000 barrels a day, with the agreement due to remain in place until September 2022. The group agreed to meet monthly to reaffirm members' commitments to ensure adequate supply and maintain market stability. For the remainder of 2021, the group stayed cautious and did not adopt any changes to the agreement, citing the continued risks of the COVID-19 pandemic to global oil demand. However, the group underperformed on their announced agreements between September and December. The supply shortfall, attributed to technical issues in upstream sectors, is estimated to have resulted in a loss to the global market of around 800,000 barrels a day since the start of 2021. Overall in 2021, OPEC+ output rose by 2.3% from 2020 levels, to average 49 million barrels a day.

OPEC+ has maintained their agreement so far in 2022, but the group still appears to be underperforming on production targets. Data for February 2022 shows that OPEC+ members involved in the supply deal pumped an additional 120,000 barrels a day, far less than the mooted 400,000 barrel a day increase. OPEC+ confirmed that it will proceed with monthly increases through April, and met on 31 March (after we went to print) to make a decision on May's output. Results of these production decisions continue to be a key source of uncertainty around global supply.

Russia is the world's third-largest producer of liquid fuels (after the United States and Saudi Arabia). In 2021, Russian crude oil production averaged 10 million barrels a day, up 2.1% from 2020. Russia's invasion of Ukraine has created considerable uncertainty regarding Russian oil production, and appetite for Russian product on the global market. While the nation's production and export capacity will likely remain largely available, there is significant uncertainty around how many countries will continue to import Russian oil. The impact of Russia's invasion of Ukraine on global oil markets continues to evolve, and additional commentary has been included in Box 8.1.

The potential full re-entry of Iran — which is currently exempt from output cuts — into the global oil market, would have a significant impact on world production. In February 2022, international negotiations to revive the Joint

Comprehensive Agreement Plan of Action resumed. Talks were still progressing at the time of writing. At the time the deal was made in 2015, Iran's crude output rose by 1 million barrels a day over a 9 month period. Early estimates suggest an easing of sanctions could see the addition of up to 1.3 million barrels a day into global markets from 2022.

Production in Libya averaged 1.2 million barrels day in 2021. In December 2021, armed militants shut off an estimated 370,000 barrels a day from the four key oil fields. While Libyan production is expected to remain stable in 2022 and 2023, the delayed presidential and parliamentary elections, originally scheduled for late December 2021, remain a source of key uncertainty. In addition, ongoing maintenance on the nation's ageing oil and gas infrastructure will continue to affect production.

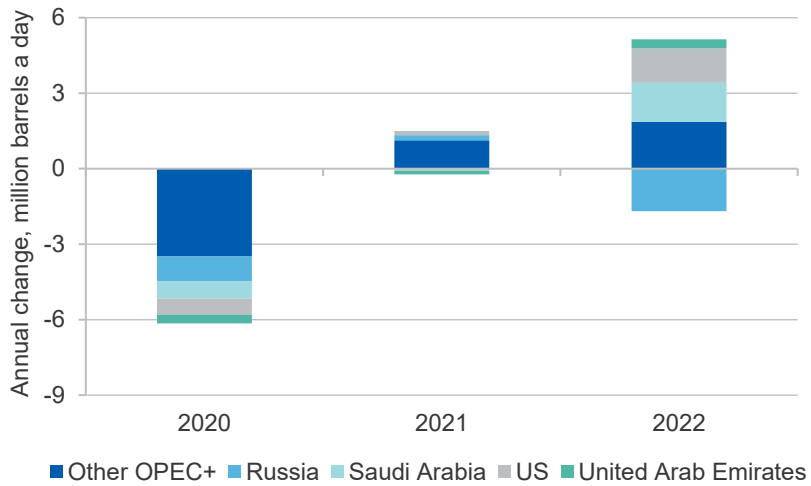
In 2022, OPEC+ production is expected to rise 4.2% to 51 million barrels a day. Forecasts assume OPEC+ will continue increasing quotas by 400,000 barrels a day each month until September 2022, and that Libya, Venezuela and Iran remain exempt from quotas. However the continuing underperformance of member nations outside the Middle East, will remain a risk to production targets. Additional uncertainty also exists over whether and how the group chooses to respond to future developments resulting from Russia's invasion of Ukraine.

Non-OPEC+ output saw modest growth in 2021, but expect faster in 2022

Non-OPEC+ output rose by 0.40 million barrels a day, or 0.9%, in 2021. Heavy maintenance programs (to catch up on works delayed in 2020), extreme weather, and lengthy outages due to COVID-19, constrained the 2021 output recovery.

US output recovered modestly from the steep falls of 2020, rising by 1.0% in 2021. Recovery efforts were hindered by a number of extreme weather events and COVID-19 disruptions. Severe winter conditions affected output in Texas in February, and Hurricane Ida passed through the Gulf of Mexico (GoM) in late August. In the December quarter 2021 production surged to the highest level since the March quarter of 2020, driven by the return in the GoM from Hurricane Ida and on the back of high prices.

Figure 8.4: Change in oil production by major producers



Source: Department of Industry, Science, Energy and Resources (2022); International Energy Agency (2022).

US production is forecast to rise 8.2% to 18 million barrels a day in 2022 — potentially the highest annual average US production on record. Given current price levels, and the recently imposed sanctions on US imports of Russian crude, there is heightened pressure on US producers to ramp up output. US output is projected to rise further over the outlook. Future growth looks to be driven by an acceleration in shale/tight crude production, but will be partially offset by the natural decline in onshore conventional fields. Investment levels in the US shale sector remain a key risk to production: a shift toward tighter Environmental, Social and Governance (ESG) measures as part of the Biden Administration's climate plans, could present some downside risks to future output over the projection period and beyond.

Other drivers of non-OPEC supply growth in 2022 are anticipated to be Brazil, Canada and Norway. In 2022, non-OPEC+ production is expected to surpass pre-COVID-19 levels, averaging 48 million barrels a day.

8.4 Prices

Prices rose to average $US70 a barrel in 2021, with continuing increases

In 2021, oil prices followed a sharp upwards trajectory, following the dramatic falls in the first half of 2020. An uptick in global demand amid recovering economic activity, a disciplined approach from OPEC+, and a lagged recovery from other major producers, facilitated stock drawdowns and boosted prices. A steep surge occurred in the second half of the year, but was dampened with the news of the Omicron variant global outbreak. However, markets regained confidence by the end of December, when the Omicron variant appeared less 'aggressive' than first expected, recovering to $US77 a barrel by 31 December 2021. The average Brent price for 2021 was $US70 a barrel — up 67% from the 2020 average.

A tight market supported the rally into early 2022 — with prices in January rising 15% m-o-m, to average US$86 a barrel. Despite soaring levels of COVID-19 Omicron cases in early 2022, global consumption has remained robust. The stronger-than-expected demand has come amid tightening global supplies and already low inventories, with OPEC+ struggling to increase output in line with the agreed quotas.

Figure 8.5: Brent oil prices, 2010 to 2022

Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022).

Prices grew by 12% m-o-m to average $US96 a barrel in February, as concerns around a Russian invasion of Ukraine increased. Following Russia's invasion, the risk of sustained energy supply shocks, and the imposition of sanctions from various nations, saw prices spike well over the $US100 a barrel in March — the highest levels since July 2008. Prices remained extremely volatile in March as the situation evolved, with prices declining in mid-March as Russia–Ukraine negotiations progressed. The overall price rise over the last year has been dramatic — with the March quarter 2022 average (estimated) up 65% y-o-y.

Brent prices to remain elevated in near term, but eventually decline

The rapidly evolving conditions surrounding Russia's invasion of Ukraine have led to unusually high levels of uncertainty in global oil markets. To assist in assessing these uncertainties, a pricing scenario analysis has been included in Box 8.1. The analysis explores the effects of potential developments which may result from the conflict, on oil prices, and on how this will impact Australian exports. The forecast scenario discussed in this section is the 'baseline' case, but the scenario analysis also considers more and less severe scenarios.

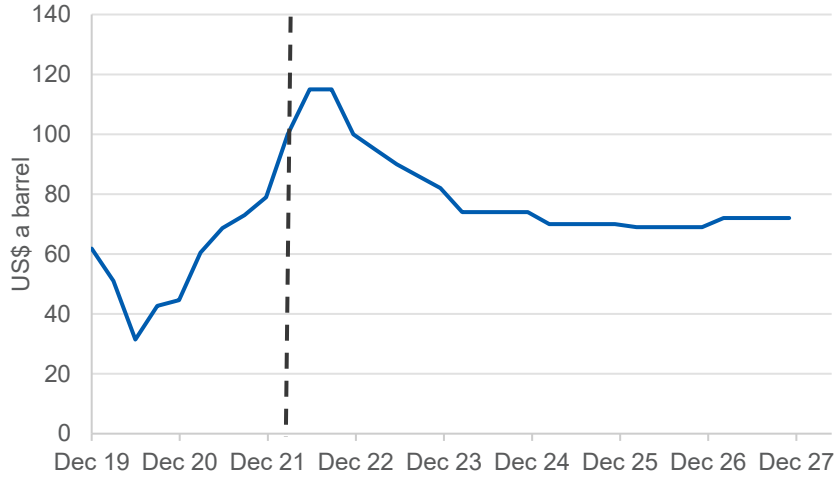
Prices are expected to remain elevated in 2022 and 2023, as consumption continues to rise against a backdrop of volatile supply and low global inventories. The rapidly changing conditions in Ukraine, and the evolving Western response, is triggering immense volatility in global prices, and creating a more difficult forecasting environment. It is anticipated that 2022 quarterly average prices will peak in the June and September quarters, averaging $US115 a barrel, before beginning a gradual decline. It is anticipated that the scheduled increases in the OPEC+ output, alongside rising output from other producers, should help to put some downward pressure on prices later in the year. By the December quarter 2022, Brent prices are forecast to average $US100 a barrel.

The supply side is expected to dominate risks to prices in the near term. In addition to Russia's invasion of Ukraine, (see Box 8.1 for a detailed discussion) uncertainty also exists over whether the joint Comprehensive Agreement Plan is revived, and if it is, the speed at which sanctions are

lifted and Iranian crude can thus enter the global market. During the March quarter 2022, prices fluctuated noticeably as the negotiations waxed and waned. The decisions and actions of OPEC+ also add to supply uncertainty. While it's anticipated the group will continue with their monthly production increases, they are currently failing to meet announced production targets. There is also uncertainty around whether the group revises their agreement in light of Russia's invasion of Ukraine. While US production is set to increase this year, uncertainty exists about the rate by which producers will ramp up drilling.

These risks to supply will exist amid the uncertain trajectory of the COVID-19 pandemic, where future virus variants will continue to dominate the demand risk landscape. While it is anticipated that global consumption will continue on an upward trajectory throughout 2022, the effectiveness of vaccines against new virus strains, and the response from authorities when new outbreaks occur — particularly for nations who have adopted zero-COVID policies — has strong potential to impact global demand and impact market confidence.

Figure 8.6: Brent oil price outlook



Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources

Under the baseline scenario, in 2023, the Brent price is forecast to average $US88 a barrel. Beyond 2023, it is anticipated prices will continue to decline gradually, as global inventories are restored amidst moderate consumption growth and a shift among major countries towards less oil-intensive transportation.

Any oil market reorganisation due to the conflict in Ukraine is likely to be well established by the mid/late outlook period. Prices are projected to average US$74 a barrel in 2024, falling to US$69 a barrel in 2026 and stabilising at $US72 a barrel in 2027 (in 2022 dollars) (Figure 8.6).

8.5 Australia

Future production influenced by potential new projects and natural decline

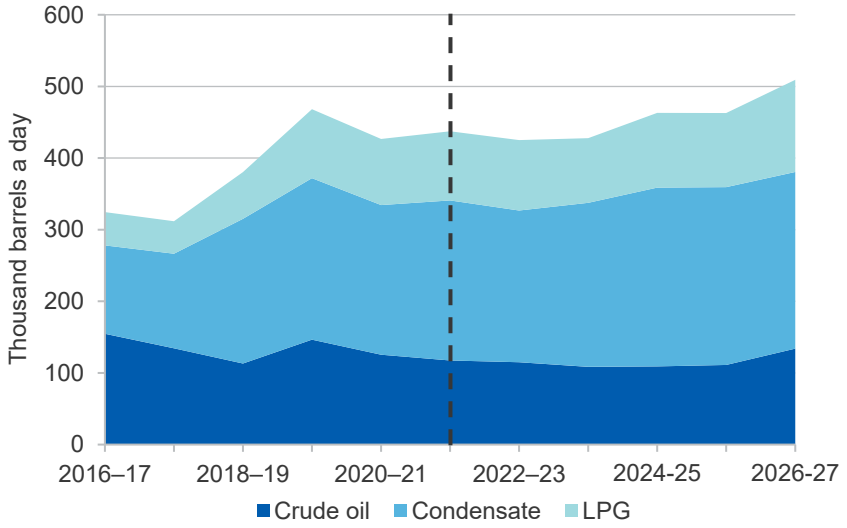
In 2020–21, condensate accounted for 49% of total Australian crude oil, condensate and LPG production. Crude oil accounted for 29% (Figure 8.7). In 2021–22, Australian crude and condensate production is forecast to increase by 0.8% to 337,000 barrels a day. Crude production figures will be boosted by the successful tie-in and start-up activities for the two remaining wells in Santos' Van Gogh Phase 2 infill program (at the end of 2021), and an increase in production at the Vincent field. Condensate production is expected to lift in 2021–22, in tandem with the record LNG production (see *Gas* chapter) in the last half of 2021, since the majority of Australian condensate is a by-product of gas. Condensate production was impacted throughout 2020–21 by technical issues that caused prolonged shut-downs at Gorgon and the Prelude FLNG project. However, a fire and subsequent power failures in December 2021, have seen production again suspended at Prelude. In mid-March 2022, Prelude received approval from NOPSEMA to restart operations, however restart timeframes were unclear at the time of writing.

Several potential and progressing Australian oil and gas projects will affect crude, condensate and LPG production later in the projection period (see *Resources and Energy Major Projects: 2021 Report*). Santos is anticipating a Final Investment Decision (FID) on the Dorado oil project in the Bedout sub-basin off the Western Australia coast in the middle of this year. This project has an estimated initial capacity of 75-100k barrels a

day — nearly a quarter of 2020–21 Australian crude oil and condensate production. According to Santos, the development is progressing, with the front-end engineering and design (FEED) phase commencing for the FPSO and Wellhead Platform. First output is expected by 2026. First oil output at the Pyrenees Infill Phase 4 Project could be possible by 2023, with an estimated peak production rate of 13,500 barrels a day. In 2021, Santos announced a FID to proceed with their Barossa backfill to Darwin LNG gas and condensate project. First production is targeted for 2025.

In 2022–23, Australian crude and condensate production is forecast at 327,000 barrels a day. While upcoming projects like Dorado will work to boost crude production later in the projection period, this will be met with the natural decline at existing fields and projects. Output is projected to increase to 381,000 barrels a day by 2026–27.

Figure 8.7: Composition of Australian oil production



Source: Australian Petroleum Statistics (2022); Department of Industry, Science, Energy and Resources (2022)

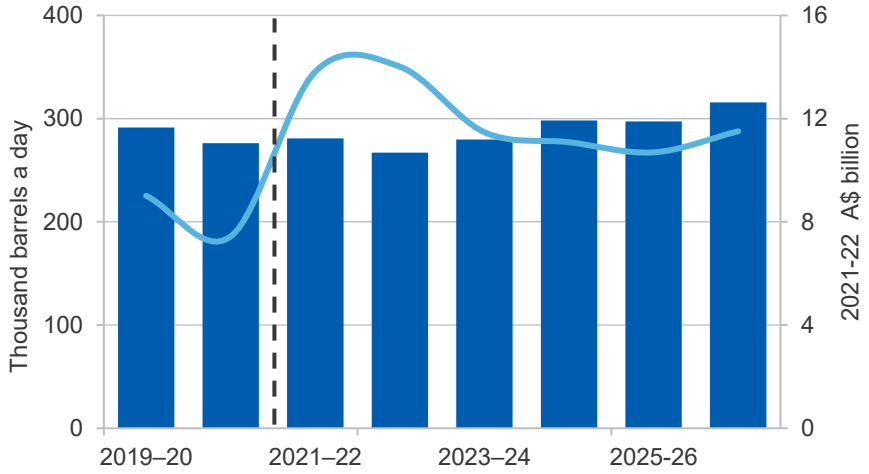
Australian export earnings to lift with high prices and solid production

In 2021–22, Australian crude and condensate export values are forecast to increase by 86% to $13.8 billion, driven by high oil prices, as well as stronger production volumes, particularly for condensate. Exports are forecast to rise slightly in 2022–23, due to the higher oil prices forecast for 2022 and 2023. Between 2023–24 and 2026–27, export values are projected to remain around $11 billion, as prices gradually decline (in 2021–22 dollars) (Figure 8.8).

Domestic refinery production falling with refinery closures

After a challenging 2020 — with low transport fuel demand combined with commercial and international factors — half of Australia's refineries began converting to import terminals in the 2020-21 financial year. The closure of the Kwinana (WA) and Altona (VIC) refineries will contribute to a fall in refinery output of petrol, diesel and jet fuel for 2021–22. Output for 2021–22 is expected to decline by 33% from 2020–21 levels.

Figure 8.8: Australian oil and feedstock exports



Notes: Includes crude oil and condensate, but excludes LPG.
Source: Australian Bureau of Statistics (2022); Department of Industry, Science, Energy and Resources (2022).

The two remaining refineries — Ampol's refinery in Lytton (Queensland) and Viva Energy's refinery in Geelong (Victoria) — have committed to continue to operate until at least mid-2027, with the offer of Government support. As part of the 2021–22 Budget, the Australian Government announced a new fuel security package. The package includes a variable fuel security services payment to the two refineries, which provides payment for the production of key transport fuels (jet fuel, petrol and diesel). The refiners will also receive up to $302 million each to conduct major infrastructure upgrades to produce and supply better quality fuels. A minimum stockholding obligation (MSO) is also included in the package, requiring importers and refiners in Australia to maintain minimum stocks of key transport fuels.

Consumption figures for the financial year will be constrained by south east coast state lockdowns, which occurred in the second half of 2021. However, consumption will be aided by stronger demand for transport fuels in the first half of 2022, when restrictions were lifted and state borders reopened. The rebound in transport fuel demand was already evident at the end of last year; in December 2021, sales of jet fuel rose 22%, and petrol sales rose 6%, compared with November 2021 levels. Throughout the COVID-19 pandemic, demand for diesel has remained strong. Consumption for 2020–21 was 2% higher than in 2019–20, owing to its broad consumption base. Demand for diesel is anticipated to grow further in 2021–22.

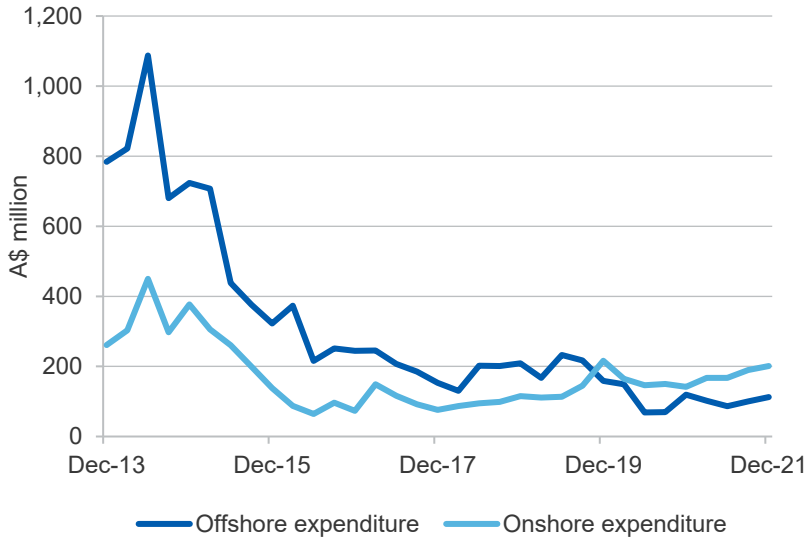
Refined product imports for 2021–22 are expected to increase by 20%, driven by the reduced refinery capacity. Meanwhile, imports of crude oil and other refinery feedstocks are expected to decrease 27%, reflecting the closure of the Kwinana and Altona refineries. Imports of diesel and petrol reached record levels in November and December 2021.

Consumption for 2022–23 is expected to recover to pre-pandemic (2018–19) levels, driven by growing demand for aviation fuels — with the reopening of Australia's international border. In 2018–19, aviation consumption accounted for a relatively high share of product usage — around 16%. For the remainder of the outlook period, Australian oil consumption is projected to increase marginally, reaching one million barrels a day by 2026–27. Reduced Australian refining capacity will likely see imports of refined products increase significantly over the outlook.

Exploration

In the December quarter 2021, Australia's petroleum exploration expenditure was $314 million on a seasonally-adjusted basis — a quarterly increase of $24.2 million or 8.3%. This is 20% higher year-on-year. Onshore exploration rose 6% to $201 million, while offshore increased by 13% to $113 million (Figure 8.9).

Figure 8.9: Australian petroleum exploration



Source: Australian Bureau of Statistics (2022) Mineral and Petroleum Exploration, 8412.0.

Revisions to forecasts

Since the December 2021 REQ, the forecast for Australia's crude and condensate export earnings has been revised up by around $1.2 billion in 2021–22 and $2.7 billion in 2022–23, due to significantly higher oil price forecasts. Compared to $11.4 billion in the March 2021 REQ, export earnings in 2025–26 are now forecast at $10.7 billion.

Box 8.1: Impact of Russia's invasion of Ukraine on global oil and gas markets – scenario analysis

Oil and gas prices have been highly volatile since early January 2022, when speculation of a Russian invasion of Ukraine began to affect energy markets. Prices rose after the invasion began, with oil prices reaching US$134 at the beginning of March. North East Asian LNG spot prices have risen to over US$54 a mmBtu.

Russia is the second largest supplier of gas and the third largest supplier of oil into global markets. There is a particularly heavy reliance on Russian energy products in Europe, where Russia accounted for 40% of gas imports and 25-30% of oil imports in 2021.

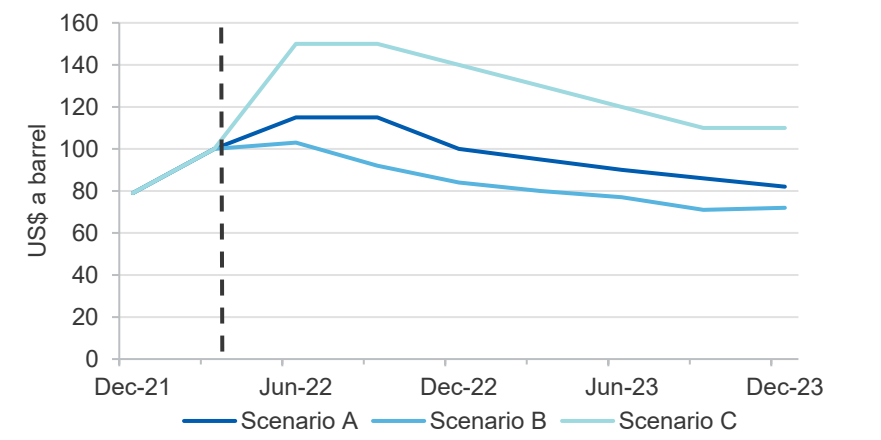
Russian energy exports are now facing sanctions from various countries, including the US, UK and Australia, though significant gas importers in Europe have not yet committed to stopping their purchases. Other countries and companies are turning away from Russian supply in less formal ways. These impacts on Russian supply will have significant and highly variable impacts on the prices of key energy commodities such as oil and gas/LNG.

The situation in Ukraine and the global response continues to change rapidly. As a result, price forecasts for oil and LNG face significant uncertainty, which leads to uncertainty around Australia's export revenue. The forecast oil price affects Australia's LNG export earnings, since almost three quarters of Australian LNG is sold under long-term oil-price linked contracts.

Three pricing scenarios have been developed to provide a sense of the possible outcomes. These are a 'baseline', a 'lower impact' case (under which prices correct more rapidly), and a 'severe impact' case (under which high prices persist for longer). The scenarios cover 2022 and 2023.

The baseline scenario for oil and LNG underpins the analysis in the oil and LNG chapters for this edition.

Figure 8.10: Oil price scenarios



Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022).

Scenario A: Baseline

Under this scenario, OPEC+ are assumed not to make any changes to their monthly scheduled increase in oil production. The revival of the Joint Comprehensive Agreement Plan of Action between the US and Iran is delayed, and full Iranian oil exports therefore do not re-enter the global market before the end of 2023. Russian oil supply to Europe is assumed to continue over the outlook. Heightened price volatility persists, due to the increased risk premium associated with active conflict, even as Russia-Ukraine negotiations progress.

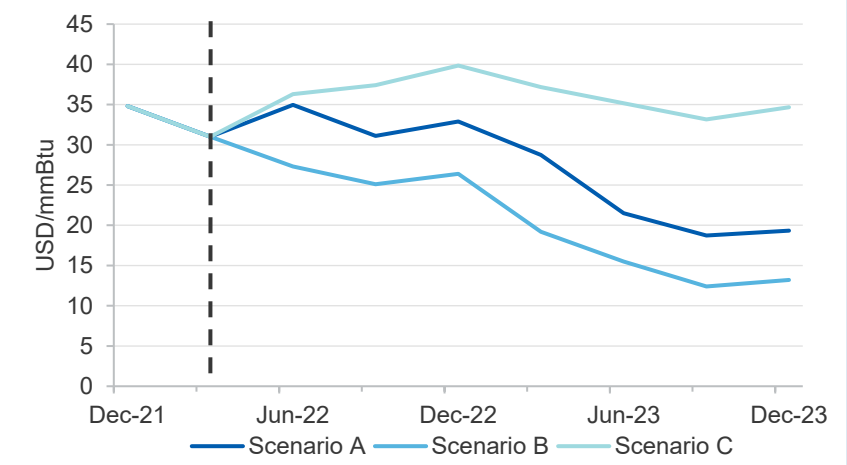
Under these conditions, it is expected that prices peak in the June and September quarters of 2022, averaging $US115 a barrel, before declining gradually as markets re-organise. The scheduled increases from OPEC+, along with higher output from other producers, help to build global inventories and place downward pressure on prices. Prices start to ease from late 2022 and average $US90 a barrel by the June quarter of 2023.

For LNG, the baseline case assumes no significant disruptions to Russian flows to Europe, and no sanctions against Russian LNG exports into Asia.

Prices are assumed to stay above long-run averages in 2022, as Europe seeks to rebuild depleted inventories and diversify its sources of gas supply — in line with IEA guidelines. Demand for LNG is expected to increase, with prices peaking in the June quarter 2022, at US$35 a mmBtu, before slowly falling into 2023 as markets reorganise and additional US supply comes online.

The baseline scenario suggests that Australian oil export earnings (crude and condensate) will reach $13.8 billion in 2021–22, and $14.0 billion in 2022-23. Combining the oil price forecasts and the LNG spot price forecasts, Australia's export earnings from LNG are forecast to be $70.2 billion in 2021–22 and $82.0 billion in 2022–23.

Figure 8.11: North East Asian LNG spot price scenarios



Source: Argus (2022); Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022)

Scenario B: prices decline more quickly

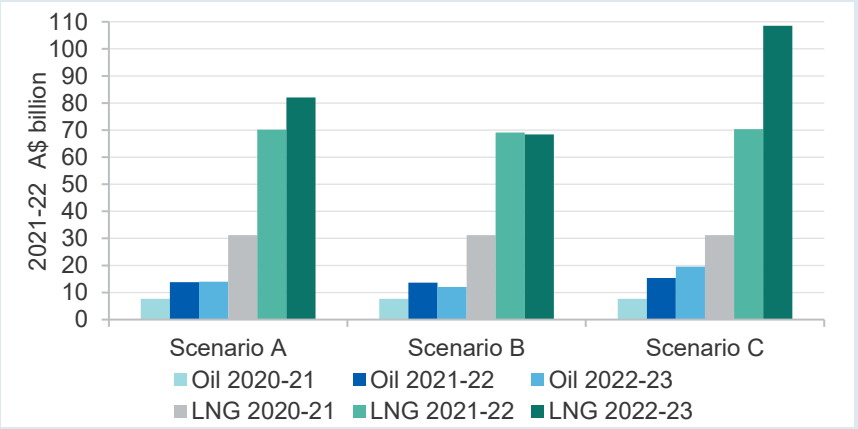
This scenario assumes that current volatility in pricing is short-lived, and that prices for both oil and LNG soon start to track towards their long-run averages. Oil prices are forecast to average $US103 a barrel for the June quarter 2022, declining to $US84 a barrel by the December quarter 2022.

OPEC+ is assumed to maintain scheduled monthly output increases, and no other major nations are assumed to impose sanctions on Russian oil imports. Full Iranian oil exports potentially enter the market within the next year. Market 'reorganisation' occurs rapidly. Under these conditions, prices could be expected to reach $US77 a barrel by the June quarter 2023.

LNG prices remain elevated in the June quarter 2022, but decline sooner and more sharply than in the baseline scenario. Disruptions to LNG flows from Russia to European and other markets are minimal, and Europe's demand for LNG (and gas more generally) declines. In this scenario, prices track towards their long-run averages by the end of 2023, reaching US$13.2 a mmBtu in the December quarter.

Scenario B implies that Australia's oil export earnings will be $13.7 billion in 2021–22, and $12.1 billion in 2022–23. Combining the oil price forecasts and LNG spot price forecasts, Australia's LNG export earnings are forecast at $69.1 billion in 2021–22 and $68.4 billion in 2022–23.

Figure 8.12: Australian Oil and LNG export earnings by scenario



Notes: Includes crude oil and condensate, but excludes LPG.
Source: Australian Bureau of Statistics (2022); Department of Industry, Science, Energy and Resources (2022).

Scenario C: prices reach higher levels, and remain there for longer

Under this scenario, the fallout from the Russian invasion of Ukraine has a tangible impact on supply in both global oil and gas markets, with prices reaching record levels, and sustaining high levels for far longer than under the baseline scenario.

The ongoing conflict is assumed to cause severe damage to infrastructure and delays to seaborne freight, and European markets turn away from Russian crude. Under these conditions, prices are forecast to reach $US150 a barrel in the June quarter, holding until early 2023 and then declining slowly to average $US110 a barrel by December quarter 2023.

For LNG, prices continue to rise through 2022, peaking at US$40 a mmBtu in the December quarter. It is assumed that both Asian and European markets turn away from Russian gas, with significant impacts given Russia's importance as a supplier to countries such as Japan. With limited ex-Russian supply available, prices peak late in 2022, rising even during the conventional "low demand" seasons, as consumers seek to refill storage. This impact is expected to soften in 2023, as markets re-organise. Prices nonetheless remain above US$35 a mmBtu at the end of 2023, close to the level of the December quarter 2021.

Under the severe impact scenario, Australia's export earnings from oil are forecast to reach $15.4 billion in 2021–22, and $19.6 billion in 2022–23. Combining the oil price forecasts and the LNG spot price forecasts, Australia's export earnings from LNG are forecast to reach $70.3 billion in 2021–22 and $109 billion in 2022–23.

Table 8.1: Oil Outlook

World	Unit	2021	2022[f]	2023[z]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR r
Production [a]	mb/d	95	99	102	103	104	105	105	1.7
Consumption [a]	mb/d	98	100	102	103	104	105	106	1.4
WTI crude oil price									
Nominal	US$/bbl	68	99	84	70	65	63	65	-0.7
Real [b]	US$/bbl	70	99	82	66	60	57	57	-3.2
Brent crude oil price									
Nominal	US$/bbl	70	108	88	74	70	69	72	0.4
Real [b]	US$/bbl	73	108	86	70	65	62	64	-2.2
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[z]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR r**
Crude and condensate									
Production[ac]	kb/d	335	337	327	338	359	359	381	2.2
Export volume[a]	kb/d	276	281	267	280	298	297	316	2.3
– Nominal value	A$m	7,434	13,823	14,013	11,473	11,086	10,693	11,510	7.6
– Real value[h]	A$m	7,685	13,823	13,589	10,837	10,212	9,610	10,092	4.6
Imports[a]	kb/d	247	181	185	183	178	174	168	-6.2
LPG production[acd]	kb/d	92	96	98	90	104	103	102	1.7
Refined products									
– Refinery production[ac]	kb/d	375	249	233	230	227	224	222	-8.4
– Export volume[ae]	kb/d	13	10	9	9	9	9	9	-6.2
– Import volume[a]	kb/d	647	773	843	862	894	907	911	5.9
– Consumption[acg]	kb/d	913	944	997	1,020	1,038	1,050	1,052	2.4

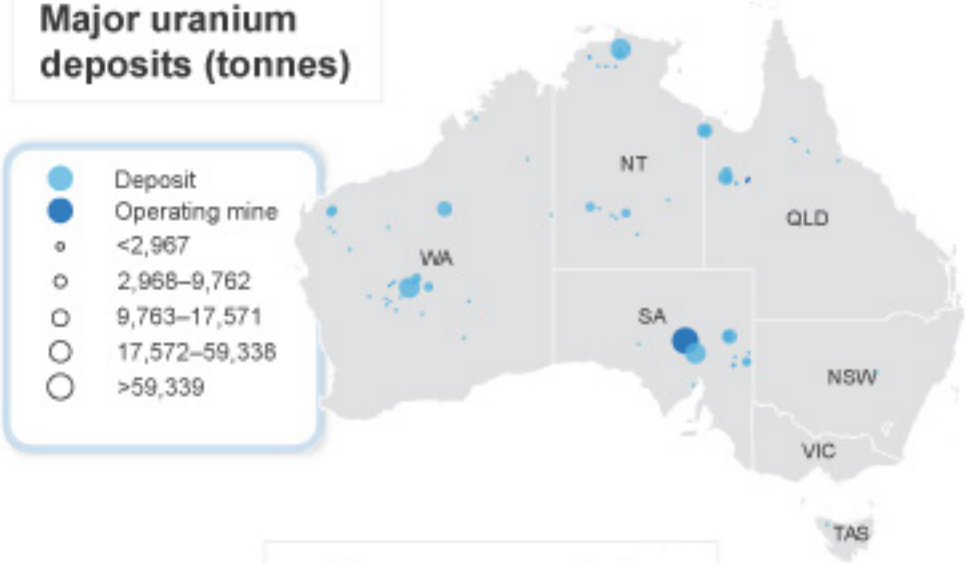
Notes: **a** The number of days in a year is assumed to be 365, and a barrel of oil equals 158.987 litres; **b** In 2022 calendar year US dollars; **c** Historical production data was revised in the December quarter 2021 to align with the Australian Petroleum Statistics **d** Primary products sold as LPG; **e** Excludes LPG; **f** Forecast; **g** Domestic sales of marketable products, including imports; **h** In 2021-22 financial year Australian dollars; **s** estimate.

Source: ABS (2022) International Trade in Goods and Services, Australia, Cat. No. 5368.0; International Energy Agency (2022); EnergyQuest (2022); US Energy Information Administration (2022); Department of Industry, Science, Energy and Resources (2022).

Uranium

92 U 238.029

Major uranium deposits (tonnes)



Uranium facts

- Originally formed in supernovae more than **6 billion years ago**
- Nuclear plants can supply electricity to **4-5 million people**
- Nuclear has among the **lowest death and accident rates** of any power source

Consumer markets

- 27% EU
- 26% USA
- 21% Others
- 15% China
- 9% Russia
- 2% Japan

Australia's Uranium

- **Ranked no 1** for **uranium resources**
- **3rd largest uranium producer** in the world
- **Exports** worth more than **$400m**

9.1 Summary

- Uranium prices are forecast to lift from US$36.50 a pound in 2021 to US$47 a pound by 2027 (in real terms). A long period of low prices resulted in many uranium projects being deferred or cancelled, leading to potential uranium shortfalls during the outlook period.
- Australian production is forecast to decline from 2021, as the number of active uranium mines falls from three to two.
- Price growth is expected to see uranium export values increase from $500 million in 2021–22 to $729 million by 2026–27 (in real terms).

9.2 World consumption

More countries are showing interest in nuclear reactors

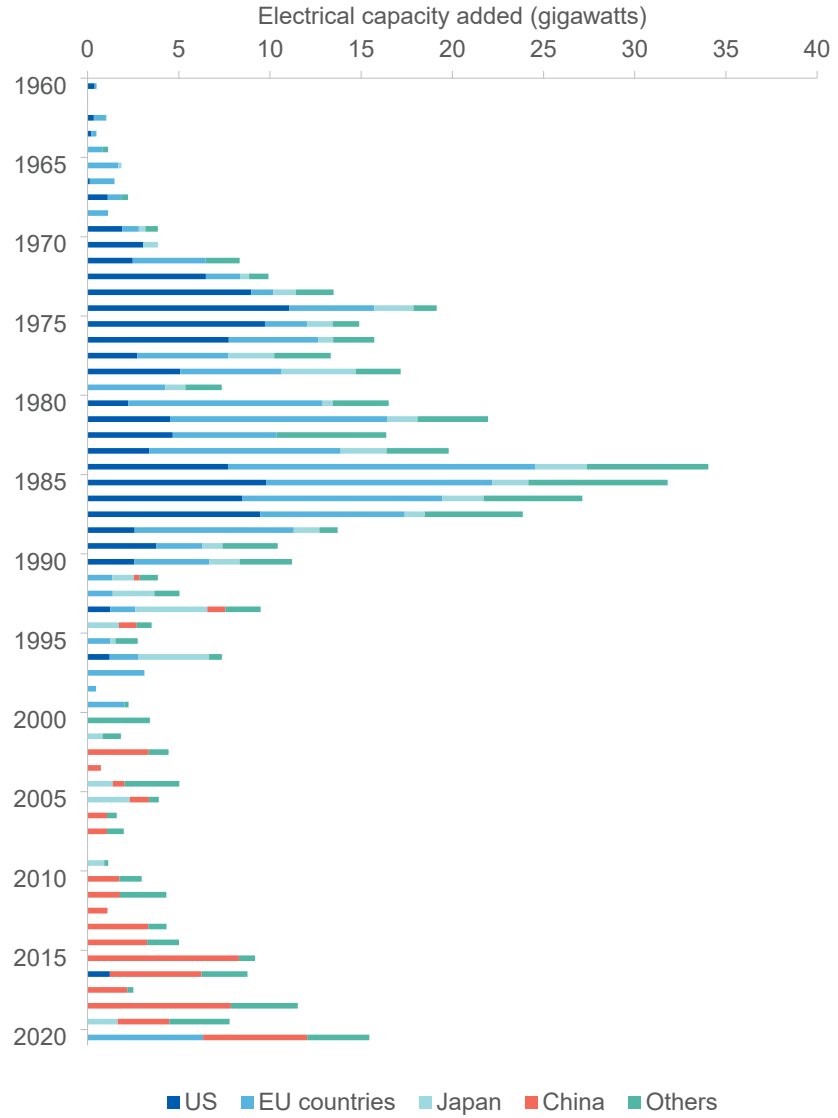
Nuclear power development is being taken up by a broader array of countries (Figure 9.1 and 9.2), with several building nuclear power for the first time, or pivoting back to it.

Among the latter countries is France, where the Government has announced that six new nuclear reactors will be constructed, with a further eight under consideration. The French Government has also announced that it will seek to progress development of small modular reactor technology for domestic use. France generates the bulk of its electricity from nuclear power, but had slowed construction in recent years.

Uptake is also growing in other parts of Europe. A small modular reactor has been scheduled for deployment in Poland from 2029, with NuScale Power and Polish company KGHM signing a work agreement. In Belarus, fuel loading has begun at the Ostrovets plant's second reactor. Finland's Olkiluoto unit 3 has started supplying electricity to the national grid, with the plant expected to produce around 14% of Finland's electricity needs.

The Slovenian Government has announced that it will close all coal-fired power plants by 2033, and will construct a nuclear plant at Krško as a replacement. Seeking to build on current momentum for coal replacement, Bryden Wood – a UK company – has announced that it is developing a new digital platform intended to enable easier replacement of coal-fired boilers with modular nuclear reactors.

Figure 9.1: Growth in world nuclear power generation



Source: International Energy Agency (2021); World Nuclear Association (2021); Department of Industry, Science, Energy and Resources (2021)

China continues to progress with numerous reactors. Unit 6 of the Fuqing nuclear plant entered commercial operation in early 2022, following a similar connection of Fuqing 5 in 2021. Concrete has been poured at unit 2 of the San'ao nuclear power plant. The first of six units at the Taipingling nuclear power plant passed a key milestone, with installation completed on the safety dome.

Several reactors reached scheduled closure in late 2021. Russia's Kursk 1 reactor shut down after 45 years of use. Reactor 4 of Scotland's Hunterston B nuclear plant closed at the end of 2021. In Germany, the Brokdorf, Grohnde and Gundremmingen C reactors all closed, in line with the country's nuclear phase-out policy. The last three active German reactors are scheduled to close by the end of 2022, but this could be reconsidered in the wake of the Russian invasion of Ukraine and a growing push to avoid heightened dependency on imported Russian gas.

Reactor connections are expected to largely offset closures over the outlook period. On balance, uranium consumption is expected to remain largely steady at around 90,000 tonnes annually, with growth picking up from the late 2020s.

9.3 World production

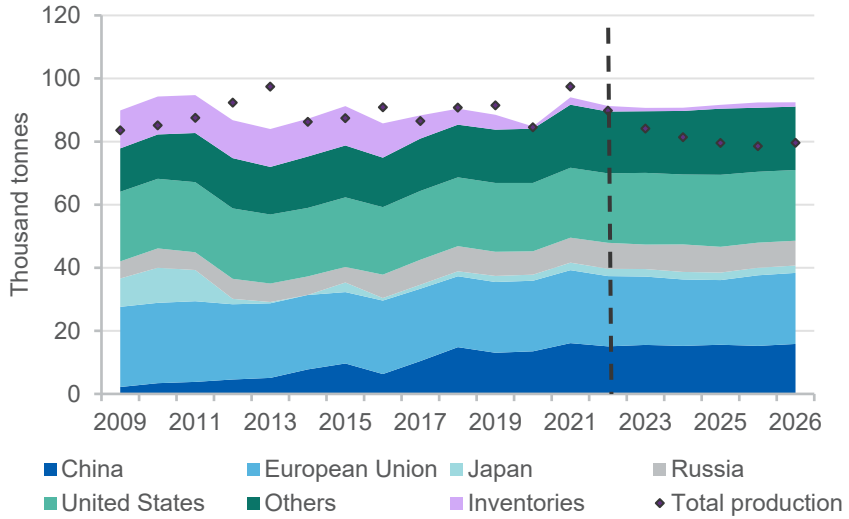
Large suppliers are shifting back to full production

In Canada, Cameco has announced that production will re-commence at its McArthur River mine, which has been idle for more than three years. The mine is one of the world's largest, but the company has announced that supply will be kept constrained for the time being.

Prospects for use of the extensive Khokhlovskoye uranium deposit in Russia have picked up, following a decision by the Russian Government to classify the area as 'industrial land'.

Ukraine's Government has announced a program to make Ukraine fully self-sufficient in uranium by 2027. This program will aim to expand domestic uranium mining to support nuclear energy, which provides more than half of Ukraine's electricity generation. However, major uncertainties remain on the program's progress following Russia's invasion of Ukraine.

Figure 9.2: World uranium consumption and inventory build (U3O8)



Source: International Energy Agency (2022); World Nuclear Association (2022); Ux Consulting (2022)

9.4 Prices

Prices are expected to rise steadily, and potentially rapidly

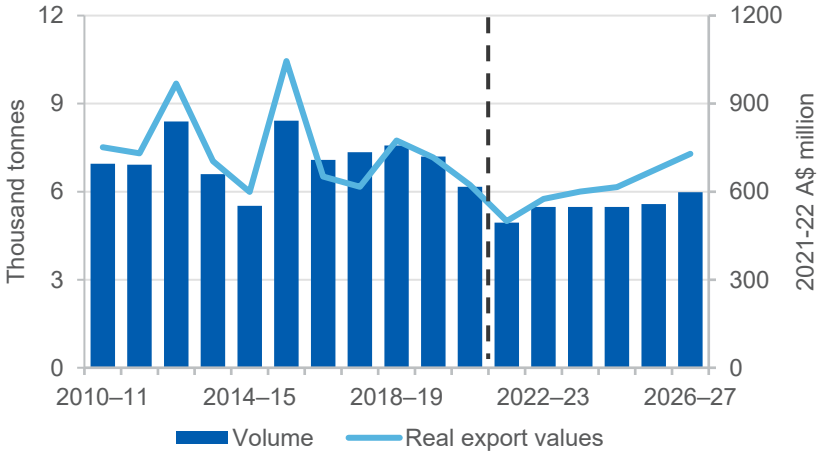
Uranium prices have lifted in recent months, supported by greater investor interest in the uranium spot market. Kazakhstan, which is the world's largest supplier of uranium, also faced significant public protests in early 2022, and the possibility of further protests presents a possible supply and price risk.

Price gains are also expected to be driven by long-term factors (Figure 9.3). After years of deferrals of uranium projects, there is a growing prospect that supply shortfalls could emerge as existing mines gradually deplete during the second half of the outlook period. Uranium mines typically take a long time to obtain approvals, potentially drawing out supply shortages over the longer term and creating a baseline for structurally higher prices in the late 2020s. The shortfall could lead to prices spiking significantly above forecast levels, though global reserves remain high among most major importers.

Figure 9.3: Uranium price outlook

Source: Cameco Corporation (2022) Uranium Spot Price; Ux Consulting (2022) Uranium Market Outlook

Figure 9.4: Australia's uranium exports



Source: Department of Industry, Science, Energy and Resources (2022)

9.5 Australia

Production and exports are set to decline in the short term

Production at Olympic Dam fell in the December 2021 quarter, due to disruptions caused by maintenance. This maintenance was completed in January 2022, and solid production is expected through the rest of the year.

Prospects for additional output in Australia over the longer term are mixed. Of the four potential mines granted permits in Western Australia, three have now seen their permits lapse, due to a failure to pass key milestones for 'substantial commencement' of the projects. The remaining deposit — Vimy's Mulga Rock — has achieved sufficient progress to continue, with Vimy forecasting production from 2025. Cameco has announced that it remains committed to its proposed mine in Yeelirrie, and has requested an extension to Western Australia Government approval processes.

Re-opening of the Honeymoon mine in South Australia also remains in prospect, though mine owners are currently building inventory from spot markets in lieu of opening up new deposits.

Overall mining exploration fell to $3 million in the December quarter 2021, continuing a trend of low exploration spending in recent years. Growth in uranium exploration is expected if uranium prices continue to rise.

Uranium export earnings are expected to grow from $500 million in 2021-22 to $729 million in 2026-27 (in real terms). Higher prices are expected to build on output growth (including from the Mulga Rock deposit) towards the end of the outlook period (Figure 9.4).

Revisions to the outlook

Export earnings forecasts for 2021–22 and 2022–23 have been revised up by around $50 million (nominal terms) in line with a stronger price forecast. The export earnings forecast for 2025–26 is unchanged from the March 2021 *Resources and Energy Quarterly*.

Table 9.1 Uranium outlook

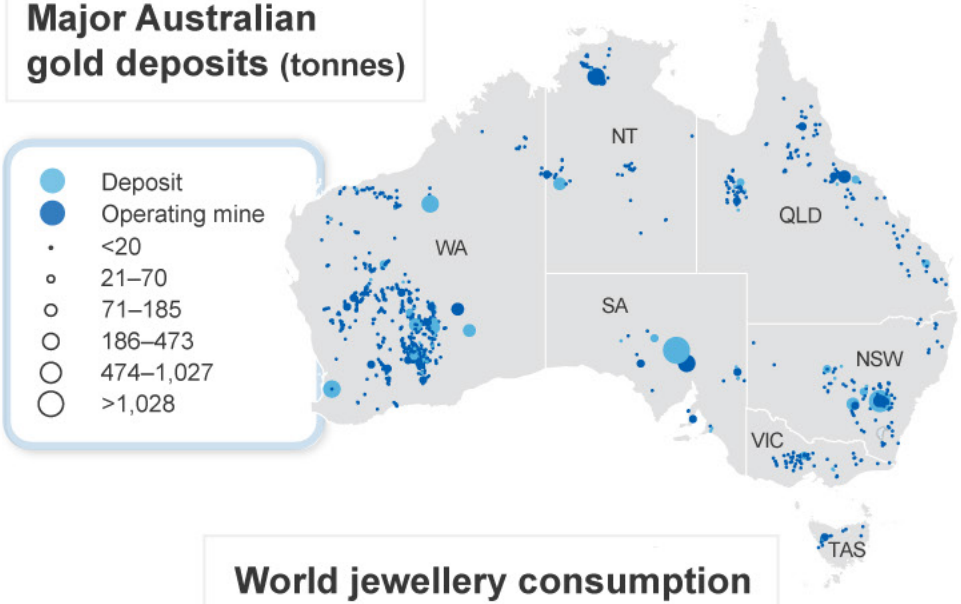
World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Production	kt	55.0	59.3	61.2	63.5	63.9	65.2	66.9	3.3
Africa[b]	kt	9.1	8.9	10.0	10.5	10.1	9.4	9.0	0.0
Canada	kt	5.4	8.2	8.6	8.6	8.6	10.5	11.4	13.2
Kazakhstan	kt	26.6	26.6	26.6	28.3	28.6	28.3	29.4	1.7
Russia	kt	3.3	3.3	3.7	3.9	4.1	4.2	4.2	4.1
Consumption	kt	91.7	89.5	89.6	89.7	90.4	90.8	91.1	-0.1
China	kt	16.1	15.1	15.5	15.2	15.6	15.2	15.8	-0.3
European Union 28	kt	23.1	22.3	21.7	21.1	20.5	22.4	22.5	-0.4
Japan	kt	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.0
Russia	kt	7.9	8.2	7.8	8.7	8.1	8.0	7.8	-0.2
United States	kt	22.2	22.0	22.7	22.2	22.8	22.5	22.5	0.2
Spot price	US$/lb	35.3	43.5	44.7	45.6	48.8	52.2	52.9	7.0
real[c]	US$/lb	36.5	43.5	43.5	43.3	45.2	47.3	46.7	4.2
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Mine production	t	6,213	4,258	5,480	5,480	5,480	5,580	5,980	-0.6
Export volume	t	6,166	4,944	5,480	5,480	5,480	5,580	5,980	-0.5
– nominal value	A$m	606	500	588	627	659	737	818	5.8
– real value[d]	A$m	622	500	575	600	615	672	729	3.4
Average price	A$/kg	94.4	101.1	107.3	114.5	120.2	132.1	136.9	6.4
– real[d]	A$/kg	96.9	101.1	105.0	109.5	112.3	120.5	121.9	3.9

Notes: **b** Includes Niger, Namibia, South Africa, Malawi and Zambia; **c** In 2022 US dollars; **d** in 2021–22 Australian dollars; **s** estimate; **f** forecast; **r** Compound annual growth rate; **z** Projection
Source: Department of Industry, Science, Energy and Resources (2022); Cameco Corporation (2022); Ux Consulting (2022) Uranium Market Outlook

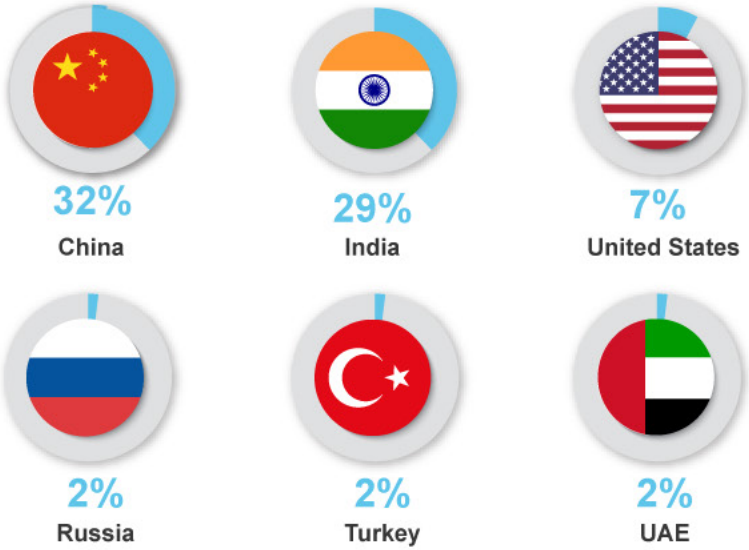
79
Au
196.967

Gold

Major Australian gold deposits (tonnes)



World jewellery consumption



Gold

- Gold is a critical component in COVID-19 diagnostic tests
- The US holds the largest stockpile of gold reserves: **8,134 tonnes**
- In 2021 jewellery fabrication made up **55% of global gold use**
- Gold makes up **3 parts per billion** of the Earth's outer layer

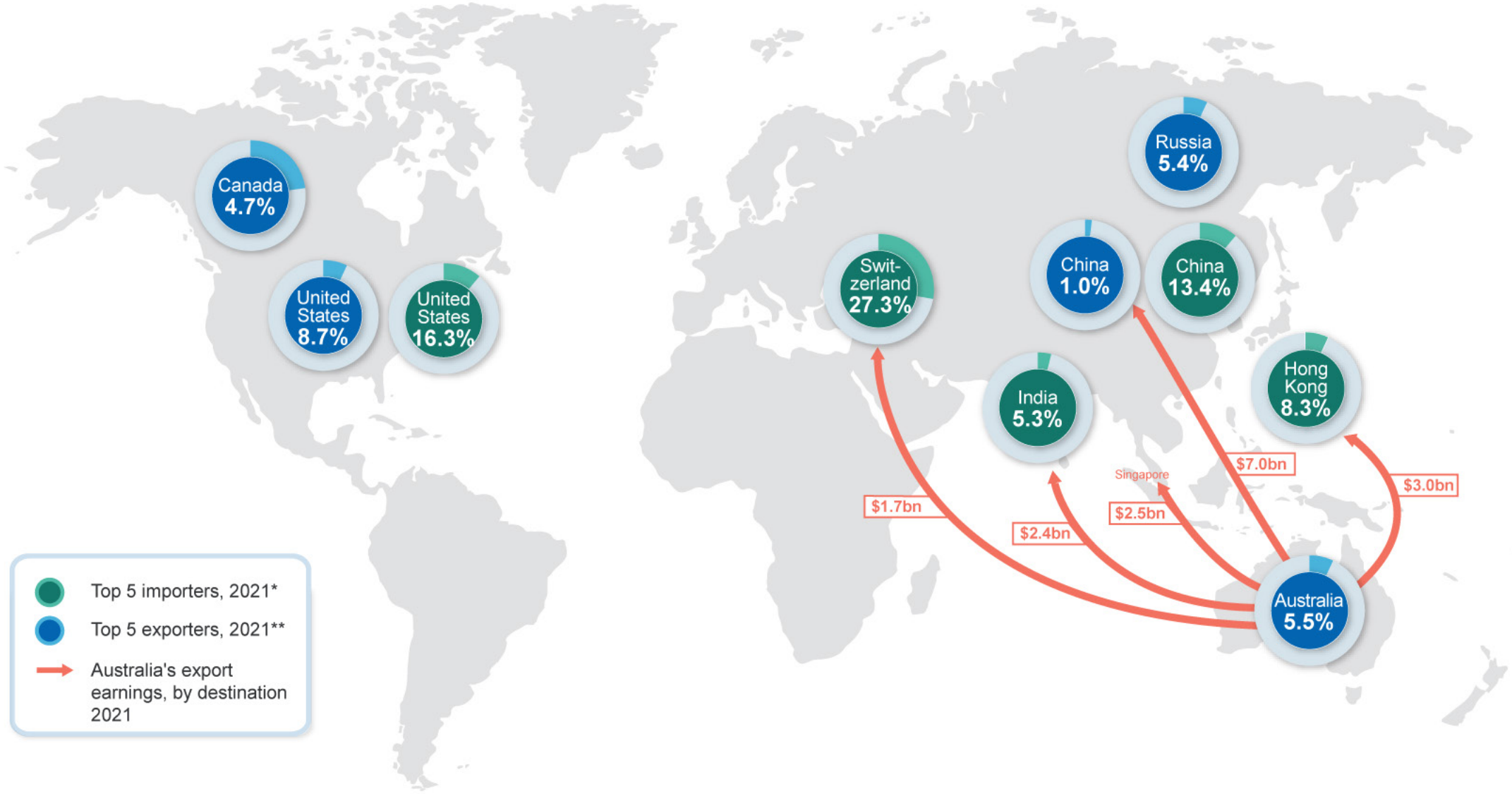
Australia's gold

- **World's no.2** producer of gold in **2021**
- **World's largest reserves** of gold
- **World record** holder for **largest gold coin** one tonne

79 Au 196.967

Gold

Trade map | March 2022



* % of world imports (including ETFs and other investments)

** % of gold export from top 5 gold producing countries

10.1 Summary

- The Russian invasion of Ukraine is likely to support gold demand and prices in the very short term. However, the gold price is forecast to slide from an average of US$1,770 an ounce in 2022 to US$1,380 an ounce in 2027 in real terms as real bond yields lift.
- Production from new mines and existing mine expansions is expected to boost gold mine production to 374 tonnes in 2026–27 (see Australia section).
- Lower gold prices are expected to push the value of Australia's gold exports down to $22 billion in 2026–27 in real terms.

10.2 Consumption

World gold consumption increased in 2021

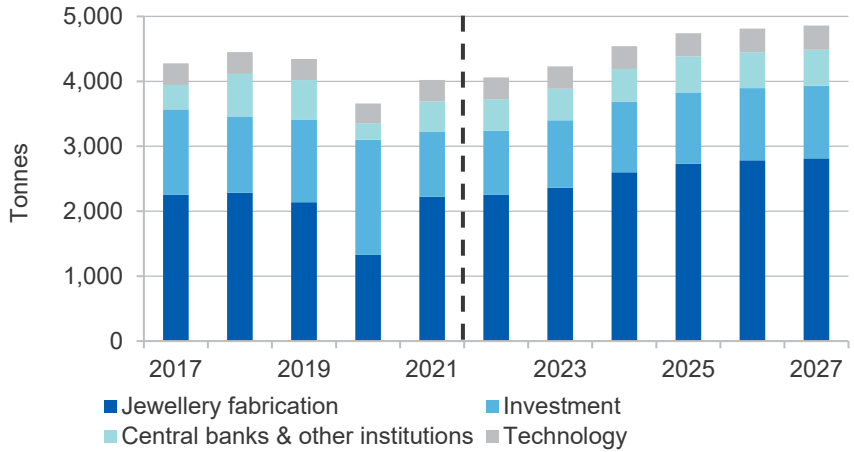
World gold consumption increased by 9.9% year-on-year to 4,021 tonnes in 2021 (Figure 10.1). The economic recovery from the pandemic provided support to gold jewellery demand in 2021, up 52% year-on-year, to 2,124 tonnes. China and India have led this recovery, as lower and more stable gold prices (compared with 2020) and rising personal income lifted gold demand.

In China, gold consumption grew by 57% year-on-year in 2021 to 960 tonnes. The growth included a 63% year-on-year rise in jewellery usage and a 44% year-on-year rise in gold bars and coins consumption.

In India, gold consumption increased by 79% year-on-year to 797 tonnes in 2021, propelled by a 93% year-on-year rise in jewellery consumption and a 43% year-on-year rise in gold bars and coins consumption. The rise in jewellery consumption was largely attributed to the postponement of weddings to 2021, following outbreaks of the COVID-19 pandemic in 2020.

In the US, gold consumption grew by 42% year-on-year to 266 tonnes in 2021, driven by the COVID-19 vaccine rollout, improved consumer sentiment and high household savings. In Europe, gold consumption rose by 8.9% year-on-year to 332 tonnes in 2021, supported by a 21% year-on-year rise in jewellery consumption.

Figure 10.1: World gold demand by sector



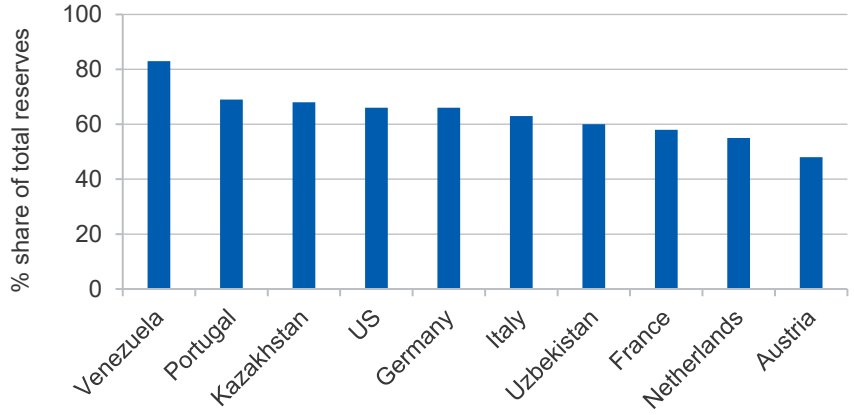
Notes: Jewellery fabrication includes jewellery consumption and jewellery inventory. Investment includes ETFs, bars and coins. Technology includes gold used in the electronic, dentistry and other industrial sectors.
Source: World Gold Council (2022); Metals Focus (2022); Department of Industry, Science, Energy and Resources (2022).

Net official sector (central banks and other government institutions) purchases increased by 82% year-on-year to 463 tonnes in 2021. A desire to diversify reserves, growing debt levels and rising inflation appear to have been the catalyst for central banks' growing appetite towards gold. According to the World Gold Council, Thailand and India were the largest gold buyers in 2021, purchasing 165 tonnes of gold. The Philippines and Kyrgyz Republic were the largest gold sellers in 2021, selling a combined total of 38 tonnes of gold.

Figure 10.2 shows the share of gold in total reserves in some selected countries. Gold accounted for 83% of Venezuela's country reserves, 69% in Portugal, 68% in Kazakhstan and 66% in the US.

Demand for gold in technology increased by 8.9% year-on-year to 330 tonnes in 2021, propelled by a 9.2% year-on-year rise in gold used in the electronics sector. The COVID-19 pandemic has increased demand for

Figure 10.2: Gold share of country reserves, 2021



Notes: Gold holdings as of June 2018 (Venezuela), November 2021 (Portugal, Germany, Italy, France, the Netherlands and Austria), and December 2021 (Kazakhstan, the US and Uzbekistan).
Source: World Gold Council (2022)

high-end LEDs which are used in skin sensors and heart rate-tracking functionality in smartphones and watches. Over this period, gold used in other industrial applications rose by 12% year-on-year to 47 tonnes. High gold prices affected demand for gold in the dental sector; usage was down by 4.2% year-on-year to 11.4 tonnes in 2021, as consumers substituted ceramics for gold.

Offsetting the rise in gold consumption in the jewellery, official and industrial sectors, gold-backed exchange traded funds (ETFs) had a net outflow of 173 tonnes of gold (equivalent to US$9.0 billion) in 2021. An improving global economy and the COVID-19 vaccine roll-out led to an exodus of institutional investors' funds from safe haven assets (such as gold ETFs) to riskier assets. Global stock markets continued to reach record highs in 2021, attracting record investment fund flows.

Wold gold consumption to rise in 2022

World gold consumption is forecast to increase by 1.0% to 4,061 tonnes in 2022 (Figure 10.1), driven by increased jewellery consumption, which is forecast to rise by 6.0% in 2022.

Jewellery demand from China is expected to remain strong, supported by rising consumer confidence and income. Chinese jewellery retailers are increasingly using private and social media channels to attract young Chinese consumers.

Demand from India is expected to continue to recover in 2022, as more people are vaccinated against COVID-19 and the economy recovers.

In the US, jewellery demand is forecast to be lower than in 2021, with consumer discretionary spending expected to move towards leisure activities as COVID-19 restrictions ease and economic activity normalises.

The official sector is expected to add to gold demand in 2022, as geopolitical tensions (especially between Russia and Ukraine) persist. Central bank gold buying is forecast to rise by 5.0% to 486 tonnes in 2022.

In October 2021, the National Bank of Poland (Poland's central bank) release its plan to purchase 100 tonnes of gold in 2022. The central bank has said this planned addition aims to lift Poland's financial security, taking the nation's gold reserve to 330 tonnes. This would put Poland ahead of other major gold holders such as the UK, Saudi Arabia and Austria.

World gold demand projected to rise until 2025, then fall in 2026 and 2027

After 2022, world gold consumption is projected to rise at an annual average rate of 4.0%, reaching 4,925 tonnes by 2027, as lower gold prices boost jewellery demand and retail investment (Figure 10.1).

Over this period, global jewellery consumption is projected to grow at an annual rate of 4.6%. Consumption is projected to reach 2,812 tonnes by 2027, driven by an improvement in consumer sentiment, rising income and lower gold prices.

Demand from China is expected to pick up, as price-sensitive Chinese consumers react to price falls. Economic growth, ongoing urbanisation, and rising incomes are all expected to contribute to higher jewellery demand in India. In the US and Europe, an improvement in consumer confidence is also likely to support the demand for gold jewellery in those markets (Figure 10.1).

The forecast decline in gold prices will likely attract a return of retail investors to the gold bar and coin markets. Gold bar and coin demand by investors is projected to grow at an annual rate of 2.6% between 2023 and 2027, to reach 1,121 tonnes by 2027.

After reaching a ten-year low of 255 tonnes in 2020, the pace of central bank gold buying is projected to increase by an average 2.7% a year over the 2023 and 2027 period, reaching 554 tonnes in 2027. Central banks are expected to shift their focus from accommodative liquidity requirements — to support economic growth during the COVID-19 pandemic — to reserves diversification, in order to try to protect their wealth.

10.3 Production

World gold supply declined in 2021

World gold supply decreased by 1.2% year-on-year to 4,666 tonnes in 2021 (Figure 10.3). Driving the decline was an 11% year-on-year fall in gold scrap supply, to 1,150 tonnes. Improved economic activity and employment opportunities reduced the sale of gold by consumers to jewellery retailers in many parts of the world.

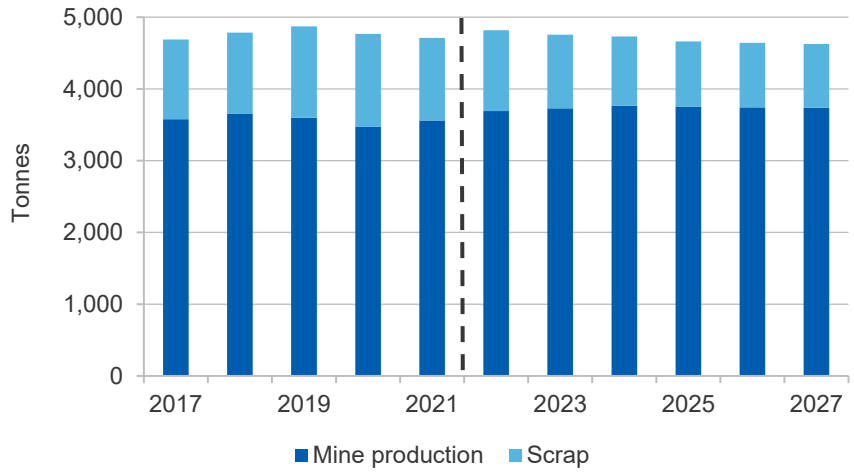
Offsetting the decline in gold scrap supply was a 2.5% year-on-year rise in world gold mine production to 3,561 tonnes, as the COVID-19 containment measures impacted less on production.

Gold mine production in Canada rose by 11% year-on-year to 189 tonnes in 2021, propelled by the ramp-up of production from new mines and the return to full production at the Musselwhite gold mine (following a fire incident in the March quarter 2019).

Indonesian gold mine output increased by 21% year-on-year to 122 tonnes in 2021, as the Grasberg gold mine ramped up underground operations.

Gold mine output in Mexico and South Africa in 2021 rose by 13% and 12% year-on-year, to 125 and 117 tonnes, respectively, as the COVID-19 pandemic impacted less on production and ore grades improved.

Figure 10.3: World gold supply



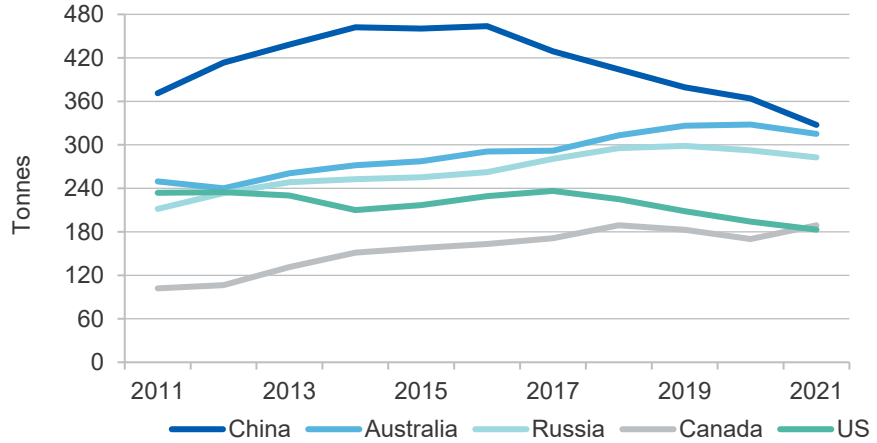
Notes: Net producer hedging is not included.
Source: World Gold Council (2022); Metals Focus (2022); Department of Industry, Science, Energy and Resources (2022).

Stricter environmental regulation and increased safety checks led to a 10% year-on-year decline in China's gold mine production to 328 tonnes in 2021.

Production in Australia decreased by 3.9% year-on-year to 315 tonnes in 2021 (see Section 10.5 *Australia's exports and production*).

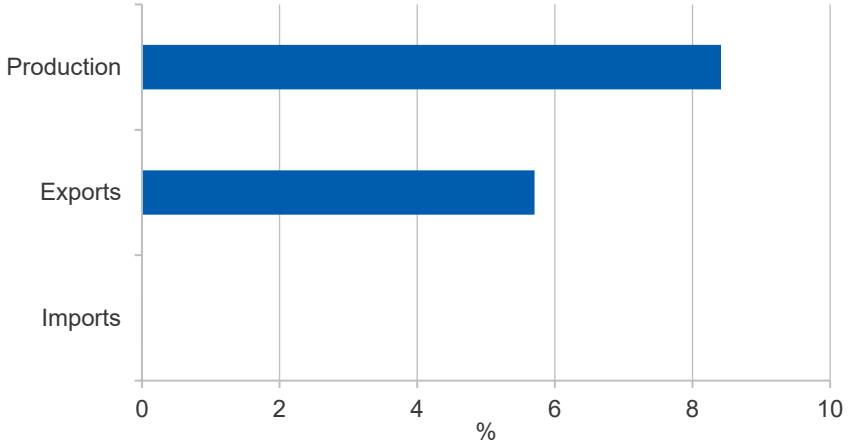
Figure 10.4 shows the world's top five gold producing countries from 2011 to 2021. China remained the world's largest gold producer, at 328 tonnes in 2021, followed by Australia (311 tonnes), Russia (283 tonnes), Canada (189 tonnes), and the US (183 tonnes). China's gold mine production has declined significantly since 2016, due to stricter environmental regulations. Production in Australia rose for eight consecutive years (from 2012 to 2020), but declined in 2021 as labour shortages, plant maintenance and lower ore grades impacted.

Figure 10.4: Top 5 gold producing countries



Notes: 2021 data is provisional.
Source: World Gold Council (2022); Metals Focus (2022); S&P Market Intelligence (2022); Department of Industry, Science, Energy and Resources (2022)

Figure 10.5: Russia's share of global gold production and trade



Source: International Trade Centre (2021); S&P Market Intelligence (2022); World Gold Council (2022)

Figure 10.5 shows Russia's share of the world gold mine production, exports and imports. Russia is the world's third largest gold producing country, accounting for 8.4% of global gold mine production. Russia exported nearly US$19 billion of gold in 2020, accounting for 5.7% of global gold exports. The country imported just US$23 million of gold in 2020, accounting for 0.01% of global gold imports.

World gold supply to rise in 2022

Lower scrap supply will be more than offset by higher gold mine production, to see world gold supply increase by 2.7% to 4,791 tonnes in 2022 (Figure 10.3).

Lower gold prices and improving economic situations of many households are likely to discourage the sale of gold jewellery: gold scrap supply is forecast to fall by 2.0% to 1,127 tonnes in 2022.

World gold mine production is forecast to increase by 3.7% to 3,692 tonnes in 2022, driven by increased production in Australia, Canada, the US and Papua New Guinea (PNG).

In Australia, a solid pipeline of projects is expected to bring the country's gold mine production to 305 tonnes in 2022.

Production in Canada and the US is forecast to increase by 19% and 9.8% to 225 and 201 tonnes in 2022, respectively.

Production in the PNG is forecast to increase by 31% to 55 tonnes in 2022, driven by a restart at Porgera gold mine, which has been in care and maintenance since April 2020.

World gold supply to fall after 2022

After 2022, world gold supply is projected to fall at an annual average rate of 0.7%, to reach 4,630 tonnes in 2027. Driving the fall will be lower gold recycling activities (Figure 10.3).

Gold scrap supply is projected to decline at an average annual rate of 4.6% over the outlook period, to 888 tonnes in 2027, as lower gold prices discourage gold selling in major jewellery consuming markets such as China and India.

Offsetting the fall in gold scrap supply is a forecast net rise in global gold mine production, as new mines come on stream and mine expansions occur; output is forecast to rise until 2024, reaching 3,767 tonnes, before falling to 3,737 tonnes in 2027. The decline in production in the final two years of the outlook period will be due to the closure of unprofitable gold mines in many parts of the world. Profitability will be squeezed by rising production costs and lower prices.

Gold output in Australia is expected to increase until 2025–26, propelled by mine expansions and new projects coming online (see Section 10.5 *Australia's exports and production*).

New projects in Canada, Chile, Brazil and Argentina are likely to increase gold output in North America and Central and South America by 124 and 82 tonnes, respectively, by 2026.

A continuation of strict environmental regulations and industry consolidation will see China's gold production fall over the outlook period.

10.4 Prices

Gold prices fell back in 2021 but have rebounded in early 2022

The global economic recovery has lifted real bond yields in recent months, undermining some of gold's appeal to institutional and retail investors. However, the strong inverse relationship between gold price and the real US 10-year Treasury bond yield seems to have weakened since early 2022: although real bond yields are higher now than they were in December 2021, tensions over the Russian invasion of Ukraine have seen the gold price rise by 7.4% since the start of 2022, reaching a 14-month high of US$2,051 an ounce on 8 March 2022 (Figure 10.6).

On 16 March 2022, the US Federal Reserve raised the target for the fed funds rate by 25 basis points to 0.25%-0.5% — the first interest rate increase in more than three years.

Gold prices to fall in the short to medium term

Gold prices are projected to fall by an average 4.9% a year over the outlook period, from US$1,770 an ounce in 2022 to US$1,380 an ounce in real terms in 2027 as accommodative monetary policies start to unwind as economies recover from the impacts of COVID-19. This is likely to be a major factor in curbing institutional investment demand for gold. With real interest rates increasing, the opportunity cost of holding gold will rise, lowering its attractiveness as an investment asset. The lower US dollar gold price, in combination with a higher Australian dollar, is expected to push the Australian dollar gold price lower, down from A$2,410 an ounce in 2022 to A$1,840 an ounce in real terms in 2027 (Figure 10.7).

Figure 10.6: Gold price and real US 10-Year Treasury Yield

Source: Bloomberg (2022)

There are several risks to the gold price assessment in 2022, including the arrival of any new COVID-19 variants. While the Omicron variant has proven less deadly than previous variants, new variants may be more successful in evading existing vaccines. A fresh COVID-19 outbreak would likely push the prices up. A further risk to the price assessment is the geopolitical issues between Russia and Ukraine. A faster than expected rise in real bond yields could lead to a steeper fall in gold prices.

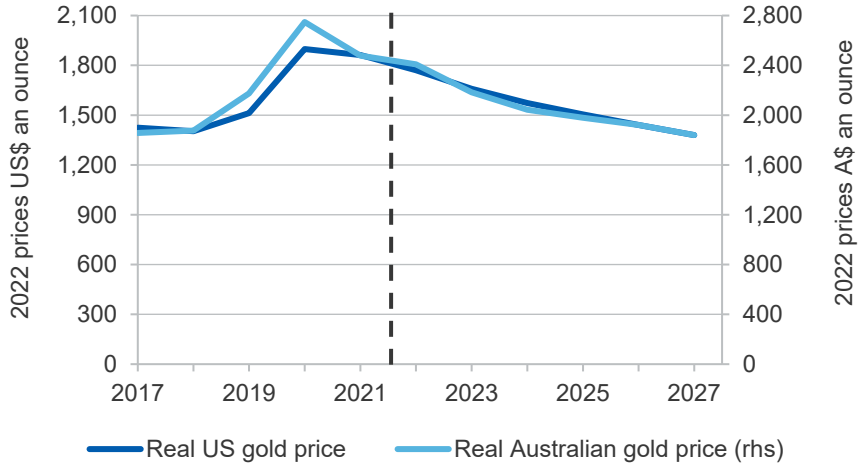
Conversely, slower unwinding of monetary policy stimulus would see slower declines in gold prices.

10.5 Australia's exports and production

Australia's gold exports fell in 2021

In 2021, Australia's gold exports fell by 11% year-on-year to $24 billion (in real terms), due to a 16% year-on-year fall in export volumes, to 257 tonnes. Over this period, exports to the UK and the US dropped by 86% and 75% to 20 and 17 tonnes, respectively. Exports are volatile, often reflecting ETF flows.

Figure 10.7: US and Australian dollar real gold prices



Source: LBMA (2022); Department of Industry, Science, Energy and Resources (2022)

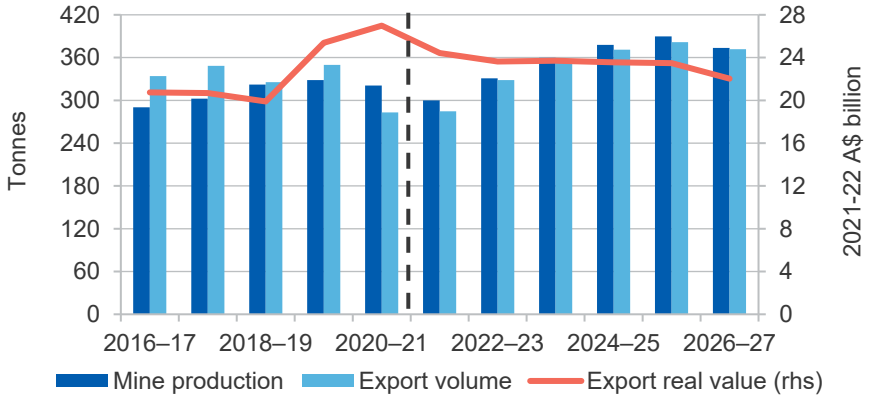
By financial year, Australia's gold export earnings increased by 6.3% year-on-year to nearly $27 billion in real terms in 2020–21, propelled by a 4.4% year-on-year rise in Australian dollar gold prices.

Offsetting the rise in gold prices, Australia's gold export volumes decreased by 19% year-on-year to 283 tonnes in 2020–21 (Figure 10.8). The decline was due to a 39% (or 68 tonnes) year-on year fall in export volumes to the UK and a 60% (or 29 tonnes) year-on-year fall in export volumes to Hong Kong.

Rising export volumes to support export earnings over the outlook period

Gold prices are projected to fall over the outlook period (see *Section 10.4 prices)*. The reduction in gold prices is expected to boost jewellery consumption, and hence, Australian gold exports. Export volumes are projected to rise from 285 tonnes in 2021–22 to 382 tonnes in 2025–26.

Figure 10.8: Australia's gold mine production and exports



Notes: Export volume contains ash, waste and scrap gold, of which the gold content is unknown
Source: ABS (2022) International Trade, 5464.0; Department of Industry, Science, Energy and Resources (2022).

The rise in export volumes is likely to support export earnings, which are projected to remain at nearly $24 billion a year in real terms until 2025–26 (Figure 10.8).

After 2025–26, Australia's gold export values are projected to fall to $22 billion in real terms in 2026–27, due to lower gold prices and export volumes.

Figure 10.9 shows Australia's major gold export markets by percentage share. In 2021, China was Australia's largest gold export market,

accounting for 36% of total Australian gold exports. This was followed by Hong Kong (15%), Singapore (12%), India (nearly 12%), the UK (8.0%) and the US (7.0%).

Australia's gold mine production fell in 2021

Australia's gold mine production fell by 4.0% to 315 tonnes in 2021, impacted by the COVID-19 related labour shortages, plant maintenance, and lower ore grades.

In 2021, labour shortages affected gold output at some gold mines in Western Australia (WA). Production at AngloGold Ashanti and Regis Resources' Tropicana joint-venture gold project in WA fell by nearly 11% year-on-year to nearly 12 tonnes. Production at Regis Resources' Duketon gold project decreased by 4.6% year-on-year to 10 tonnes.

Production at Newcrest's Cadia mine in New South Wales (NSW) declined by 27% year-on-year to nearly 19 tonnes in 2021, due to planned maintenance in the September quarter 2021, which included replacement and upgrade of the mill motor.

Lower ore grades impacted output at a number of mines in Victoria and WA in 2021. This included Agnico Eagle's Fosterville gold mine in Victoria (down by 20% year-on-year to nearly 16 tonnes), and AngloGold Ashanti's Sunrise Dam in WA (down by 11% year-on-year to 7.1 tonnes).

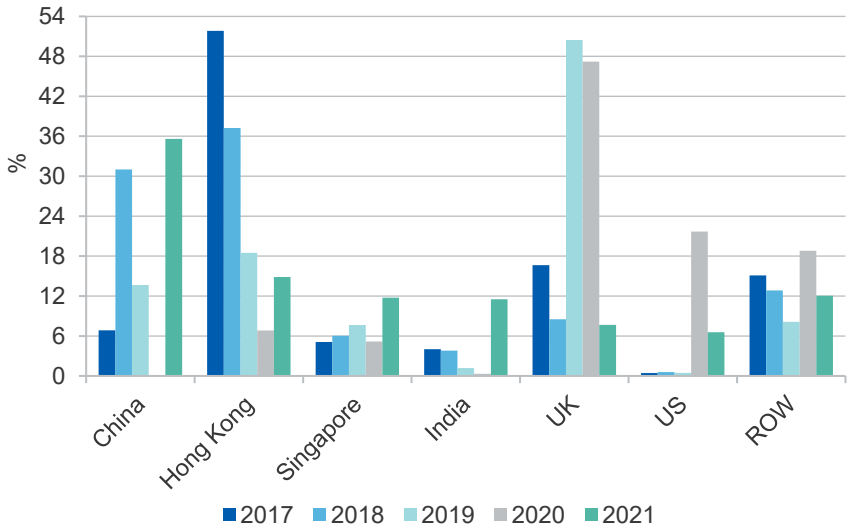
Higher gold mine production until 2025–26

Australian gold mine production is forecast to fall by 6.5% year-on-year to 300 tonnes in 2021–22, due to the impacts of the Omicron COVID-19 variant on mine operations.

Nineteen gold projects, worth $5.1 billion, were at the committed stage of development in 2021. The largest of these is Newmont Mining's $900 million Tanami Expansion 2 project in WA, and Newcrest's $685 million and $175 million Cadia Stage 1 and Stage 2 Expansion projects in NSW (Figure 10.10).

Sandfire Resources' 1.2 tonnes a year DeGrussa gold mine in WA is in its final year of scheduled operation. The mine is expected to close by the end of 2021–22.

Figure 10.9: Australia's major gold export markets (% share)



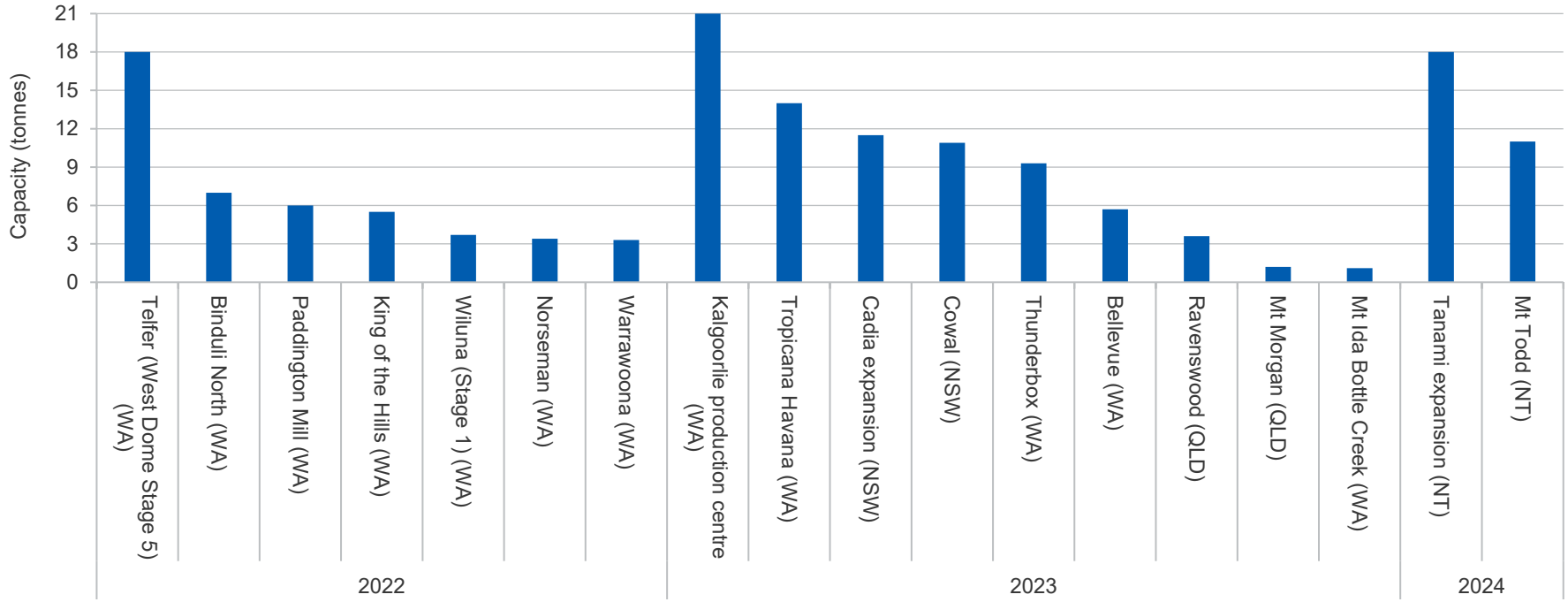
Notes: ROW: Rest of the world
Source: ABS (2022) International Trade, 5464.0

After 2021–22, Australian gold mine production is projected to rise at an average 6.8% a year between 2022–23 and 2025–26, reaching a peak of 390 tonnes in 2025–26 (Figure 10.8). Growth is expected to be driven by mine reactivation and expansions, as well as production from new mines.

Red 5's 6.2 tonnes a year King of the Hills gold project in WA is on track to start production in mid-2022, with construction activities accelerating on multiple fronts. Ramelius Resources started mining at its Tampia mine in WA on 18 June 2021. It is expected that the mine will add 3.2 tonnes of gold to Australian gold output from 2021–22 and onwards.

Calidus' 4.3 tonnes of gold a year Warrawoona gold mine in WA is expected to commence production in the June quarter 2022.

Figure 10.10: Operational schedule and capacity of committed gold projects in Australia



Notes: Committed projects include new, expansion and reactivation projects. The operational schedule is estimated as at the end of October 2021.
Source: Department of Industry, Science, Energy and Resources (2022)

Newcrest has proceeded with the $246 million West Dome Stage 5 Cutback project to extend the life of its Telfer mine in WA. The first ore from the cutback is expected in the first half of 2022.

Heritage Minerals plans to reopen the 1.6 tonnes a year Mount Morgan gold mine in Queensland in 2023. The mine was once one of the richest in the world, but was contaminated with acid water and abandoned in 1990. Four companies have previously attempted and failed to revive the historic mine site, which produced its first gold in 1882.

Bellevue Gold's 5.7 tonnes a year Bellevue gold mine in WA is expected to come online in June 2023.

Vista Gold's 11 tonnes a year Mt Todd in the Northern Territory is expected to restart in the March quarter 2024.

Gold production to eventually decline as reserves are exhausted

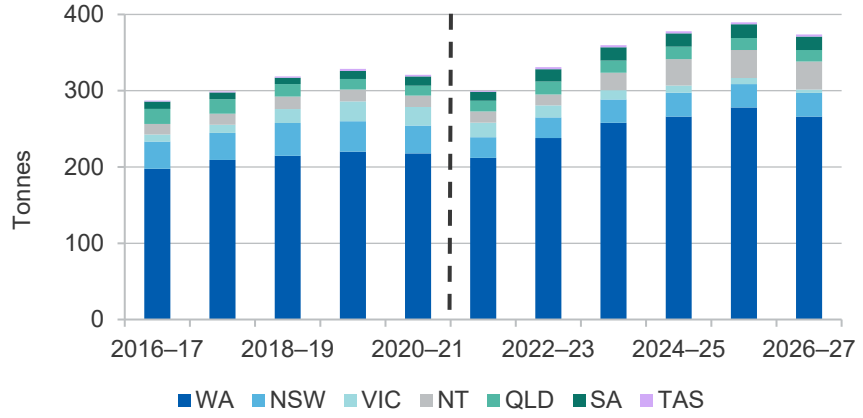
After reaching a peak in 2025–26, Australian mine output is projected to decline by 4.1% year-on-year to 374 tonnes in 2026–27 (Figure 10.8). Output will be weighed down by lower grade ores, reserve exhaustion and closures, exacerbated by falling gold prices (in real and nominal terms).

Western Australia is the centre of Australian gold production

In 2020–21, Western Australia was the largest gold producing state in Australia, accounting for 68% (or 218 tonnes) of Australian total gold mine

output, followed by New South Wales (11% or 36 tonnes), Victoria (7.6% or 24 tonnes), the Northern Territory (4.7% or 15 tonnes), Queensland (4.1% or 13 tonnes), South Australia (3.8% or 12 tonnes), and Tasmania (0.7% or 2.1 tonnes) (Figure 10.11).

Figure 10.11: Australia's gold production by state and territory



Source: Department of Industry, Science, Energy and Resources (2022)

At the end of the outlook period, Western Australia is expected to remain Australia's largest gold mine producing state. Production in New South Wales and Victoria is expected to fall, whereas production in the Northern Territory, South Australia and Tasmania is expected to rise.

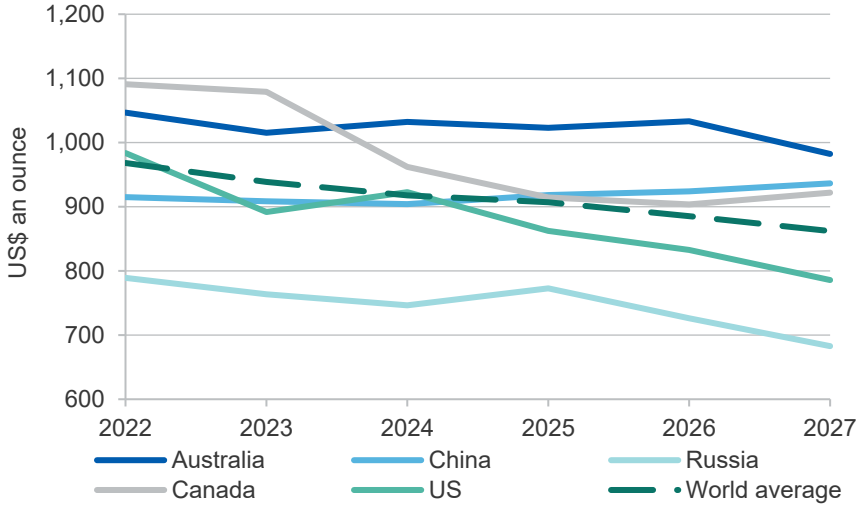
Australia's gold mine production costs higher than the global average

Figure 10.12 shows gold production total cash and sustaining capex costs of selected major gold producing nations between 2022 and 2027. Australia's gold mine production costs are forecast to be above the world average costs in the short to medium term. Australian gold miners are less competitive (have higher costs) than Chinese, Russian, and North American producers.

Exploration continued to rise in 2021

Australia's gold exploration expenditure increased by nearly 22% in 2021 to $1,601 million — accounting for 45% of Australia's total minerals exploration expenditure during the year — driven by high US dollar and Australian dollar gold prices. Western Australia remained the centre of gold exploration activity in Australia, accounting for nearly 70% (or $1,117 million) of total gold exploration expenditure (Figure 10.13).

Figure 10.12: Gold mine total cash and sustaining costs, selected countries

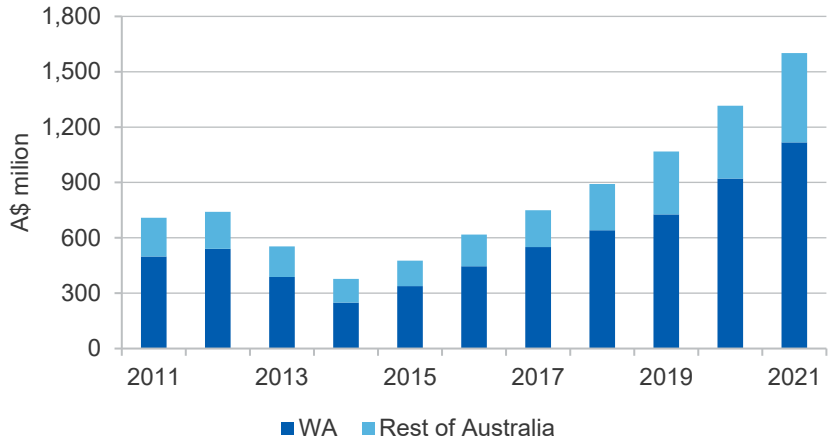


Notes: Total cash and sustaining capex costs include cash charged to production, realisation, depreciation, royalty, other indirect costs and sustaining capex.
Source: Wood Mackenzie (2022)

Revision to the outlook

The forecast for Australian gold mine production in 2021–22 and 2022–23 has been revised down from the December 2021 *Resources and Energy Quarterly* forecast. At 300 and 331 tonnes, we now expect output to be 17% and 12% lower than we did in December 2021. The downward revision reflects the larger than expected impacts of the Omicron variant

Figure 10.13: Australia's gold exploration expenditure



Source: ABS (2022) Mineral and Petroleum Exploration, Australia, 8412.0

on Australian gold mine production in the December quarter 2021, and the rising cases of COVID-19 in WA.

The forecast for Australian gold production in 2025–26 has been revised down by 4.6%, to 374 tonnes, from the March 2021 *Resources and Energy Quarterly* forecast. The downward revision reflects the larger than expected lower grade ores and reserve exhaustion.

The forecast for Australian gold exports in 2021–22 and 2022–23 has been revised down by 14% and 14% to $24.4 billion and $24.4 billion, respectively, reflecting a larger than expected fall in export volumes and values in the December quarter 2021. Other factor that contributes to the downward revision includes the COVID-19 containment measures in China and Hong Kong, due to rising COVID-19 cases. These COVID-19 containment measures are likely to impact Australian gold exports, as China and Hong Kong are Australia's two largest gold export markets.

Table 10.1: Gold outlook

World	Unit	2021	2022[f]	2023[f]	2024[f]	2025[z]	2026[z]	2027[z]	CAGR[r]
Total demand	t	4,021	4,061	4,230	4,542	4,805	4,879	4,925	3.4
Jewellery consumption	t	2,221	2,251	2,364	2,600	2,730	2,785	2,812	4.0
Mine production	t	3,561	3,692	3,729	3,767	3,755	3,744	3,737	0.8
Price[c]									
Nominal	US$/oz	1,800	1,771	1,703	1,657	1,624	1,592	1,560	-2.4
Real[d]	US$/oz	1,862	1,771	1,659	1,573	1,504	1,441	1,380	-4.9
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[f]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Mine production	t	321	300	331	360	378	390	374	2.6
Export volume	t	283	285	328	357	371	382	372	4.6
– nominal value	A$m	26,105	24,425	24,376	25,098	25,580	26,137	25,124	-0.6
– real value[e]	A$m	26,987	24,425	23,638	23,707	23,563	23,489	22,028	-3.3
Price									
– nominal	A$/oz	2,481	2,457	2,310	2,191	2,144	2,130	2,101	-2.7
– real[e]	A$/oz	2,565	2,457	2,240	2,069	1,975	1,914	1,842	-5.4

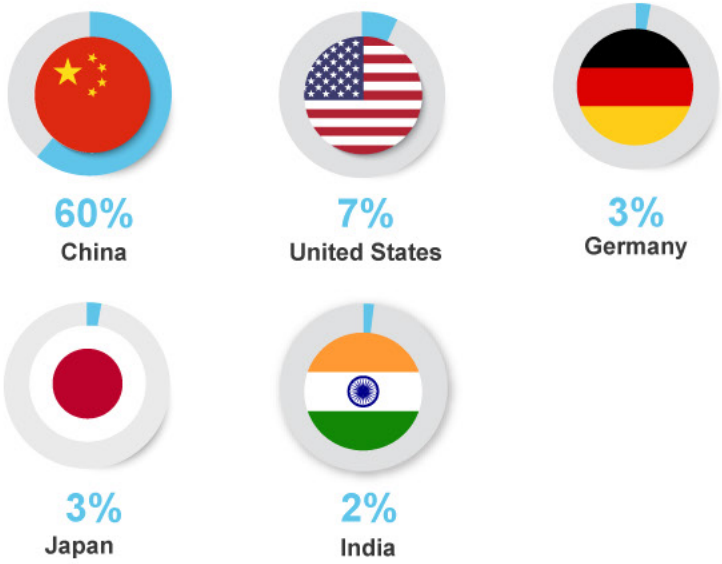
Notes: **c** London Bullion Market Association; **d** In 2022 calendar year US dollars; **e** In 2021–22 financial year Australian dollars; **f** Forecast; **z** Projection; **r** Compound annual growth rate for the period from 2021 to 2027, or from 2020–21 to 2026–27.

Source: ABS (2022) International Trade, 5465.0; London Bullion Market Association (2022); World Gold Council (2022); Department of Industry, Science, Energy and Resources (2022)

13 Al 26.982 Aluminium

Major Australian bauxite deposits (Gt)

Key consumer markets for primary aluminium, 2021



Aluminium

Bauxite is refined to **recover alumina** and smelted to make **aluminium**

2-3 tonnes of bauxite is required to produce one tonne of alumina

China is the world's largest producer & consumer of **primary aluminium**

Each electric vehicle **contains 0.25 tonne** of aluminium

Australia's aluminium

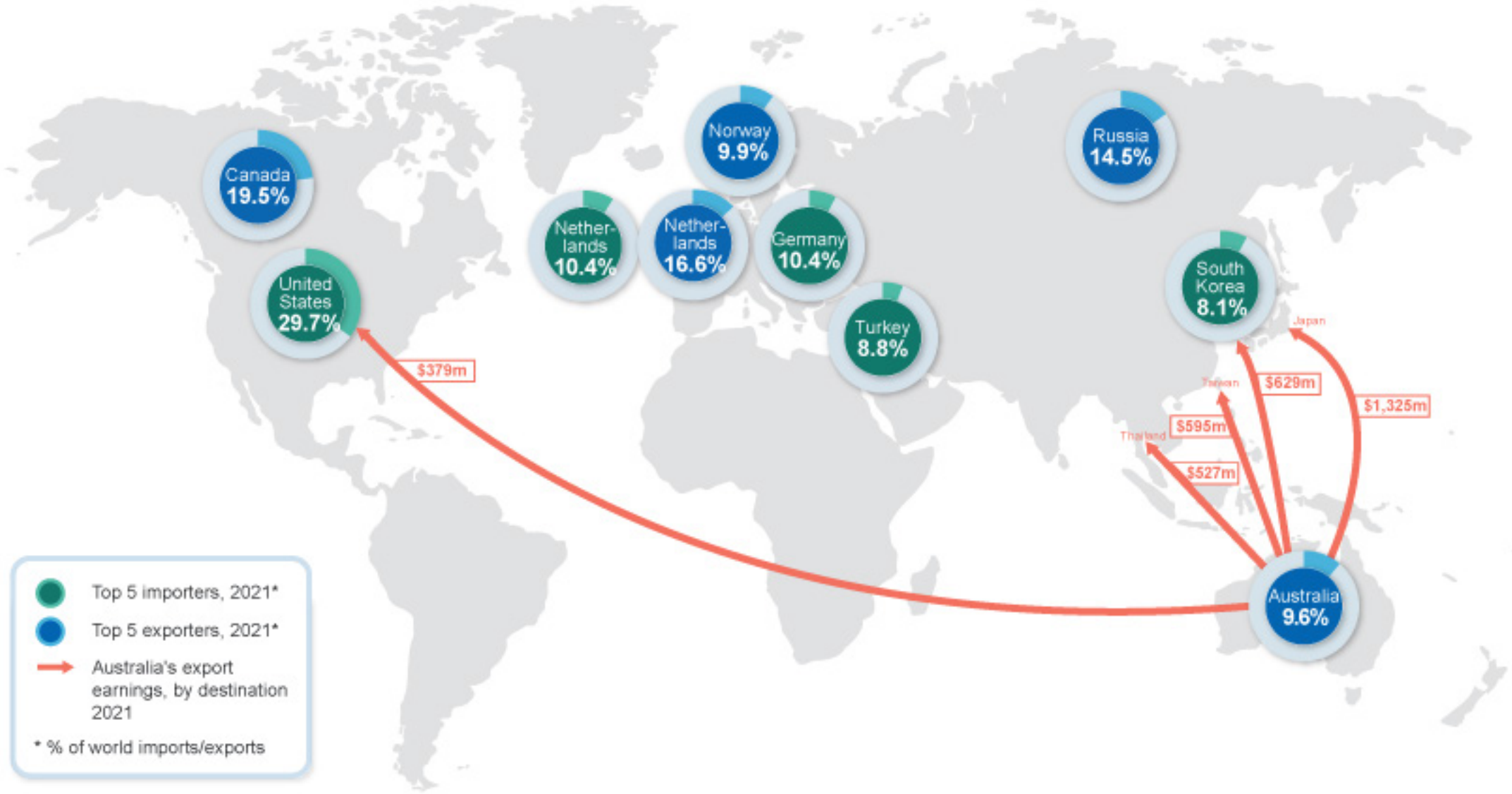
World's 1st **bauxite** producing nation in 2021

World's 1st **alumina** exporter in 2021

World's 2nd **alumina** producer in 2021

Aluminium

Trade map | March 2022



11.1 Summary

- The Russian invasion of Ukraine is likely to push primary aluminium prices higher in the short term, averaging US$3,100 a tonne in 2022. The global economic recovery, supply constraints and strong demand are expected to see continued support for primary aluminium prices. Prices are projected to remain high, averaging US$2,648 a tonne by 2027.
- A restart of idled capacity at the Portland Aluminium smelter from the September quarter 2022 is expected to boost Australian primary aluminium output to 1.6 million tonnes a year by 2022–23. Annual Australian alumina output is expected to be broadly steady over the outlook period, remaining at 21 million tonnes. Australian bauxite output is projected to reach 106 million tonnes in 2023–24, before falling to 101 million tonnes in 2026–27 (see Australia section).
- Australia's aluminium, alumina and bauxite export earnings are forecast to increase by 32% to $16 billion in real terms in 2021–22, before falling to $15 billion by the end of the outlook period.

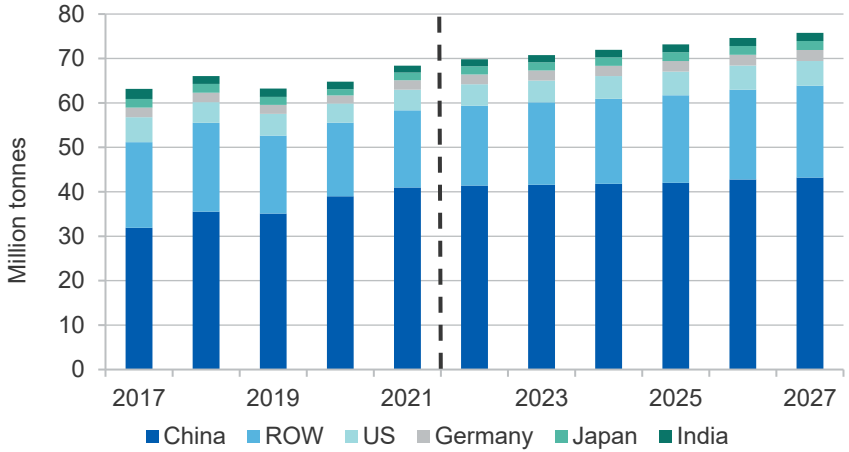
11.2 World consumption

China led higher aluminium, alumina and bauxite consumption in 2021

Global aluminium consumption increased by 5.6% year-on-year to 68 million tonnes in 2021 (Figure 11.1). This gain was driven by a 5.1% year-on-year rise in consumption in China, the world's largest primary aluminium consuming country. A rise in the use of aluminium in infrastructure and construction projects initiated with the Chinese government's stimulus package contributed to a large jump in Chinese aluminium consumption in 2021.

Over this period, primary aluminium consumption also grew in the United States (US) (up 7.3% year-on-year to 4.6 million tonnes), Germany (up 20% year-on-year to 2.1 million tonnes), and Japan (up 21% year-on-year to 1.7 million tonnes) (Figure 11.1). The growth in primary aluminium consumption partly reflects an increased aluminium use in new, energy-efficient car models.

Figure 11.1: World primary aluminium consumption



Source: World Bureau of Metals Statistics (2022); Macquarie (2022); Department of Industry, Science, Energy and Resources (2022)

World alumina usage increased by 1.4% year-on-year in 2021 to 131 million tonnes, driven by higher global aluminium production, which was up by 1.4% year-on-year in 2021 (Figure 11.2). China remained the world's largest alumina consuming country, accounting for 57% of global alumina consumption. In 2021, a 3.8% rise in Chinese primary aluminium production led to a 3.8% rise in alumina consumption, to 75 million tonnes. Outside of China, alumina consumption in India and Russia rose by 10% and 1.9% to reach 7.7 and 7.7 million tonnes in 2021, respectively.

World bauxite usage rose by 4.0% to 353 million tonnes in 2021, propelled by increased global alumina production (up 4.4% in 2021). China remained the world's largest bauxite consuming country, accounting for 53% of global bauxite consumption (Figure 11.3).

Aluminium, alumina and bauxite demand to rise over the medium term

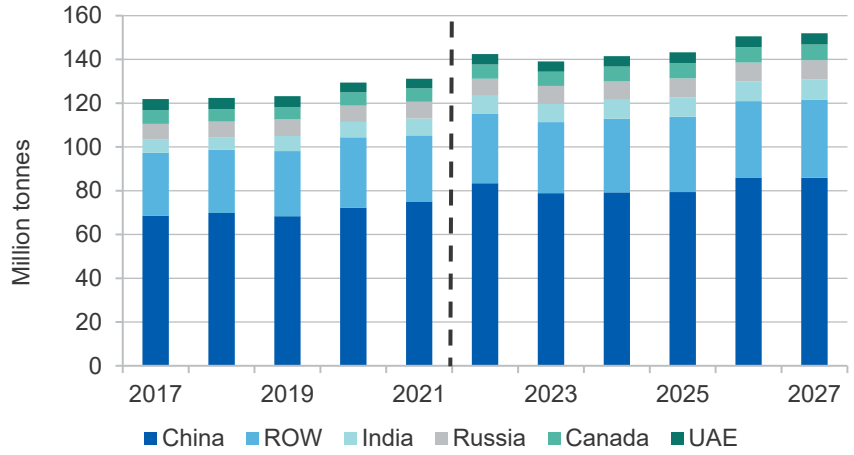
Demand for primary aluminium in 2022 is expected to be mainly driven by China, as the Chinese government continues to inject fiscal and monetary stimulus into the economy through the first half of 2022. An economic

recovery in the US, United Kingdom, Eurozone, India, South Korea and Japan is likely to add more demand for primary aluminium. As a result, global primary aluminium consumption is forecast to increase by 2.1% in 2022, to 70 million tonnes (Figure 11.1).

Beyond 2022, world primary aluminium consumption is projected to grow at an annual average rate of 1.5%, to 75 million tonnes by 2027 (Figure 11.1). The global economic recovery is expected to support demand for cars, houses and electrical equipment, and thus aluminium consumption.

A significant driver of aluminium demand is expected to come from cars, particularly energy-efficient vehicles and electric vehicles (EV), which contain a higher proportion of aluminium components. Automakers across the world are working to replace internal combustion engines with electric battery engines, and are seeking to reduce vehicles' weight by increasing the use of aluminium, which is 10 to 40 % lighter than steel.

Figure 11.2: World alumina consumption



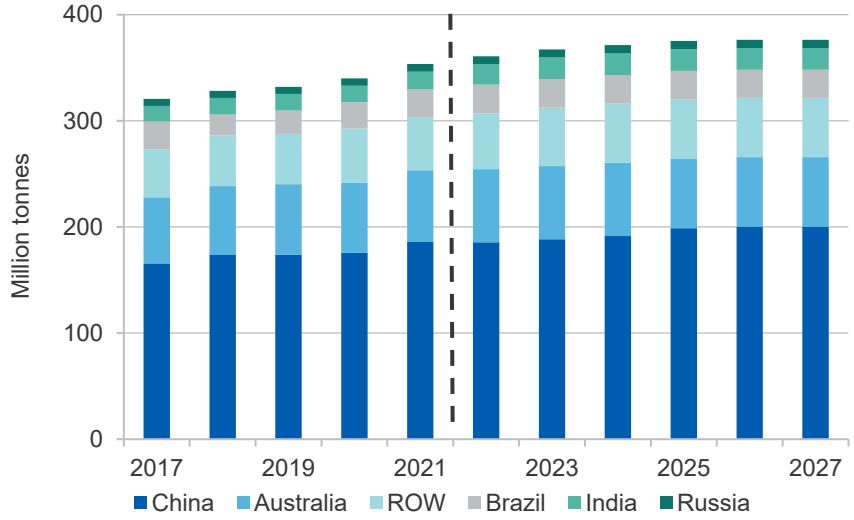
Notes: ROW: Rest of the world

Source: Department of Industry, Science, Energy and Resources (2022)

World alumina usage is projected to rise at an average annual rate of 1.3% over the outlook period, reaching 152 million tonnes by 2027 (Figure 11.2). Alumina demand is driven by primary aluminium production, which is projected to lift by an average 1.7% a year between 2023 and 2027.

World bauxite usage is projected to grow at an average annual rate of 1.0% over the outlook period to 376 million tonnes in 2027 (Figure 11.3). The gains are expected to be driven by higher alumina output from existing refinery capacities in China and India.

Figure 11.3: World bauxite consumption

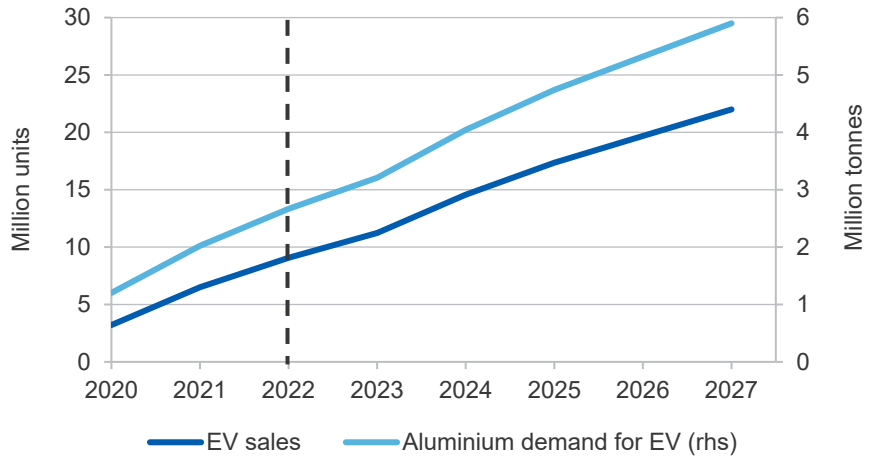


Notes: ROW: Rest of the world

Source: Department of Industry, Science, Energy and Resources (2022)

It is estimated that EV sales will rise from 6.5 million units in 2021 to 22 million units in 2027. With an estimated average aluminium content of 250 kilograms per electric vehicle, aluminium usage in EVs is projected to increase from 1.6 million tonnes in 2021 to about 5.5 million tonnes in 2027 (Figure 11.4).

Figure 11.4: Global EV sales and aluminium demand



Notes: EV sales include all types of EV.

Source: Bloomberg New Energy Finance (2021); International Energy Agency (2021); Macquarie (2021); Department of Industry, Science, Energy and Resources (2022).

11.3 World production

Aluminium and alumina output grew, but bauxite output fell in 2021

In 2021, world primary aluminium output was 67 million tonnes, a 1.4% rise from 2020. This was propelled by higher output from China — the world's largest primary aluminium producer — which rose by 3.8% to nearly 39 million tonnes in 2021 (Figure 11.5). China's primary aluminium producers raised output in response to higher primary aluminium prices and government stimulus measures on infrastructure and construction.

Over this period, primary aluminium output in Norway increased by 8.1% year-on-year to 1.4 million tonnes, driven by the production ramp up at Hydro's Husnes aluminium smelter.

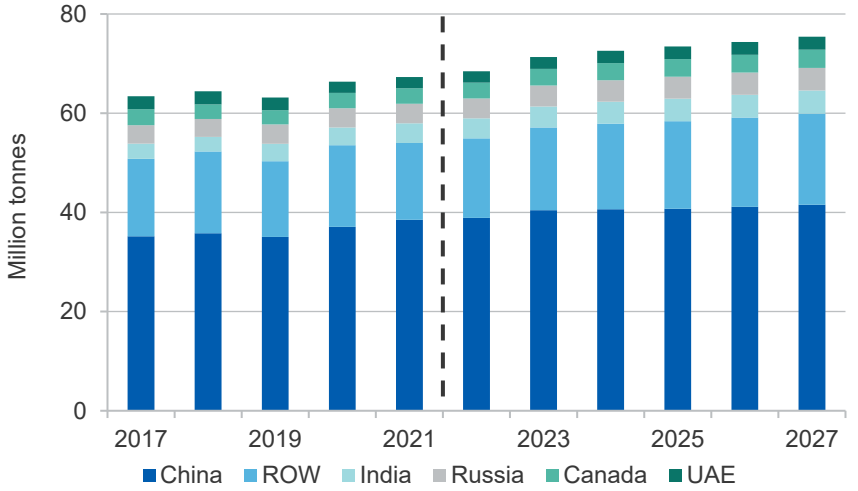
In 2021, primary aluminium production in Iran rose by 34% year-on-year to 507,000 tonnes, driven by the ramp up of production at the 1.0 million tonnes per year SALCO aluminium smelter.

Primary aluminium production in Canada grew by 0.8% year-on-year in 2021 to 3.1 million tonnes. The growth was driven by the ramp up of production at the Alouette aluminium smelter (600,000 tonnes a year).

World alumina supply rose by 4.4% year-on-year to 139 million tonnes in 2021, driven by higher output in China and Brazil (Figure 11.6). Production in China — the world's largest alumina producer — rose 5.9% year-on-year to 77 million tonnes in 2021, as Chinese refiners raised output to accommodate higher aluminium production.

In 2021, production in India and Brazil rose by 7.5% and 5.5% to 7.0 and 11 million tonnes, respectively. In Brazil, Norsk Hydro's Alunorte refinery (annual capacity of 6.4 million tonnes) ramped up production in 2021, following the completion of maintenance work at its Paragominas bauxite mine in October 2020.

Figure 11.5: World primary aluminium production



Notes: ROW: Rest of the world

Source: World Bureau of Metals Statistics (2022); Macquarie (2022); Department of Industry, Science, Energy and Resources (2022)

Alumina production in Australia — the world's second largest alumina producer — fell by 2.3% in 2021, to 20.4 million tonnes, due to lower production at Rio Tinto's Yarwun refinery.

World bauxite production decreased by 1.0% in 2021 to 365 million tonnes, due to political instability in Guinea (Figure 11.7). Production in Guinea — the world's second largest bauxite producer — fell by 5.9% to 83 million tonnes in 2021.

Output in Australia — the world's largest bauxite producing country — decreased by 0.6% year-on-year to 103 million tonnes in 2021 (see *Section 11.4 Australia's exports and production*).

Aluminium, alumina and bauxite output set to rise over the outlook period

World primary aluminium output is forecast to grow by 1.8% year-on-year to 68 million tonnes in 2022 (Figure 11.5). The gain is expected to be driven by higher primary aluminium prices.

China's primary aluminium output is forecast to reach 39 million tonnes by 2022, up 1.0% year-on-year. Outside of China, primary aluminium production in India is forecast to increase by 2.0% year-on-year to reach 4.0 million tonnes in 2022.

In Australia, Alcoa Corporation is scheduled to restart its 35,000 tonnes a year idled capacity at its Portland Aluminium smelter in Victoria in the September quarter 2022. The reactivated capacity is expected to bring Australian primary aluminium output to 1.6 million tonnes a year.

Central and provincial authorities in China are expected to continue implementing strict environmental regulations — restricting energy consumption and emissions — that take into account local realities.

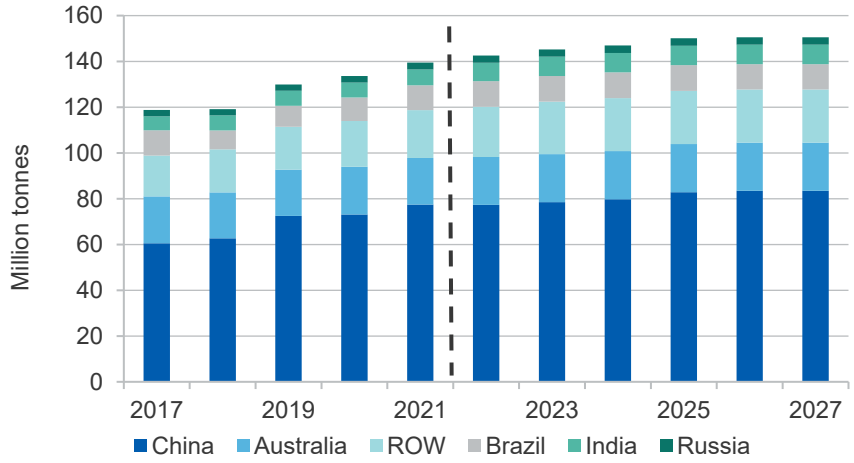
On 2 November 2021, the Central Committee of the Communist Party of China and the State Council released the opinions on deepening pollution prevention and control. The opinions outline that a clean and low-carbon energy economy is to be strongly promoted, with outdated and excess production capacity to be eliminated. No extra aluminium and alumina capacity will be approved in key regions.

After 2022, world primary aluminium production is projected to rise by 1.7% a year over the outlook period, reaching 75 million tonnes by 2027 (Figure 11.5). The gains will be driven by China, as more output is produced from greenfield aluminium smelters. China's primary aluminium production is projected to reach 42 million tonnes by 2027. This is edging closer to the capacity cap of 45 million tonnes of primary aluminium per year, a policy introduced by the Chinese Government in 2017 in response to environmental and oversupply concerns. The Chinese Government's Five Year Plan (2021–25), calls for China's production and capacity of both primary aluminium and alumina to peak by 2025.

As China edges closer to its primary aluminium capacity cap, this will provide greater opportunity for other primary aluminium producing nations — such as India, Russia, Canada and the UAE — to fill the output gap.

World alumina output is forecast to grow by 2.2% year-on-year to 143 million tonnes in 2022, driven by rising output from existing refineries in Australia, Brazil and India (Figure 11.6).

Figure 11.6: World alumina production



Notes: ROW: Rest of the world

Source: World Bureau of Metals Statistics (2022); Macquarie (2022); Department of Industry, Science, Energy and Resources (2022)

Production in Australia is forecast to rise by 2.9% year-on-year to nearly 21 million tonnes in 2022, driven by higher production in Alcoa's Kwinana refinery and South 32's Worsley refinery in WA.

Indian output is forecast to rise by 15% year-on-year to 8.0 million tonnes in 2022. Hindalco's 1.5 million tonnes a year Utkal Alumina Refinery expansion project is expected to finish in 2022. The refinery's capacity is expected to rise to 2.0 million tonnes a year. In Indonesia, China Hongqiao and joint-venture partners' 2.0 million tonnes a year Well Harvest alumina refinery expansion project is expected to come online in 2022.

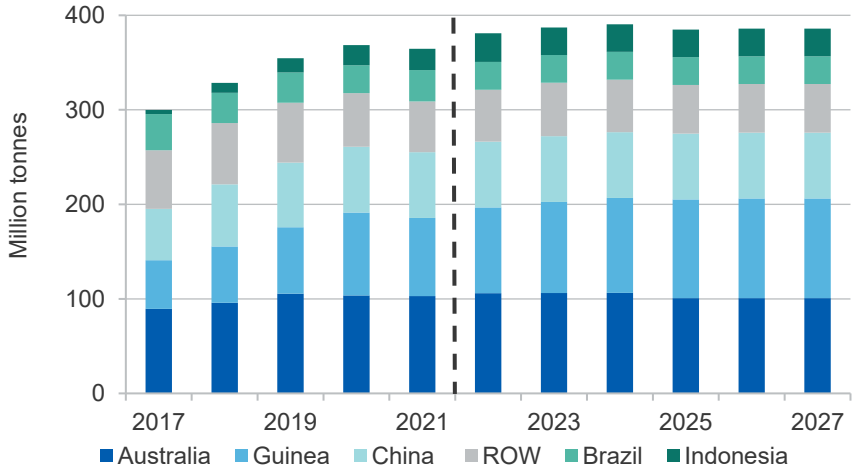
World alumina output is projected to increase by 1.1% a year over the outlook period, reaching 151 million tonnes by 2027 (Figure 11.6). The gains are forecast to be driven by China, Australia, India, Indonesia, and other small alumina refining nations.

World bauxite output is forecast to grow by 4.5% year-on-year to 381 million tonnes in 2022 (Figure 11.7). The gains are expected to be driven by newly added capacity in Guinea, where output is rising rapidly. Guinea's Compagnie des Bauxites de Guinée mine, which expanded from 13 to 18 million tonnes a year in 2019, is due to expand further to 28 million tonnes by 2022. Emirates Global Aluminium is also ramping up output at its 12 million tonnes a year bauxite mine in Guinea. After 2022, world bauxite production is projected to increase by 0.3% a year over the outlook period, reaching 386 million tonnes by 2027 (Figure 11.7). Australia and Guinea are expected to contribute most to this rise.

Russia's share of global alumina/aluminium/bauxite output and exports

Russia is the world's third largest exporter of primary aluminium and the world's third largest producer of primary aluminium, accounting for 14.5% of global primary aluminium exports and 5.8% of global primary aluminium production (Figure 11.8). In 2021, Russia produced 3.9 million tonnes of primary aluminium, and exported 2.1 million tonnes of primary aluminium.

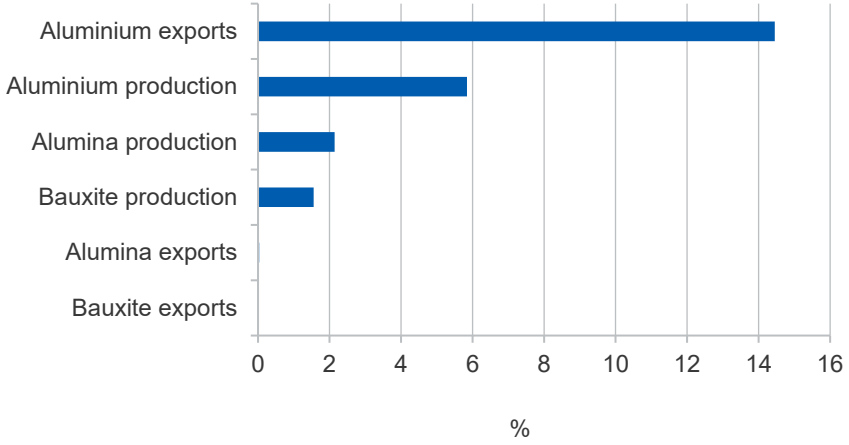
Figure 11.7: World bauxite production



Notes: ROW: Rest of the world

Source: World Bureau of Metals Statistics (2022); Department of Industry, Science, Energy and Resources (2022)

Figure 11.8: Russia's share of global production and exports of alumina/aluminium/bauxite



Source: World Bureau of Metals Statistics (2022)

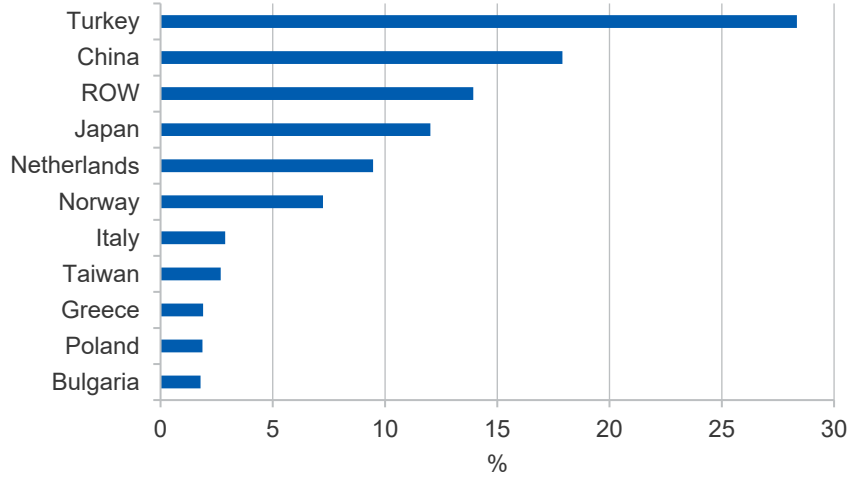
Russia is a minor producer and exporter of alumina and bauxite, accounting for around 2.1% of global alumina production and 1.6% of global bauxite production (Figure 11.8).

Turkey, China and Japan are Russia's three largest primary aluminium export markets, together accounting for 58% of Russia's total primary aluminium exports (Figure 11.9).

Ukraine, Australia and Ireland are Russia's three largest suppliers of alumina, together accounting for 78% of Russia's total alumina imports (Figure 11.10).

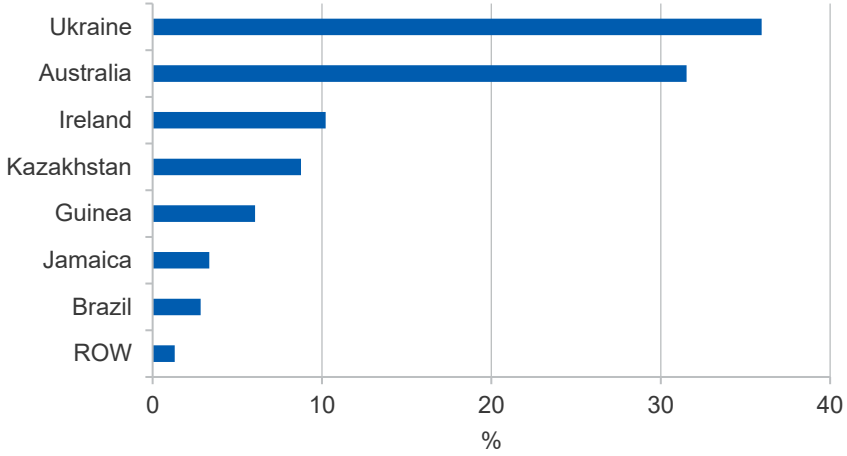
The international sanctions against Russia's invasion of Ukraine are likely to have a significant impact on Russia's alumina supply and primary aluminium production. Russia consumes 7.7 million tonnes of alumina a year, of which 39% from domestic production and 61% from imported overseas.

Figure 11.9: Russia's major primary aluminium export markets



Source: International Trade Centre (2022)

Figure 11.10: Russia's alumina import sources



Source: International Trade Centre (2022)

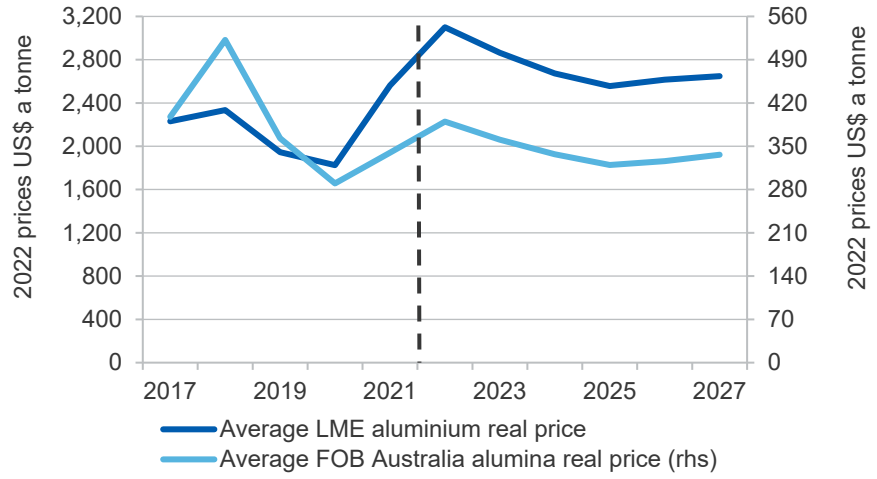
11.4 Prices

2021 was a very strong year for aluminium prices

The London Metal Exchange (LME) spot price for aluminium rose by 40% year-on-year to US$2,562 a tonne (in real terms) in 2021, as demand outpaced supply (Figure 11.10). Global demand for everything from beer cans to packaging and new energy efficient car models rebounded from the lows of the COVID-19 pandemic in 2020 (see *Section 11.2 world consumption*). On the supply side, energy consumption restrictions and strict environmental regulations in China's output. Political instability in Guinea — the world's second largest bauxite producer and the world's largest bauxite exporter — pushed up the cost of bauxite — the material used to produce alumina and then aluminium.

Global energy supply constraints and rising input costs led to a decline in global primary aluminium inventories in 2021. LME stocks reached a 4-year high in March 2021, at 1.9 million tonnes, but then fell to 939,200 tonnes in December 2021. SHFE stocks rose in the March quarter 2021, but fell from April to September 2021.

Figure 11.11: World primary aluminium and alumina prices



Source: LME (2022); Bloomberg (2022); Department of Industry, Science, Energy and Resources

LME off-warrant stocks rose in the year after the data was first released in early 2020, but have fallen sharply since February 2021 when they exceeded 2 million tonnes (Figure 11.12).

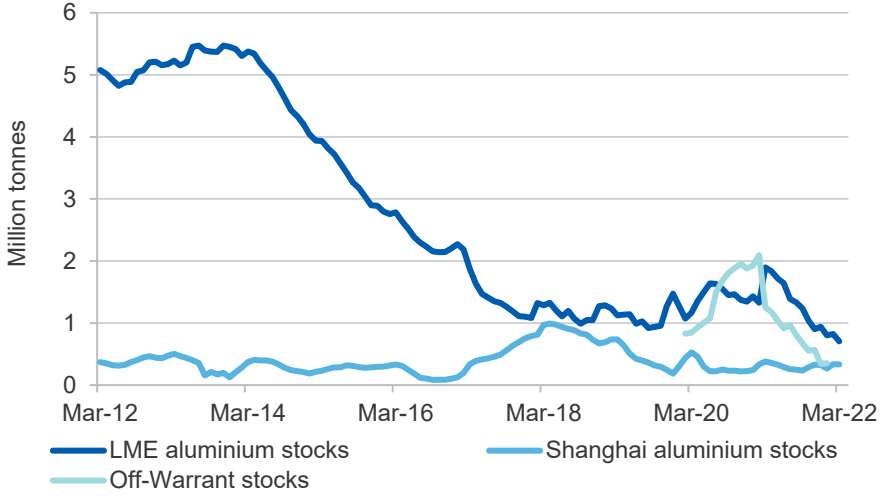
In line with the rise in primary aluminium price, the free on board (FOB) Australian alumina price grew by 17% year-on-year to US$340 a tonne (in real terms) in 2021. The growth was driven by higher alumina demand, as world aluminium output rose by 1.5% in 2021.

Supply disruptions push aluminium prices to a record high in early 2022

The LME aluminium prices rose to a 34-year high on 7 March 2022, reaching US$3,985 a tonne. This was driven by the concerns over Russia-Ukraine tensions, the COVID-19 outbreak in China, and energy shortages in Europe (Figure 11.13). Primary aluminium remains highly exposed commodity to supply disruptions and international trade sanctions on Russia. High energy prices have forced aluminium output cutbacks in France, Spain and the Netherlands.

In China, COVID-19 containment measures in Baise City — the alumina and aluminium hub of Guangxi province — has inhibited the recovery of aluminium supply in China. Guangxi accounts for 14% of alumina refining capacity in China, and has 2.7 million tonnes per year of primary aluminium capacity, of which 2.2 million tonnes are located in Baise.

Figure 11.12: Exchange aluminium stocks



Source: London Metal Exchange (2022); Bloomberg (2022)

Primary aluminium and alumina prices to rise in 2022

In 2022, the LME aluminium spot price is forecast to rise by 21% year-on-year to average US$3,100 a tonne (in real terms) (Figure 11.11). Rising input costs and rising primary aluminium consumption in China and in the global transport (aviation and car manufacturing) industry generally are expected to be significant drivers of increased aluminium prices.

The FOB Australian alumina price is forecast to increase by 15% year-on-year to average US$390 a tonne (in real terms) in 2022, driven by increased primary aluminium production in China (Figure 11.11).

After 2022, the LME aluminium price is projected to drift down to average US$2,556 a tonne in real terms in 2025 (Figure 11.11). Despite this fall,

primary aluminium prices are expected to remain at relatively high levels, as growing demand for new, energy-efficient cars and technologies supports aluminium usage. Higher demand from renewable technologies is likely to lift primary aluminium prices to US$2,648 a tonne in real terms in 2027 (Figure 11.11).

As a result, the FOB Australian alumina price is projected to fall to US$336 a tonne in real terms in 2025 (Figure 11.11).

Figure 11.13: LME primary aluminium spot prices

Source: Bloomberg (2022)

11.5 Australia's exports and production

Higher aluminium prices drove exports in 2021

Australia's aluminium, alumina and bauxite (AAB) exports increased by 11% year-on-year to nearly $14 billion in real terms in 2021, driven by higher primary aluminium prices. A 46% year-on-year rise in the LME aluminium price in 2021 and stronger demand for primary aluminium boosted Australian primary aluminium export values by 27% year-on-year to nearly $5.0 billion in real terms in 2021.

Primary aluminium exports to Japan increased by 65% year-on-year to $1.3 billion in 2021, as more energy efficient car models require higher aluminium content. In a similar trend, Australian primary aluminium exports to Thailand and Taiwan rose by 101% and 46% year-on-year in 2021.

Australian alumina export volumes and values rose by 0.8% (to 18.4 million tonnes) and 8.1% (to nearly $7.9 billion in real terms) year-on-year, respectively, in 2021.

Australian bauxite export volumes and values decreased by 5.2% (to nearly 36 million tonnes) and 18% (to nearly $1.3 billion in real terms) year-on-year in 2021, respectively.

Australia's AAB exports rose by 24% year-on-year to $7.7 billion in real terms in the first half of 2021–22. As the LME aluminium spot price reached a 13-year high of US$3,180 a tonne on 18 October 2021, Australian primary aluminium exports values also reached a 13-year high of $2.7 billion in real terms in the first half of 2021–22.

A strong earning year for Australia's AAB exports in 2021–22

An expected gain in aluminium and alumina prices in 2022 is likely to provide additional earnings for Australian aluminium smelters, alumina refiners and bauxite miners. Australia's AAB exports are forecast to increase by 32% to $16.4 billion in real terms in 2021–22 (Figure 11.14).

The recently announced ban on Australia's alumina exports to Russia is not expected to have a significant impact on Australia's AAB export earnings. Australia exports to over 20 different countries, and has high capacity to redirect exports to alternative markets. High aluminium prices are also expected to provide ongoing support to export earnings.

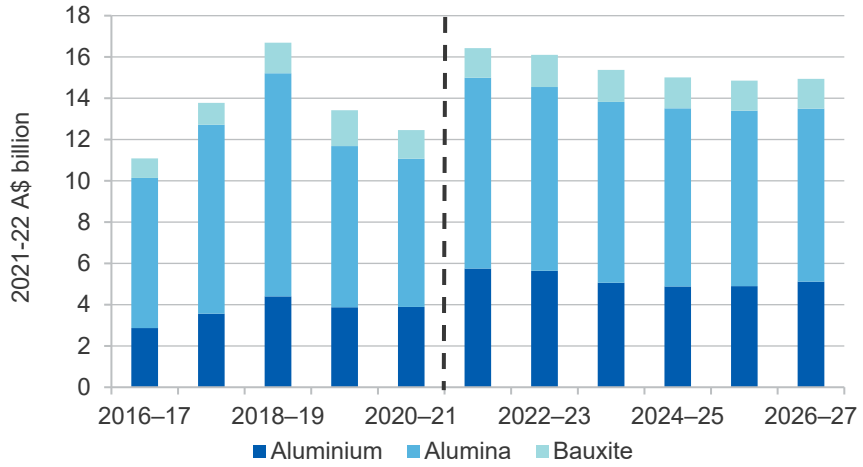
A golden opportunity for Australian primary aluminium exporters

The international trade sanctions against Russia may provide Australian primary aluminium producers with an opportunity to fill any gaps that open in the global market. Australia is the world's sixth largest primary aluminium producer and the world's fifth largest primary aluminium exporter. At present, Russian exports of primary aluminium are banned for Japan, South Korea and China.

Steady alumina, aluminium and bauxite export earnings after 2021–22

After 2021–22, Australia's AAB exports are projected to be steady, at $15-16 billion a year in real terms over the outlook period, with the prices of primary aluminium are projected to remain relatively high over the outlook period (Figure.11.14).

Figure 11.14: Australian aluminium/alumina/bauxite exports



Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources.

Australia's alumina, aluminium and bauxite production fell in 2021

Australia's primary aluminium production fell by 1.1% year-on-year to 1.57 million tonnes in 2021. This was primarily due to a 1.8% year-on-year decline (to 502,000 tonnes) at Rio Tinto's Boyne Island aluminium smelter in Queensland, and a 1.6% year-on-year decline (to 189,000 tonnes) at Rio Tinto's Bell Bay aluminium smelter in Tasmania.

Australia's alumina production fell by 2.3% year-on-year to 20.4 million tonnes in 2021, due to a 2.6% year-on-year fall (to 3.1 million tonnes) at Rio Tinto's Yarwun alumina refinery in Queensland.

Australia's bauxite output fell by 0.6% year-on-year to 103 million tonnes in 2021, due to a 4.4% year-on-year decline (to nearly 12 million tonnes) at Rio Tinto's Gove mine in the Northern Territory and a 2.6% year-on-year fall (to 34 million tonnes) at Rio Tinto's Weipa mine in Queensland.

Steady aluminium/alumina, lower bauxite output over the outlook period

On 7 November 2021, Alcoa announced a restart of 35,000 tonnes a year idled capacity at its Portland Aluminium smelter in Victoria. The reactivated capacity is expected to come online in the September quarter 2022, and will bring Australia's primary aluminium output to 1.6 million tonnes a year from 2022–23 and beyond (Figure 11.15).

No expansions or major disruptions are expected at existing alumina operations in Australia over the outlook period. Australia's alumina output is projected to remain at about 21 million tonnes a year over the outlook period. Australia's bauxite output is projected to reach 106 million tonnes in 2023–24, before falling to 101 million tonnes in 2026–27 (Figure 11.15).

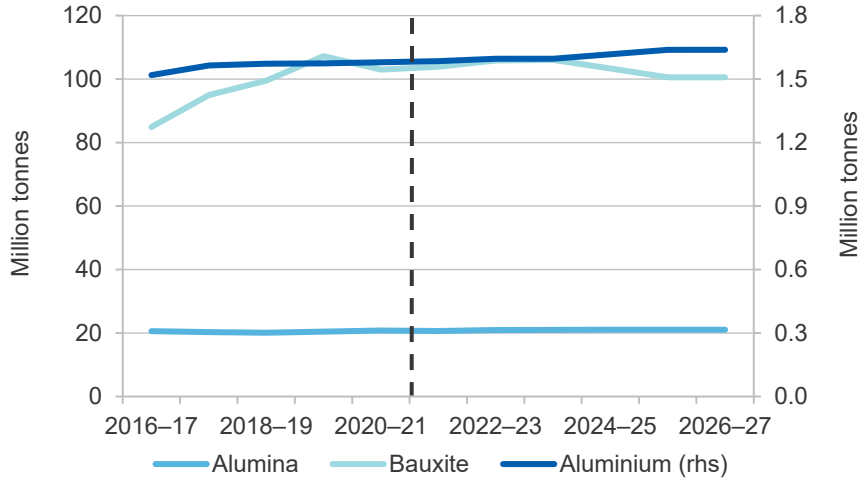
Figure 11.16 shows the operating costs of aluminium smelters in select major primary aluminium producing nations, including the United States, Australia, China, India and Russia. Australian (and United States') smelters' operating costs are significantly above the world average (of US$1,860 a tonne in 2022).

Figure 11.17 shows the operating costs of alumina refinery in selected major alumina producing nations, including Australia, China, Brazil, India and Russia. Australian refiners' operating costs are below the world average of US$280 a tonne in 2022.

Figure 11.18 shows the operating costs of bauxite mine in selected major bauxite producing nations, including Australia, Guinea, China, Brazil and Indonesia. Australian miners' operating costs are below the world average of US$20 a tonne in 2022.

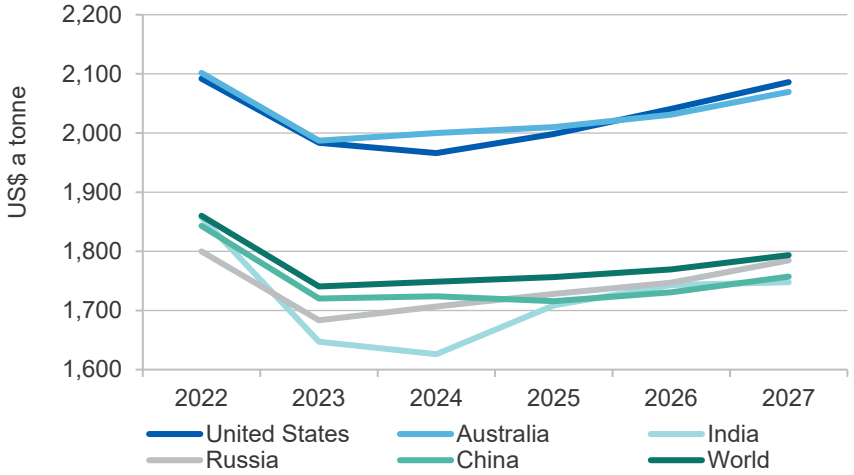
The data suggests that a decline in electricity costs would go a substantial way to improving Australia's market share in the aluminium sector.

Figure 11.15: Australian alumina/aluminium/bauxite output



Source: Department of Industry, Science, Energy and Resources (2022)

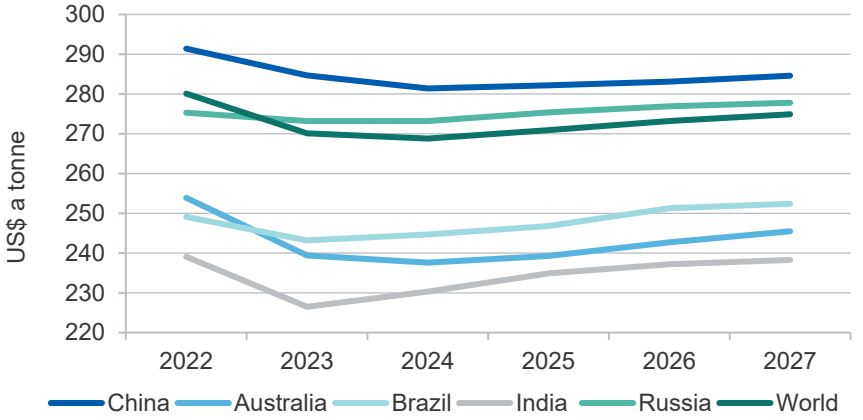
Figure 11.16: Aluminium smelter total operating costs



Notes: Total operating costs include alumina, other raw materials, energy, labour and other costs.

Source: Wood Mackenzie (2022)

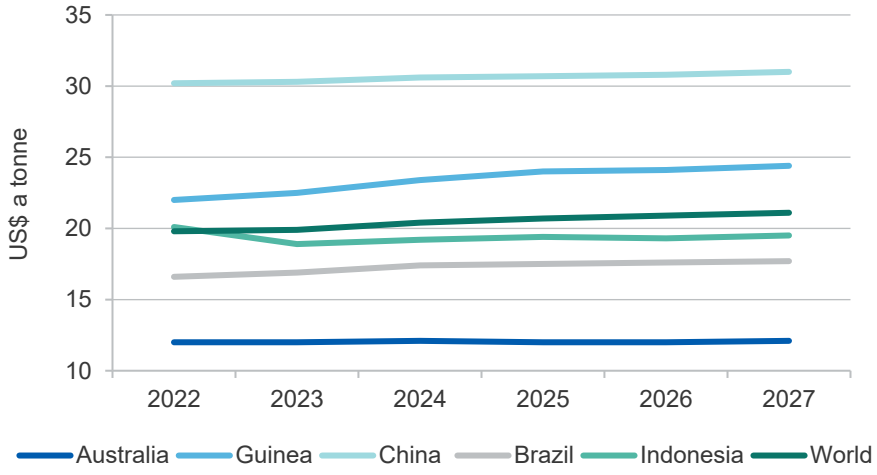
Figure 11.17: Alumina refinery total operating costs



Notes: Total operating costs include bauxite, other raw materials, energy, labour and other costs.

Source: Wood Mackenzie (2022)

Figure 11.18: Bauxite mine total operating costs



Notes: Total operating costs include fuel, labour, consumables, other materials and services, bauxite levy, royalties and taxes, and depreciation.

Source: Wood Mackenzie (2022)

Revisions to the outlook

The forecast for Australia's AAB export earnings has been revised up from the December 2021 *Resources and Energy Quarterly* — by $667 million in 2021–22. The revision reflects larger than expected rise in aluminium prices in the March quarter 2022.

We now expect 2022–23 earnings to be $16.6 billion, compared to $14.8 billion in the December 2021 *Resources and Energy Quarterly*. The change is driven by high aluminium prices. Compared to the March 2021 *Resources and Energy Quarterly*, we forecast 2025–26 earnings to be $16.5 billion instead of $13.0 billion.

Table 11.1: Aluminium, alumina and bauxite outlook

World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Primary aluminium									
Production	kt	67,547	68,577	71,443	72,689	73,567	74,477	74,741	1.7
Consumption	kt	68,385	69,818	70,765	71,943	73,157	74,623	75,774	1.7
Prices aluminium[c]									
- nominal	US$/t	2,477	3,100	2,940	2,815	2,760	2,890	2,995	3.2
- real[d]	US$/t	2,562	3,100	2,863	2,673	2,556	2,615	2,648	0.6
Prices alumina spot									
- nominal	US$/t	328	390	370	355	345	360	380	2.5
- real[d]	US$/t	340	390	361	337	320	326	336	-0.2
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production									
Primary aluminium	kt	1,579	1,585	1,596	1,596	1,617	1,638	1,638	0.6
Alumina	kt	20,772	20,632	20,961	21,011	21,050	21,050	21,050	0.2
Bauxite	Mt	103.0	103.9	105.9	106.0	103.3	100.5	100.5	-0.4
Consumption									
Primary aluminium	kt	284	220	208	208	210	212	212	-4.8
Exports									
Primary aluminium	kt	1,357	1,417	1,437	1,437	1,456	1,474	1,474	1.4
- nominal value	A$m	3,763	5,752	5,818	5,362	5,300	5,448	5,836	7.6
- real value[e]	A$m	3,890	5,752	5,642	5,065	4,882	4,896	5,117	4.7
Alumina	kt	18,600	18,250	18,236	18,280	18,314	18,314	18,314	-0.3
- nominal value	A$m	6,948	9,239	9,182	9,274	9,366	9,460	9,555	5.5
- real value[e]	A$m	7,183	9,239	8,904	8,760	8,628	8,502	8,377	2.6
Bauxite	kt	35,782	36,828	37,139	37,195	36,256	35,276	35,276	-0.2
- nominal value	A$m	1,339	1,440	1,604	1,639	1,628	1,617	1,649	3.5
- real value[e]	A$m	1,384	1,440	1,555	1,548	1,500	1,453	1,446	0.7
Total value									
- nominal value	A$m	12,050	16,430	16,604	16,275	16,295	16,525	17,040	5.9
- real value[e]	A$m	12,458	16,430	16,102	15,372	15,010	14,851	14,940	3.1

Notes: **c** LME cash prices for primary aluminium; **d** In 2022 calendar year US dollars; **e** In 2021–22 financial year Australian dollars; **f** Forecast; **r** Average annual growth between 2021 and 2027 or 2020–21 and 2026–27; **z** Projection. Source: ABS (2022) International Trade in Goods and Services, 5368.0; Bloomberg (2022); London Metal Exchange (2022); Department of Industry, Science, Energy and Resources (2022); World Bureau of Metal Statistics (2022).

29 Cu 63.546 Copper

Major Australian copper deposits (Mt)

Copper facts

- The average home contains **180 kg of copper**
- 80% of copper ever produced **is still in use today**
- An electric car contains about **5x more copper** than an equivalent ICE car
- China consumes half of the **world's copper**

World consumption

- **31%** Equipment
- **30%** Building Construction
- **15%** Infrastructure
- **12%** Transport
- **12%** Industrial

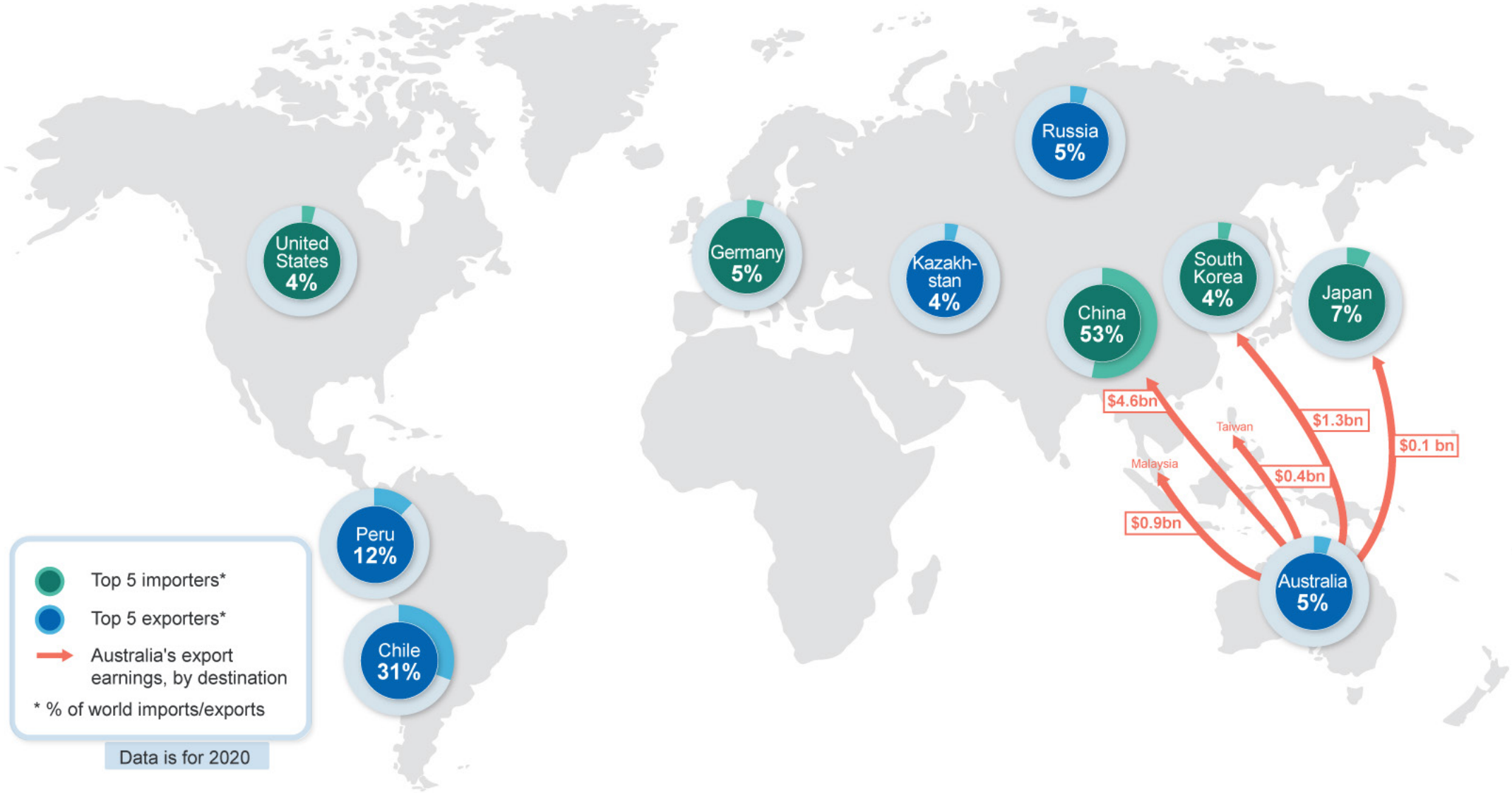
Australia's copper

- **Ranked no 2** for **copper resources**
- **6th largest mined copper producer** in the world
- **Copper exports** worth more than **$11 billion** in 2021

29 Cu 63.546

Copper

Trade map | March 2022



12.1 Summary

- Copper prices increased 51% to US$9,300 in 2021 as global industrial activity recovered from COVID-19. Prices are expected to ease slightly as mine production comes online over the outlook period, stabilising at around US$8,000 a tonne (in real terms) in 2027.
- Australia's copper exports are projected to fall to 834,000 tonnes in 2021–22 as scheduled maintenance is completed. Copper exports are expected to grow to over 1 million tonnes in 2026–27 as high copper prices incentivise production from new mines and mine expansions (see *Australia section*).
- As prices and output grow, Australia's copper export earnings are projected to lift from $11.8 billion in 2020–21 to $13.8 billion (in real terms) in 2026–27, up an average 2.6% a year.

12.2 World consumption

China looks set to pick up after the Winter Olympics

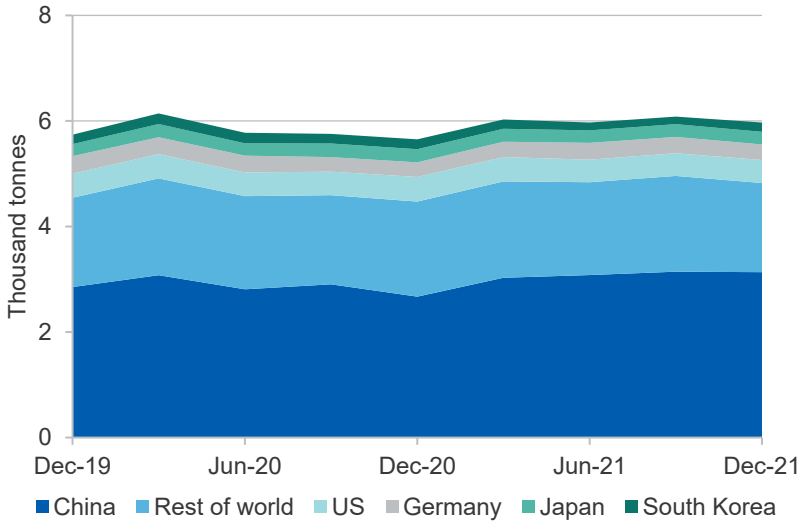
China accounted for more than half of global refined copper consumption in 2021 (Figure 12.1). However, Chinese consumption slowed towards the end of 2021, as episodes of power rationing and uncertainty in the property market softened industrial production, a key consumption industry for copper.

Industrial production remained similarly soft early in the March quarter 2022, due to the Lunar New Year holiday and Beijing Winter Olympic Games. The Caixin Manufacturing PMI fell to a 23-month low of 49.1 in January, indicating manufacturing activity contracted during the month. While PMIs rose in February — a sign that activity is picking up — recent COVID-19 outbreaks in eastern China remain a downside risk for the first half of 2022.

As a result of weak refined copper consumption in the second half of 2021, growth in consumption has been downgraded to 1.4% for 2021 (from 3.7% in the December 2021 *Resource and Energy Quarterly*). Consumption is estimated to grow by 2.5% in 2022, to reach almost 26 million tonnes.

That said, headwinds are starting to emerge. The US Federal Reserve and other central banks are expected to raise interest rates on several occasions in 2022, in response to inflation hitting 40-year highs. In addition, the Russian invasion of Ukraine is creating high levels of uncertainty in Western markets, which, over time may lead to impacts for industrial production and global copper demand.

Figure 12.1: Outlook for refined copper consumption



Source: World Bureau of Metal Statistics (2022); Department of Industry, Science, Energy and Resources (2022)

Energy transition and growing applications to support consumption

The global energy transition towards low emissions technologies is expected to positively impact copper consumption over the outlook period. Copper's conductivity, malleability and durability, make it vital to electric vehicles (EVs), batteries and renewable energy generation. Expanding EV charging networks and improving transmission infrastructure will also support consumption.

Copper used in EVs, batteries and chargers could account for as much as 10% of world refined consumption by 2030.

Demand for EVs — which contain up to five times more copper than conventional cars — has continued to exceed expectations. Infrastructure such as charging stations and improved transmission lines will be needed to support this growing trend.

While EVs and other energy economy technologies will increase their share of total refined copper consumption, traditional copper applications will still account for the majority of consumption. China remains the largest source of consumption risk, given it has the lion's share of copper consumption. If China's rapid industrial growth levels out, consumption growth will be heavily affected.

Government policies to support long-term copper consumption

Implementation of new Government policies should support future global copper consumption. China's 14th Five Year Plan includes increased investment in high speed rail, telecommunications, and electrification of transport and renewable energy, all of which would result in greater copper use.

The EU is also pushing ahead with its de-carbonisation plans which will support copper consumption. In the US, the Biden administration has signalled an intention to increase EV usage, wind generation capacity and investment in charging infrastructure. However, these intentions may face headwinds trying to pass legislation.

Refined copper consumption is expected to grow at an average annual rate of 1.7% to reach 28 million tonnes in 2027. Most of this growth is weighted towards the first half of the outlook period, however there is potential for growth to be upgraded towards the second half of the outlook if nations bring plans to de-carbonise forward.

12.3 World production

Uncertainty around Chile and Peru production

Mine production in Peru continues to improve quarter-on-quarter, with output growth of 4.0% in the December quarter 2021. However, protest activities at MMG's Las Bambas mine are an ongoing risk. While the blockade referenced in the December 2021 REQ was lifted, a new and ongoing blockade of the road used by MMG has forced production to cease on February 20 2022. Even accounting for mine disruptions, significant growth in mine production is expected from Peru through to 2023.

Chilean production improved by 5.4% in the December quarter 2021, after falling by 2.5% in the September quarter 2021. Production at BHP's Escondida mine continues to decline quarter-on-quarter due to lower feed grade. Brazilian production declined 14% in the December quarter.

Mine production to increase, taking some heat off prices

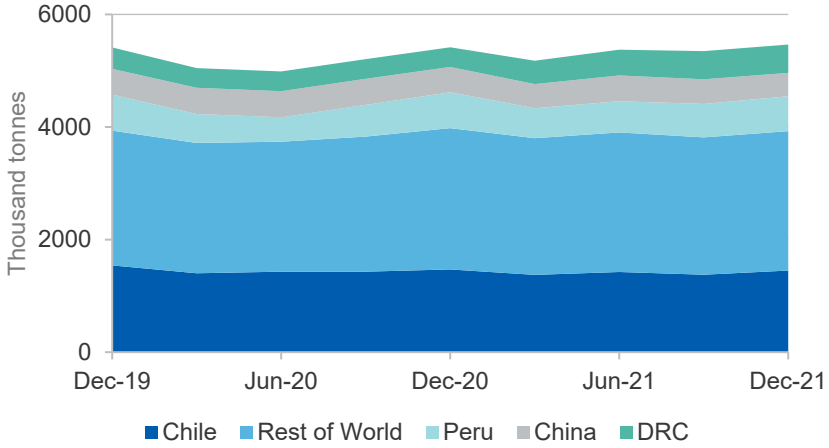
Global mine production is forecast to reach 23 million tonnes in 2022, up from 21 million tonnes in 2021 (Figure 12.2). Current high prices — a reflection of market tightness — and expectations of future demand growth, are creating strong incentives for development projects.

Over the outlook period, significant gains in production are expected to come from Peru and Chile, though both countries face some short-term issues in bringing product to export markets. Significant investment in capacity in Indonesia is also expected to boost world production growth over the outlook period.

The Kamoa-Kakula copper project in the in Democratic Republic of Congo is expected to increase the combined capacity of its two concentrators by 21%, in an attempt to reduce bottlenecks. Once these upgrades are complete, it will be the fourth-largest copper producer globally, processing 9.2 million tonnes per year. A third concentrator is expected to be commissioned in the fourth quarter of 2024. Other major copper projects set to start production in 2022 include Quellaveco (Peru), Spence-SGO (Chile), Quebrada Blanca QB2 (Chile) and Udokan (Russia).

Long project development timelines are always a risk to copper mine production forecasts. World mine production is projected to continue growing at an average rate of 3.3% to 2027, to reach almost 26 million tonnes. Mine production is expected to face headwinds at the end of the outlook period, driven by deteriorating reserves and resources, and environmental and social responsibility issues. The prices of co-products — such as cobalt — will play an important role in decisions regarding expansion or operation restarts.

Figure 12.2: Outlook for mined copper production



Source: World Bureau of Metal Statistics (2022); Department of Industry, Science, Energy and Resources (2022)

Strong momentum in refined production growth

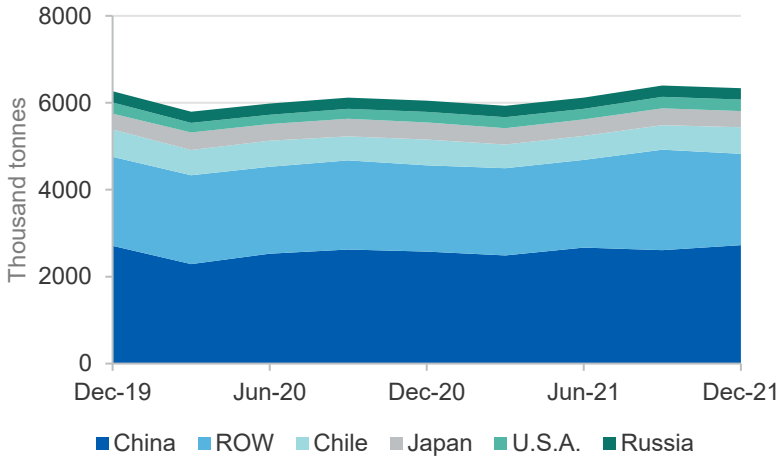
After growing by 2.8% in 2020, refined copper production has grown by 4.4% in 2021 to 25 million tonnes (Figure 12.3), as new Chinese refining capacity comes online and high prices encourage increased processing. Refined production is expected to grow by 4.1% to 26 million tonnes in 2022. This is expected to exceed copper consumption and thus stabilise inventories, in turn reducing some of the upward price pressure in the global copper market.

Chinese copper production fared well through episodes of power rationing in the second half of 2021, mainly due to its relatively low energy intensity and its importance in low emissions technology. Monthly refined production in December 2021 was 961,000 tonnes, exceeding the pre-pandemic record set in December 2019.

Refinery production is projected to increase at an average 2.2% over the outlook period, to 29 million tonnes in 2027. New refinery capacity is expected to come online in China, Peru, Russia and Indonesia. Refined copper production faces expansion challenges, concentrate and electricity cost pressures, increasingly tight emission and sulphur capture limits, as well as generally tighter approval processes.

The Russian invasion of Ukraine is not expected to have a large effect on world refined copper production. Russia typically accounts for 4.0% of the global refined market, with most of this exported to China and Europe. Any material traditionally exported to Europe could be absorbed by China in the event of sanctions.

Figure 12.3: Outlook for refined copper production



Source: World Bureau of Metal Statistics (2022); Department of Industry, Science, Energy and Resources (2022)

12.4 Prices

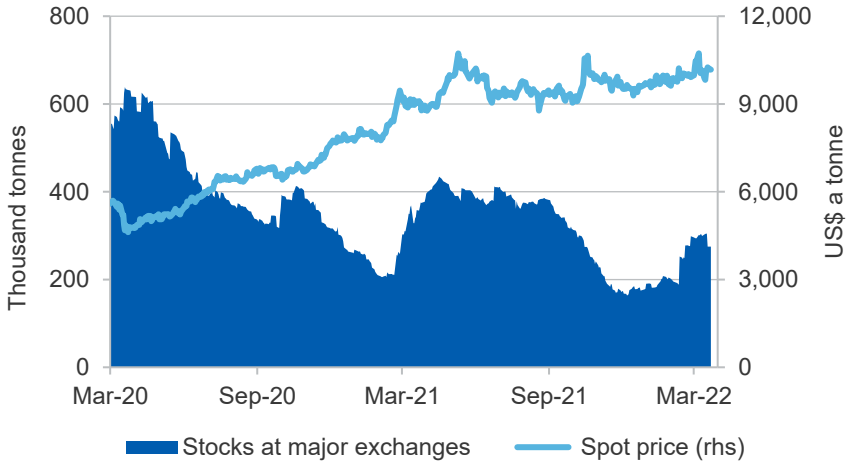
Copper price remains high despite Chinese stockpiling

2021 was a strong year for copper prices, with LME copper averaging around $9,300 a tonne — an increase of 51% year-on-year. In October 2021, prices rose from US$9,100 a tonne to US$10,600 in just 3 weeks (Figure 12.4).

Meanwhile, disruptions to industrial production in China — due to the Winter Olympics and Lunar New Year festivities, and a resurgence of COVID-19 cases — saw Chinese copper consumption soften. This led to a spike in Shanghai Futures Exchange warehouse stockpiles, which have quadrupled since the start of 2022.

Despite this, copper prices have remained stubbornly high, averaging just shy of US$10,000 in the March quarter 2022 (Figure 12.4). Logistics challenges remain present, with higher shipping costs and longer transit times reducing the ability of increasing supply to moderate prices. Prices are expected to moderate over the year and dip to around US$9,400 by the December quarter, to average $9,700 over the year.

Figure 12.4: Copper exchange inventories and spot price



Source: LME (2022) official cash price; Bloomberg (2022)

Prices are expected to average around US$8,900 in 2023. Further over the outlook period, prices are expected to moderate, as new supply comes online and pushes the market into surplus. High prices may incentivise supply to come online sooner, or for marginal projects to be pushed through — which would see downward pressures on the copper price — though higher labour costs may present challenges.

The spot price is projected to reach US$8,000 a tonne (in real terms) by 2027, as the price of copper softens. These price projections are sensitive to the balance in world copper markets, which will be affected by the pace of world economic growth, and the pace of low-emissions technology uptake.

12.5 Australia

Price and volumes growth to boost copper export earnings

Copper export earnings reached over $11 billion in 2020–21, 12% higher year-on-year (Figure 12.5). This growth is attributed to the recovery in the copper price over this period, as export volumes saw a slight decrease due to scheduled maintenance at several projects.

Export volumes are expected to remain subdued — at around 834,000 tonnes — in 2021–22, as scheduled maintenance operations reach completion. Once these operations are completed, exports are forecast to rise to 932,000 tonnes in 2022–23. Copper export volumes are expected to peak in 2024–25, remaining steady at just over 1 million tonnes in 2026–27.

Copper export earnings are expected to be strong in 2021–22 due to strong global copper prices, increasing to $13.2 billion. The increase in export volumes in 2022–23 will negate the forecast softening in copper prices, with exports expected to be worth $14.3 billion in 2022–23. Over the rest of the outlook period, exports will be relatively stable, at $13.8 billion (in real terms) (Figure 12.5).

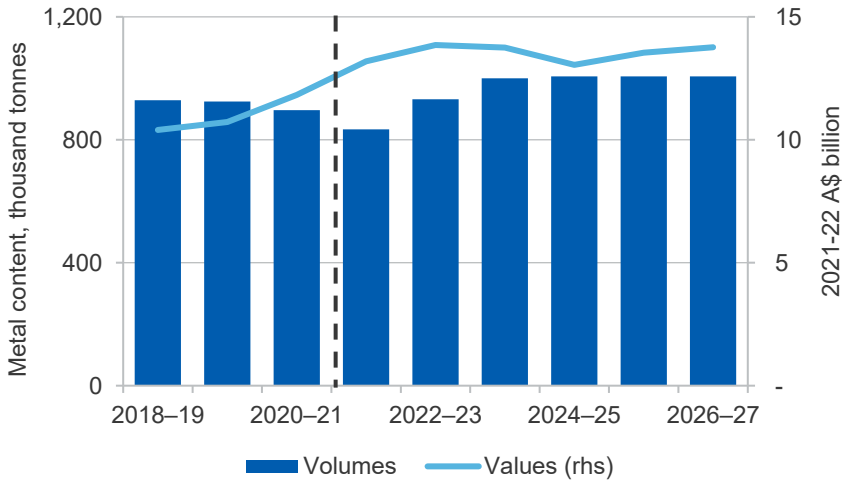
Production capacity to grow

The pace and extent of project development will depend on the persistence of current high prices. Final Investment Decisions (FIDs) are slated for several mines in 2022 and 2023, including Oz Minerals' West Musgrave project, KGL's Jervois Copper project and Havilah's Kalkaroo project. Work on the Wira shaft expansion at Prominent Hill is scheduled to start in the March quarter 2022, after a FID was made in August 2021. This capacity will come online towards the middle of the outlook period.

Meanwhile, BHP's Olympic Dam's production was down 70% year-on-year in the December quarter due to planned smelter maintenance, which was completed in January 2022. Production is expected to return to historic levels of 200,000 tonnes a year.

At 797,000 tonnes, Australian mine production in 2021–22 is expected to be 9.2% lower than 2020–21 production (Figure 12.5). Total mine production is expected to rebound to 907,000 tonnes in 2022–23, reaching 979,000 tonnes in 2026–27 (an annual growth rate of 1.8%).

Figure 12.5: Australia's copper export volumes and values



Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

High prices encouraging restarts

The Nifty copper mine in Western Australia has been acquired by Cyprium, after being placed on care and maintenance in 2019. The new owners have stated an expectation that the processing method will change to heap leaching to produce copper metal plate. Under this model, annual capacity is 20,000 tonnes, and Cyprium is targeting first production mid-2023.

Refined copper production to stabilise over the short-term

Refined output was down 30% quarter-on-quarter in the December quarter 2021. Glencore's Townsville Refinery saw a decrease in output after unusually high production in the September quarter 2021, while BHP's Olympic Dam production was reduced due to planned smelter maintenance. Refined output is expected to decrease to 380,000 tonnes in 2021–22, before rebounding by 17% to 444,000 tonnes in 2022–23.

It is uncertain whether Glencore's Townsville refinery will continue production after 2025. As a result, refined output is projected to drop substantially (from 412,000 tonnes in 2024–2025 to 299,000 tonnes in 2025–26), however strong copper prices may encourage continued operations.

Copper exploration hits new heights in the December quarter 2021

Copper exploration was $172 million in the December quarter 2021, more than doubling exploration for the December 2020 quarter and up 11% on the September quarter of 2021 (Figure 12.6). It is likely that higher copper prices and copper's involvement in the movement towards electrification is encouraging investment in exploration.

Figure 12.6: Australian copper exploration expenditure

Source: ABS (2022)

Revisions to the outlook

Since the December 2021 *Resources and Energy Quarterly*, the forecast for Australia's copper export earnings in 2021–22 has been revised down by $1.0 billion. The forecast for copper export earnings for 2022–23 has been revised down by $0.4 billion. Both downward revisions are a result of a downward revision of the price of copper export ores and concentrates.

Compared to the March 2021 *Resources and Energy Quarterly*, export earnings in 2025–26 are $2.3 billion lower at $15.1 billion (in nominal terms), due to a downward revision of export volumes and a downward revision of the price of copper ore and concentrates.

Table 12.1: Copper outlook

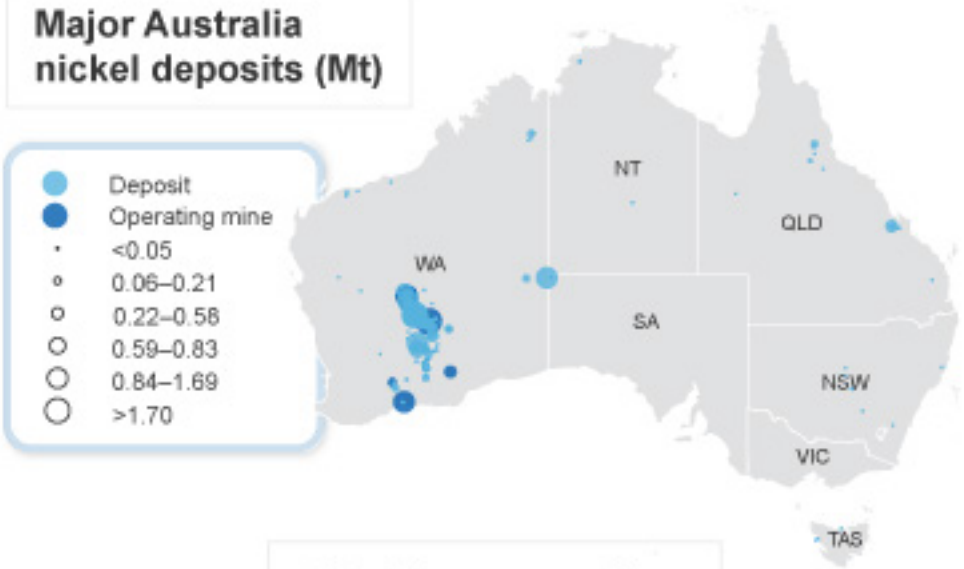
World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Production									
–mine	kt	21,253	23,102	24,165	24,382	24,504	24,627	25,831	3.3
–refined	kt	25,183	26,228	27,041	27,609	28,023	28,471	28,772	2.2
Consumption	kt	25,306	26,126	26,969	27,779	27,400	27,713	28,054	1.7
Closing stocks	kt	1 148	942	1 348	1 595	1 544	1 441	1 268	1.7
–weeks of consumption		2.4	1.9	2.6	3.0	2.9	2.7	2.4	-0.1
Prices LME									
–nominal	US$/t	9,315	9,699	8,930	8,472	8,640	8,853	8,998	-0.6
	USc/lb	423	440	405	384	392	402	408	-0.6
–real[b]	US$/t	9,637	9,699	8,698	8,043	8,002	8,013	7,958	-3.1
	USc/lb	437	440	395	365	363	363	361	-3.1
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Mine output	kt	878	797	907	975	979	979	979	1.8
Refined output	kt	452	380	444	448	412	299	225	-11.0
Exports									
–ores and cons[c]	kt	1,672	1,644	1,812	2,064	2,220	2,535	2,760	8.7
–refined	kt	420	368	424	428	394	285	215	-10.6
–total metallic content	kt	896	834	932	1,000	1,006	1,006	1,006	1.9
Export value									
–nominal	A$m	11,440	13,189	14,287	14,555	14,162	15,068	15,696	5.4
–real[d]	A$m	11,827	13,189	13,854	13,748	13,045	13,542	13,762	2.6

Notes: **b** In 2022 calendar year US dollars; **c** Quantities refer to gross weight of all ores and concentrates; **d** In 2021–22 financial year Australian dollars; **f** Forecast; r Average annual growth between 2021 and 2027 or 2020–21 and 2026–27; **z** Projection.

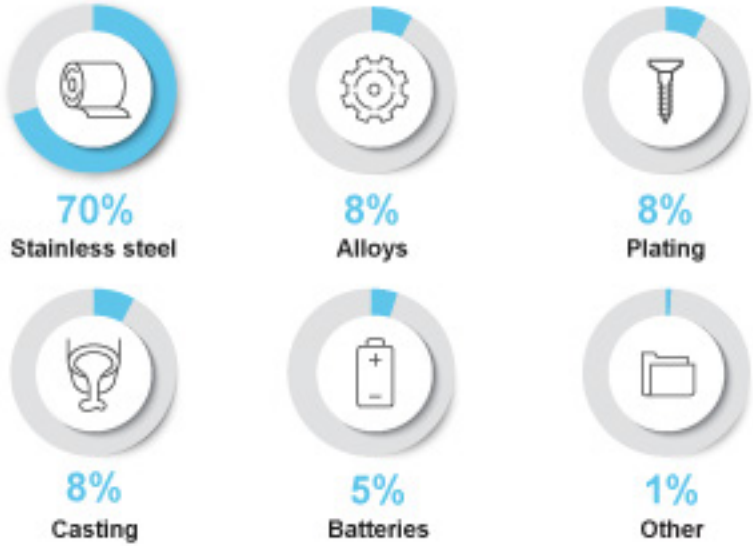
Source: ABS (2022) International Trade, 5465.0; LME (2022) spot price; World Bureau of Metal Statistics (2022) World Metal Statistics; Department of Industry, Science, Energy and Resources (2022)

28 Ni 58.693 Nickel

Major Australia nickel deposits (Mt)



World consumption



Nickel facts

- Nickel is used in the **US, UK and Euro coins**
- Nickel has a growing role in **electric vehicle batteries**
- Nickel is **magnetic** at room temperature and is **fully recyclable**
- Nickel is the **second most abundant element** in the Earth's core after iron

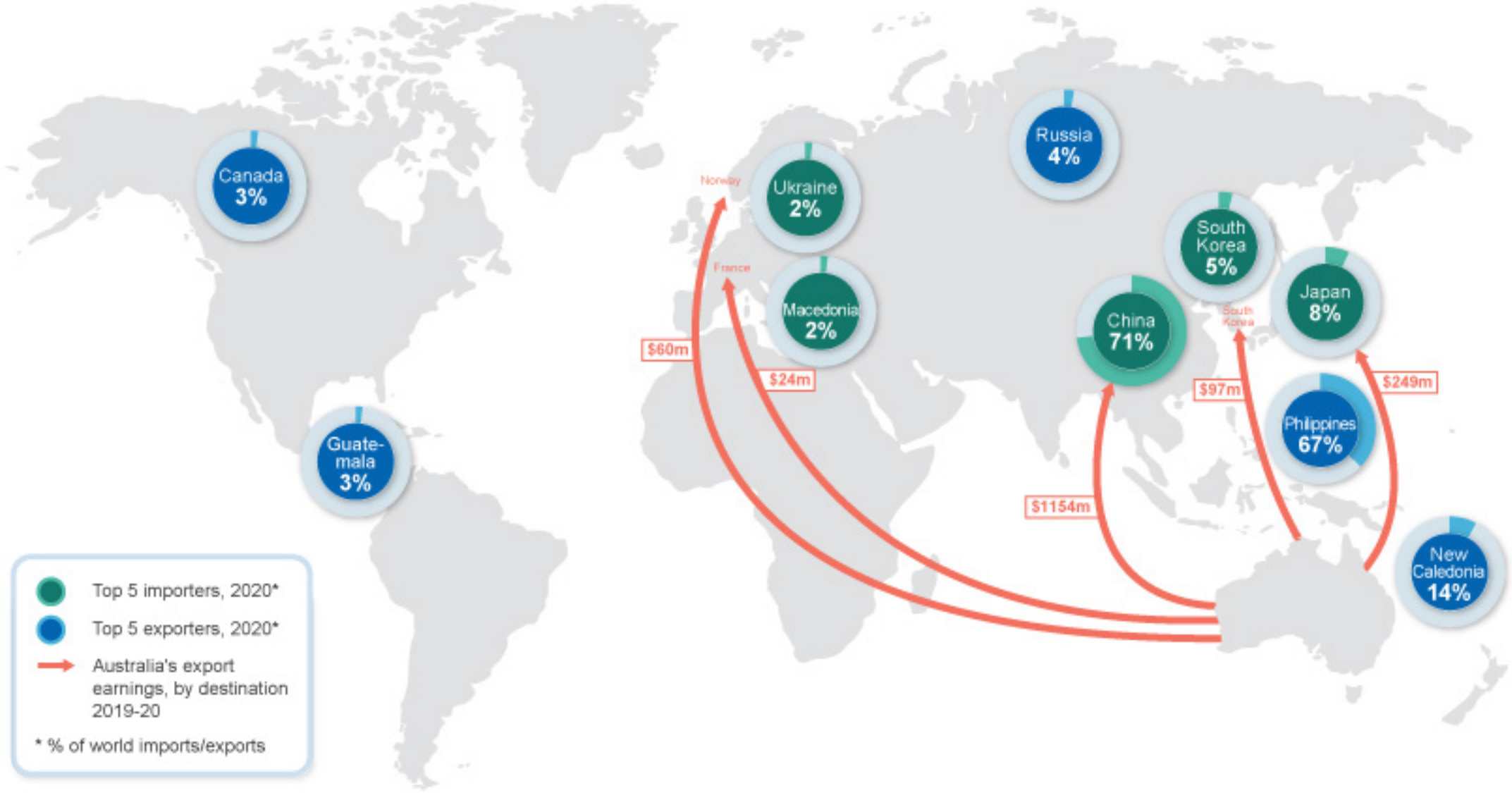
Australia's nickel

- Australia has 22% of world **nickel resources**
- **Typically produces over** 200,000 tonnes a year
- **Contributes** more than $3.8b to the economy

Nickel

28 Ni 58.693

Trade map | March 2022



Summary

- Nickel prices are expected to average US$24,875 in 2022, over declining stocks of battery grade material and the Russian invasion of Ukraine. Prices are expected to ease in the medium term, before facing upward pressure from significant demand from electric vehicle manufacturing. The forecast nickel price in 2027 is US$21,100 (in real terms) by 2027.
- Australia's export volumes are forecast to rise from 273,000 tonnes in 2021–22 to 326,000 tonnes in 2026–27. Higher nickel prices may incentivise further expansion in nickel production to capitalise on the movement towards low-emission technologies.
- Export earnings are forecast to be stable as higher export volumes offset lower nickel prices. Australia's export earnings are forecast at $7.0 billion in 2021–22, and at $7.3 billion (in real terms) in 2026–27.

13.1 World consumption

Economic recovery leads nickel demand higher

Global nickel demand rebounded in 2021, as the world economy recovered from the impact of the COVID-19 pandemic. Stainless steel production, the main use for nickel, rose 13% year-on-year, led by China (up 7.5% to 33.8 million tonnes) and Indonesia (up 86% to 5.0 million tonnes). Indonesia overtook India to become the second largest producer of stainless steel.

However, stainless steel production saw some challenges in 2021. Global energy shortages during the second half of 2021 impacted output, especially in China. Production in China is expected to be further subdued in March quarter 2022 in the provinces surrounding the 2022 Winter Olympics in Beijing, but are expected to recover in the latter half of 2022.

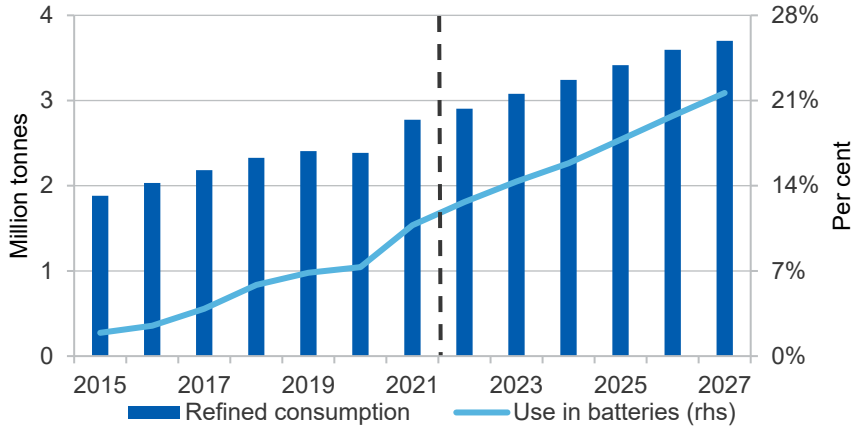
Total nickel demand rose by 16% year-on-year in 2021 to reach 2.8 million tonnes. Nickel demand growth is expected to temper in 2022, as global growth rates normalise following the COVID-19 rebound. Total nickel demand is forecast to reach 2.9 million tonnes in 2022, growing to almost 3.1 million tonnes in 2023. Nickel consumption is expected to grow at an average rate of 3.7% a year to reach 3.4 million tonnes in 2027.

EV sales a boon for nickel prospects

Despite the global automotive chip shortage, electric vehicle (EV) demand exceeded expectations in 2021. EVs have more modern computer chips than their internal combustion engine counterparts, and so were prioritised by chipmakers. At 6.5 million total sales in 2021, EV sales doubled year-on-year. By 2027, annual EV sales are expected to hit 24 million.

With more sales — and a desire for bigger battery packs — nickel use in batteries is expected to be a dominant driving force of nickel demand over the outlook period. 360,000 tonnes of nickel was used in batteries in 2021 (11% of total demand), up from 200,000 tonnes in 2020. By 2027, batteries are expected to account for 22% of total nickel demand.

Figure 13.1: Forecast nickel consumption



Source: International Nickel Study Group (INSG); Wood Mackenzie; Department of Industry, Science, Energy and Resources (2022)

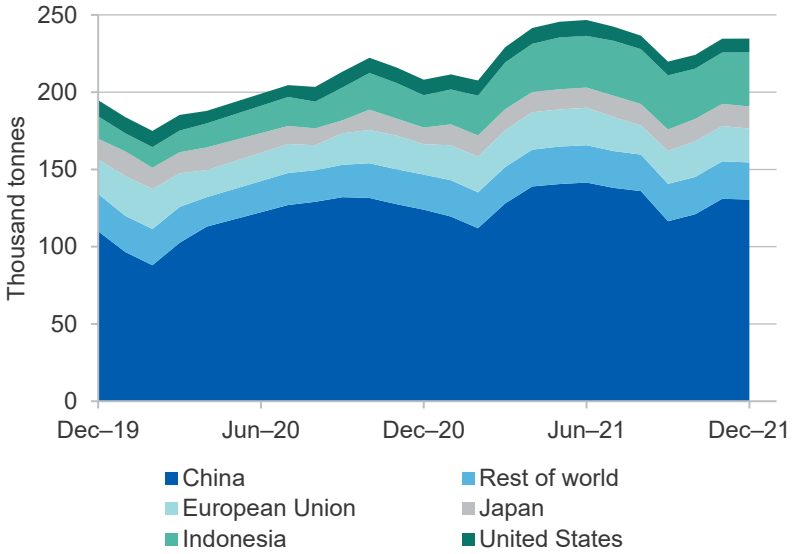
That said, the recent surge in EV sales has created some of its own pressure. The cost per kilowatt-hour (kWh) of battery packs is expected to rise in 2022, off the back of surging battery metal prices. Lithium hydroxide prices more than doubled in 2021, while nickel is facing its own price pressures following the Russian invasion of Ukraine. It is expected that price parity of EVs will occur when battery costs reach US$100 per kWh. If the price of battery metals remain elevated, this would push the 'tipping

point' for EV adoption later, creating some softening for nickel in battery demand. Alternative battery chemistries that do not use nickel are also emerging — see Prices section.

Stainless still strong into the future

While use in batteries is the driving force for nickel demand over the outlook period, stainless production is still expected to be strong. Stainless production is expected to grow at an average annual rate of 3.1% to 2027, with total production approaching 73 million tonnes.

Figure 13.2: Composition of world nickel consumption



Source: International Nickel Study Group; Department of Industry, Science, Energy and Resources (2022)

The majority of stainless steel growth is expected to come from the major producers — China, Indonesia and India. Indonesia's ore export ban has propelled it to second in the world for stainless steel exports, forcing China to import more stainless from Indonesia and more ore — for its own stainless production — from the Philippines. Currently, 71% of stainless steel comes from these three countries; this is expected to grow to 75% of global production by 2027.

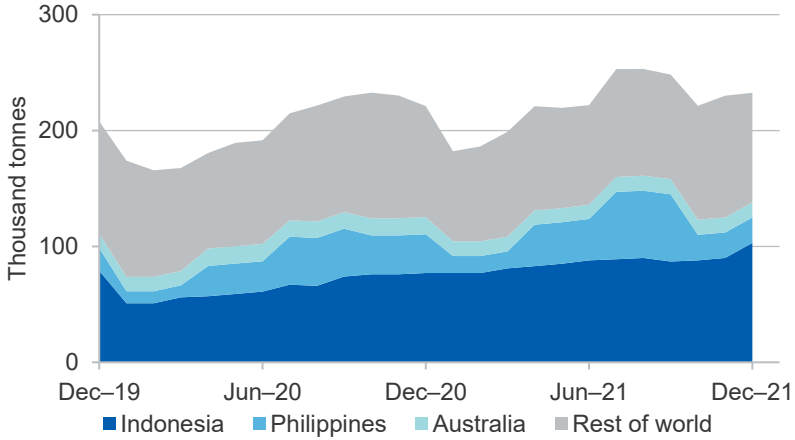
13.2 World production

Mine production ramps up

Global nickel mined production grew by 8.8% year-on-year in 2021, as production returned to normal and mines started to operate at their regular capacity following COVID-19 containment measures. Mined production is forecast to grow by 11% to almost 3.0 million tonnes in 2022, largely driven by increased mine production in Indonesia to feed domestic nickel pig iron (NPI) production. Mine production is projected to grow an average 4.2% a year over the outlook period, to reach 3.4 million tonnes in 2027.

Canadian mine output in the December quarter 2021 rose 58% quarter-on-quarter, as operations at Vale's Sudbury plant normalised following significant protest activity in the September quarter 2021. Canadian mine output is expected to remain stable to 2027.

Figure 13.3: Composition of world mined nickel production



Source: International Nickel Study Group; Department of Industry, Science, Energy and Resources (2022)

Russian mine production rose 22% quarter-on-quarter in the December quarter 2021, as operations at Nornickel return to normal following flooding in early 2021. Russian mine production is forecast to increase at an average rate of 5% annually to 2027.

Production in the Philippines decreased dramatically in the December quarter 2021 due to poor weather. Mine output fell 62% quarter-on-quarter to 66,000 tonnes, and is expected to remain subdued into 2022, as ore reserves are depleted. Mine output in the Philippines is expected to remain stable to 2027.

Already the largest producer of mined nickel, mine production in Indonesia is expected to grow as new refinery capacity in Indonesia creates a market for domestic mined output (Figure 13.3). Indonesia is expected to account for over half (52%) of global mine output in 2027, up from 45% in 2022.

Refined production: can matte conversion outshine HPAL?

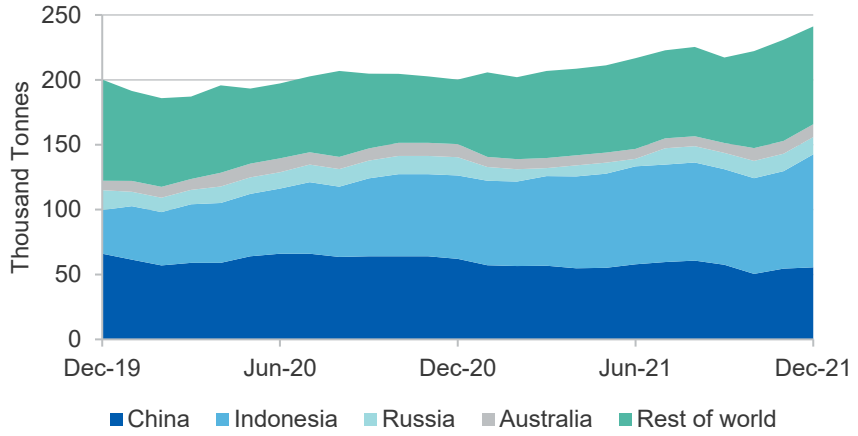
Lithium-ion batteries have conventionally used nickel sulphates derived from higher quality, Class 1 compositions of nickel sulphides. However, sulphide deposits are much less abundant than laterite deposits, resulting in a shortage of Class 1 nickel. Currently, Class 1 nickel — which has a minimum purity of 99.8% — accounts for less than 25% of total finished nickel supply.

It is widely expected that production from sulphide ores will struggle to meet the demands of the battery sector. High Pressure Acid Leach (HPAL) projects are touted as one solution, but are plagued with high capital costs and operational problems. Negative Environmental, Social and Governance (ESG) risks are also a factor, and EV manufacturers are wary of tarnishing their green credentials.

Recently, the conversion of NPI to matte has arisen as a solution to this problem. On 24 January, Tsingshan announced that the first batch of nickel matte was on its way from Indonesia to China for use as feedstock for battery precursors, reducing the need to dissolve briquettes for nickel sulphate. Tsingshan is expected to supply around 100,000 tonnes in total to two Chinese firms in 2022, and several other firms have also announced intentions to convert NPI to matte in 2022.

NPI is produced in relative abundance when compared to class 1 nickel from sulphide ores. However, the economics — and environmental credentials — of NPI to matte to battery grade material, is unproven. NPI production is relatively energy intensive even before accounting for its conversion to matte.

Figure 13.4: Composition of world refined nickel production



Source: International Nickel Study Group; Department of Industry, Science, Energy and Resources (2022)

NPI is produced in relative abundance when compared to class 1 nickel from sulphide ores. However, the economics — and environmental credentials — of NPI to matte to battery grade material, is unproven. NPI production is relatively energy intensive even before accounting for its conversion to matte. As a result, it is unlikely that US and European producers will look to such projects to source battery grade nickel. That said, China accounts for around half of the EV market, and may be less deterred if it provides a cheaper route for battery precursor production.

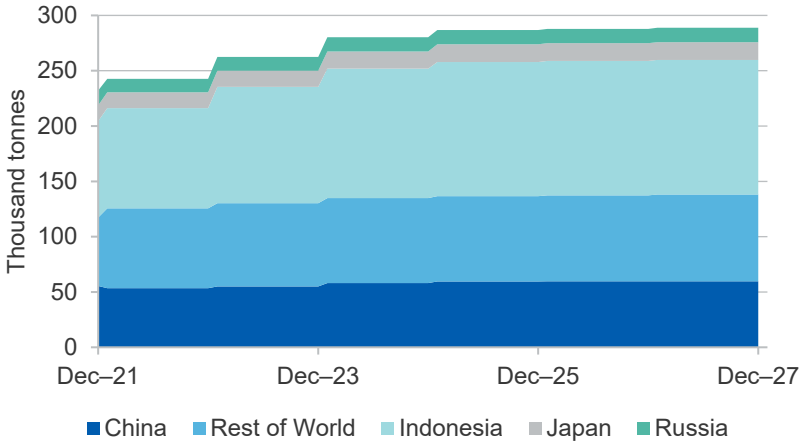
Indonesia refines its nickel market

Indonesia's bans on nickel ore exports — in order to promote production and export of value-added products — has long been discussed. However, 2020 and 2021 have really been the turning point for Indonesian refined production to reach maturity, largely with the help of Chinese investment (Figure 13.4). In 2022, Indonesia is expected to continue this trend,

growing by 24% to over 1.1 million tonnes, growing to 1.5 million tonnes by 2027 (Figure 13.5).

Chinese investment has not stopped at processed nickel (ferronickel, NPI and matte) but has continued into stainless steel with two large producers now operating. Several HPAL operations are either operating or soon to begin production, producing mixed hydroxide precipitate (MHP) for battery grade material required by Chinese EV makers.

Figure 13.5: Forecast composition of world refined nickel production



Source: International Nickel Study Group; Department of Industry, Science, Energy and Resources (2022)

13.3 Prices

Nickel prices soar due to near-record decline in inventories

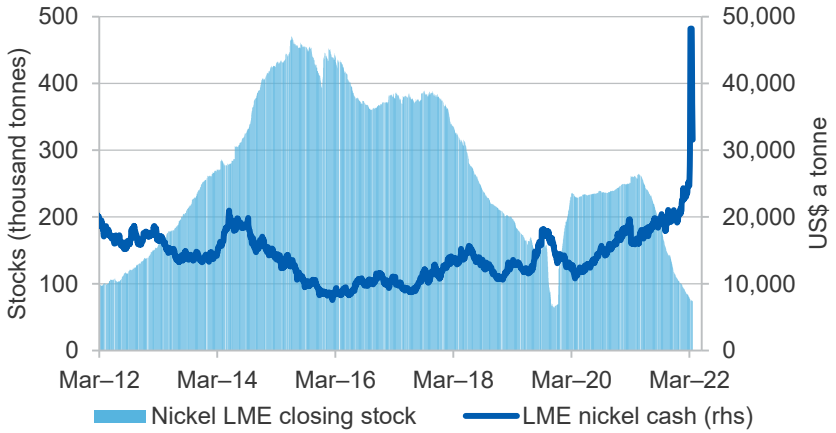
Nickel's strong price growth in 2021 continued into March quarter 2022, off the back of positive sentiment surrounding EV demand, low exchange inventories and the Russian invasion of Ukraine. Inventories at London Metals Exchange (LME) warehouses have fallen steadily over the past 12 months, from a high of 265,000 tonnes in April 2021, to just 81,000 tonnes on 23 February 2022. Over the same time period, the LME nickel price has risen from US$16,151 to $24,887 — an increase of 54%.

This rundown in stocks and upward price pressure continued following the Russian invasion of Ukraine, with the price rising to $29,609 (4 March) and $48,201 (7 March) soon after the invasion and stocks dwindling to just 77,000 tonnes.

Then, on 8 March 2022, the price of nickel spectacularly doubled to over US$100,000 due to a reported short squeeze. As a result, the LME halted all trading and cancelled the trades made on the day to avoid further volatility. The LME reopened to trading on 16 March, and as at 17 March the nickel price has fallen to US$42,150. The LME has instituted daily price change limits of 8% on both the upside and downside in order to ensure stability and avoid another short squeeze event.

The nickel (spot) price is estimated to have averaged US$26,000 a tonne in the March quarter 2022. Nickel prices are expected to moderate in the second half of 2022, however prices are still expected to average US$24,875 for the year. The nickel market is expected to be balanced in 2023, with prices to fall to around US$21,250. The market balance is then forecast to trend into deficit looking forward to 2027, given the large increase in nickel needed for batteries, with prices forecast to reach $US21,100 a tonne (in real terms).

Figure 13.6: Nickel spot price and stock at exchanges



Source: Bloomberg (2022); Department of Industry, Science, Energy and Resources (2022)

EV demand shows no sign of slowing down

The dominant theme for nickel over the forecast period is the rapid growth in passenger EVs. EV sales were 6.5 million sales worldwide in 2021, and are forecast at 9.1 million in 2022, and could reach 22 million in 2027. By this time, use in batteries as a proportion of total nickel demand is forecast to increase from 13% to 22%. This robust demand from the battery sector is forecast to keep prices strong over the outlook period.

However, downside risks exist within nickel's use in batteries. Added to a delay to the 'tipping point' (see Consumption section), alternate battery chemistries are emerging that have no nickel. Lithium Iron Phosphate (LFP) batteries are popular among Chinese manufacturers, with favourable cost and safety considerations over Nickel-Manganese-Cobalt batteries. LG has recently started using LFP technology, voicing price volatility of materials as a concern. That said, the prolific growth in EV demand will hold nickel in high demand. European manufacturers show preference towards nickel-based batteries, with some manufacturers lifting nickel intensity within their battery packs to raise energy density. Further, battery packs have grown by 7% since 2019, in order to satisfy consumer demand for higher range EVs, putting further upward pressure on demand.

Risks exist, but are unlikely to force forecasts off track

Emerging trends within the battery market are the largest source of upside and downside risks to the nickel price over the outlook period. The extent to which EV sales and battery technology differ from expectations will affect prices. Higher nickel prices may make nickel-free batteries more tempting, or consumers may delay purchasing EVs if battery packs get more expensive. Both scenarios would ease upward price pressures.

Likewise, HPAL and NPI-to-matte conversion for battery grade material has stepped in when markets expect a shortage of nickel from sulphide production. More capacity is expected from both HPAL and NPI-to-matte projects in Indonesia later in 2022. Chinese scrap markets also pose a downside usage risk — every 1% gain in the scrap ratio lowers Chinese primary demand by 1,000 tonnes. Chinese firms may be keen to lift scrap ratios to strengthen their 'green credentials', given NPI's carbon footprint.

13.4 Australia

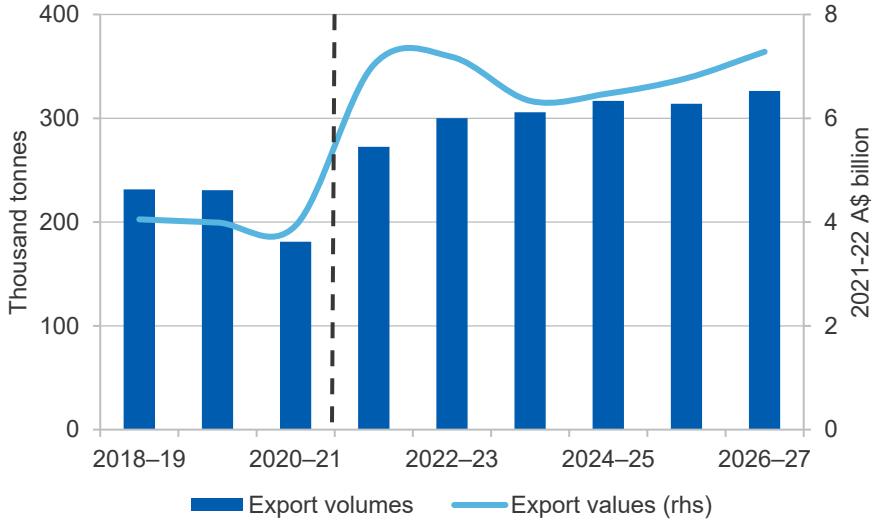
Exports expected to rise over outlook

Nickel export volumes are expected to rebound, after falling to 181,000 tonnes in 2020–21. Export volumes are expected to grow to 273,000 tonnes in 2021–22, increasing further to 326,000 tonnes by 2026–27.

Nickel export earnings are forecast to rise to $7.0 billion in 2021–22 off the back of 13-year record prices (Figure 13.7). Export earnings are expected to soften into 2023–24 as the nickel price retreats, however will be supported by stronger export volumes.

Continued growth in exports will likely depend upon the increasing demand for battery-grade material by EV manufacturers. Export earnings are expected to remain steady over the next few years, and are expected to reach $7.3 billion (in real terms) in 2026–27.

Figure 13.7: Australia's real exports stable over the outlook period



Source: Source: ABS (2022) International Trade in Goods and Services, 5368.0; Department of Industry, Science, Energy and Resources (2022)

Australia's production set to expand as new production comes online

Australia's nickel production is expected to rise from 2021–22, driven by strong prospects for consumption growth in EV battery manufacturing and higher prices. Mine production is forecast to lift from 162,000 tonnes in 2020–21 to 182,000 tonnes in 2021–22, up by 16%. Mine production is expected to increase at an average rate of 6.2% a year to 226,000 tonnes to 2026–27.

Poseidon Nickel have completed the maiden resource report for Golden Swan in the December quarter 2021, and have signed a MoU with Pure Battery Technology to investigate a battery metal refinery hub in Kalgoorlie. Work on the bankable feasibility study is ongoing. This project recently received a grant under the Australian Government's Modern Manufacturing Initiative to grow the local critical minerals processing and clean energy industries.

Western Area's Odysseus mine continues to move ahead, with its nickel offtake tender process nearing completion. Output at their Forrestania operations have improved from September quarter figures, through higher production and mined grades at Spotted Quoll.

Mincor delivered its first batch of nickel ore to BHP for processing at the Nickel West Kambalda concentrator. Work is also progressing at the Cassini orebody, with first ore expected by the end of the March quarter 2022. The mine is forecast to produce 71,000 tonnes of nickel with a peak production of 16,000 tonnes a year.

Queensland Pacific Metals also secured a non-binding letter of support from Export Finance Australia in December 2021 for its Townsville Energy Chemicals Hub project. The hub will import high grade nickel laterite ore from New Caledonia for processing, and have binding offtake agreements in place for its nickel and cobalt products.

Outlook for Australia's refined nickel production

Australia's refinery output is forecast to rise from 105,000 tonnes in 2020–21 to 129,000 tonnes in 2022–23. December quarter production for First Quantum's Ravensthorpe operations was impacted by the delayed transition to the Shoemaker Levy orebody and unplanned maintenance at the power plant main steam pipe. Skilled labour availability and high sulphur prices also pose operational challenges, however this should abate in the June quarter 2022 as Western Australia opens its borders.

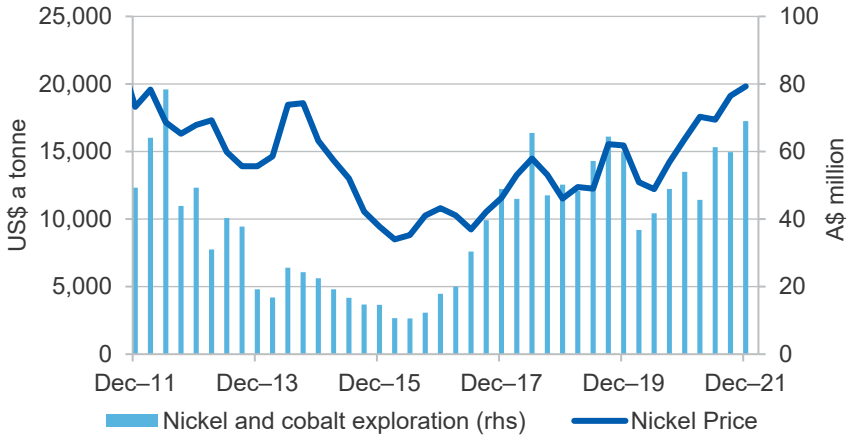
BHP's Nickel West project delivered its first batch of nickel sulphate from its Kwinana refinery in the December quarter 2021. The expansion will ramp up over 2022 to add 100,000 tonnes annual capacity for nickel sulphate refining to the Kwinana refinery.

Australia's refinery production is projected to rise to 139,000 tonnes in 2026–27, growing at an average 4.9% a year from 2020–21 figures. However, stronger increases in refined nickel production are likely, should nickel prices remain strong through the mid-2020s.

Exploration expenditure at a nine-year high

In the December quarter 2021, nickel and cobalt exploration expenditure increased to $69 million — up 15% quarter-on-quarter and 28% year-on-year. This increase is likely due to speculation of a sharp rise in demand for nickel used in EV batteries, with miners seeking new deposits of minerals that will drive the world's low emissions transition (Figure 13.8).

Figure 13.8: Nickel and cobalt exploration continues to expand



Source: Source: ABS (2022) International Trade in Goods and Services, 5368.0

Revisions to the outlook

The forecast for Australia's nickel export earnings have been revised higher since the December 2021 *Resources and Energy Quarterly*. Export earnings are up by $1.8 billion (to $7.0 billion) for 2021–22, and up by $2.6 billion (to $7.4 billion) for 2022–23, due to increases in the nickel price (due to concerns around supply and the Russian invasion of Ukraine).

For 2025–26, export earnings are $7.5 billion (in nominal terms) compared to $7.2 billion as forecast in the March 2021 *Resources and Energy Quarterly*, primarily due to an upward revision of export volumes.

Table 13.1: Nickel outlook

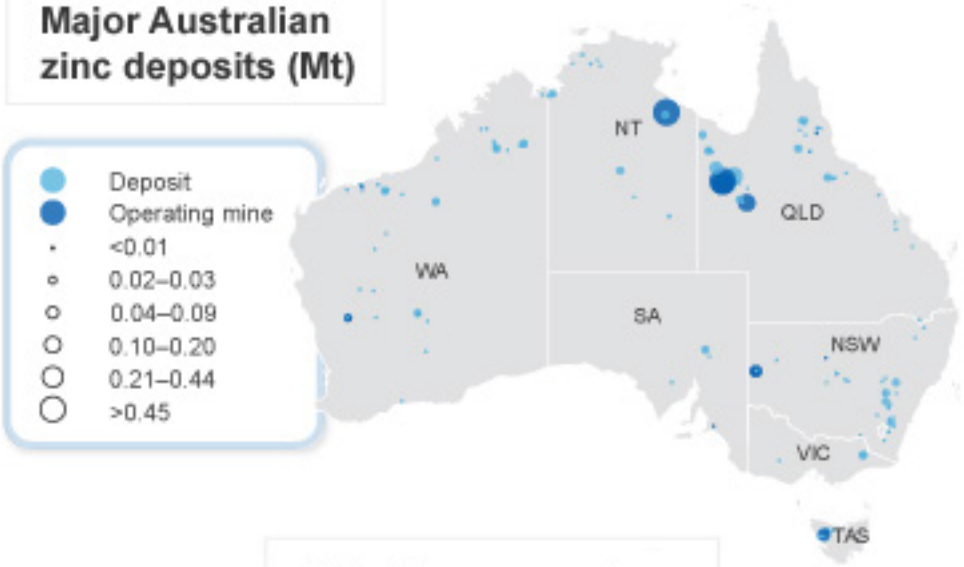
World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Production									
–mine	kt	2,668	2,972	3,210	3,363	3,437	3,433	3,406	4.2
–refined	kt	2,611	2,912	3,125	3,317	3,387	3,397	3,408	4.6
Consumption	kt	2,774	2,949	3,074	3,192	3,275	3,363	3,440	3.7
Closing stocks	kt	484	447	498	623	734	768	736	7.9
–weeks of consumption		9.1	7.9	8.4	10.1	11.7	11.9	11.1	4.1
Prices LME									
–nominal	US$/t	18,468	24,875	21,250	20,250	21,313	22,750	23,875	5.4
	USc/lb	838	1 128	964	919	967	1 032	1 083	5.4
–real[b]	US$/t	19,107	24,875	20,698	19,225	19,740	20,591	21,116	2.6
	USc/lb	867	1 128	939	872	895	934	958	2.6
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Production									
– mine[c]	kt	162	182	233	236	237	226	226	6.2
– refined	kt	105	114	129	135	139	139	139	4.9
– intermediate	kt	29	27	30	30	30	33	48	9.7
Export volume	kt	181	273	300	306	317	314	326	11.5
– nominal value	A$m	3,804	7,031	7,406	6,707	7,032	7,534	8,305	17.2
– real value[d]	A$m	3,932	7,031	7,182	6,335	6,478	6,771	7,281	13.9

Notes: **b** In 2022 calendar year US dollars; **c** Quantities refer to gross weight of all ores and concentrates; **d** In 2021–22 financial year Australian dollars; **f** Forecast; **r** Average annual growth between 2021 and 2027 or 2020–21 and 2026–27; **z** Projection.

Source: ABS (2022) International Trade, 5465.0; LME (2022) spot price; World Bureau of Metal Statistics (2022) World Metal Statistics; Department of Industry, Science, Energy and Resources (2022)

30 Zn 65.38 Zinc

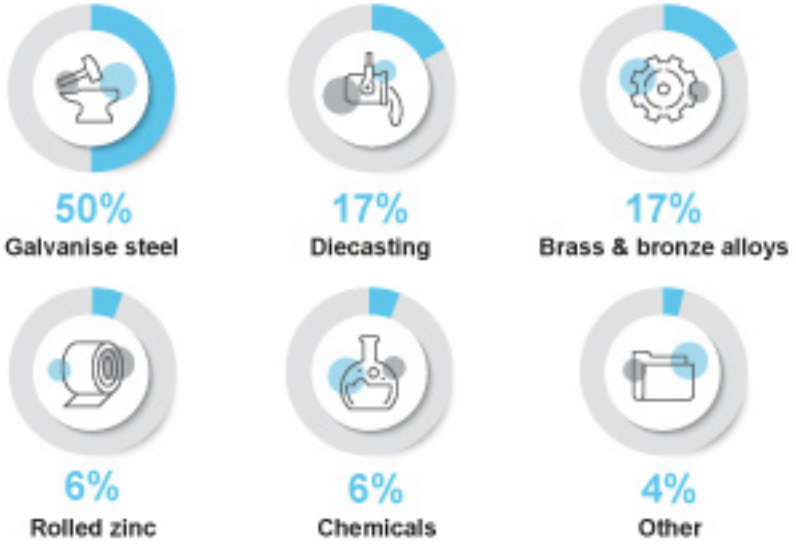
Major Australian zinc deposits (Mt)



Zinc facts

- **Zinc ore** was used in ancient Greece to produce brass
- Zinc is used by the human body to **fight infection**
- **Zinc is used** in wound-care and sunscreen
- Zinc is an **emerging battery mineral**

World consumption

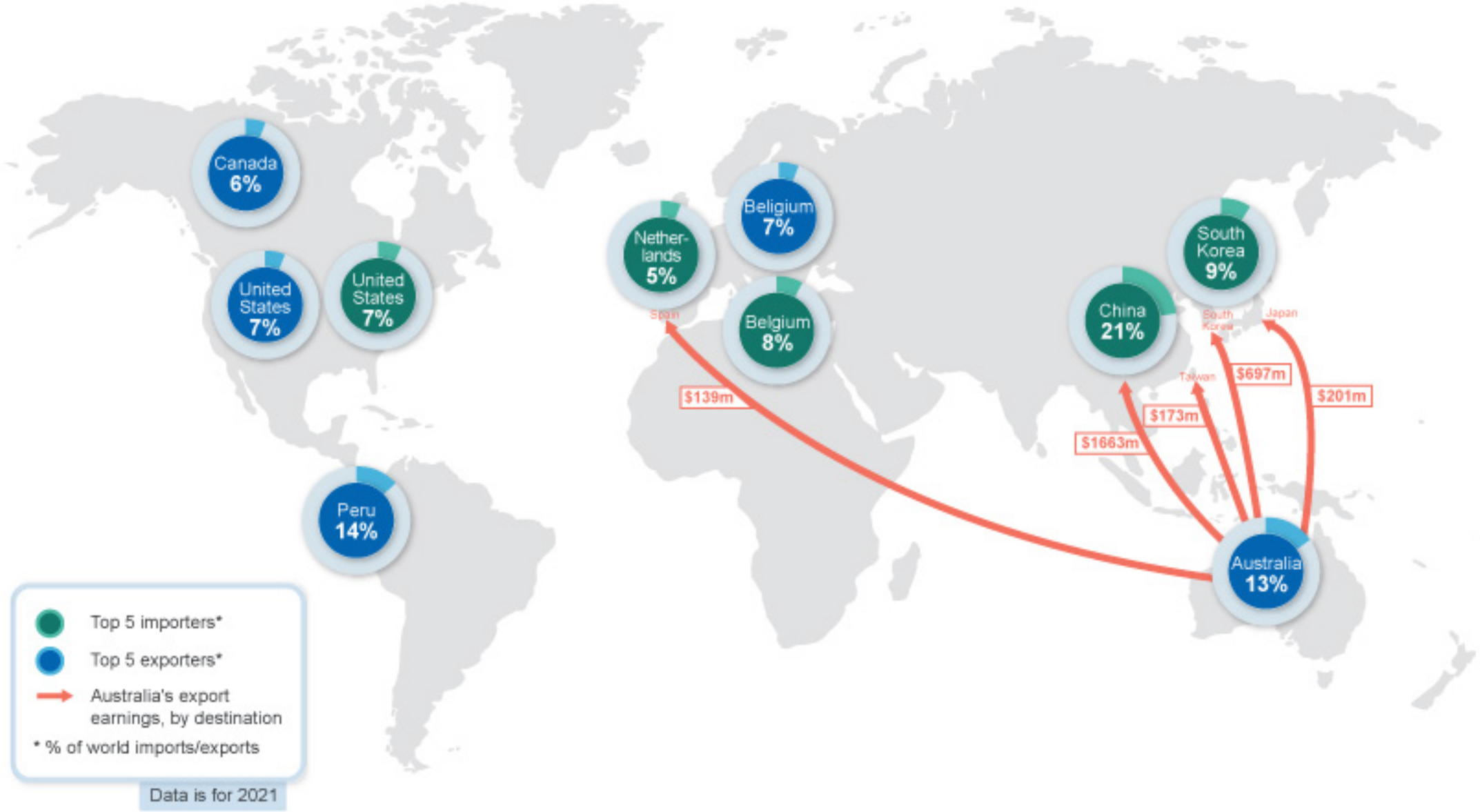


Australia's zinc

- 3rd highest **producer of zinc** in the world in 2021
- 2nd largest **exporter of zinc** in the world in 2021
- Holds 29% **of world zinc resources**

Zinc

Trade map | March 2022



14.1 Summary

- The LME zinc spot price is forecast to average around US$3,600 a tonne in 2022, with robust global construction activity expected this year, as well as continued refined supply shortages (particularly in Europe).
- Prices are expected to ease over the outlook to reach around US$2,400 a tonne (in real terms) by 2027, as global supply rises and consumption growth normalises.
- Australia's zinc production is forecast to be around 1.4 million tonnes in 2021–22, and rise by 7.8% to almost 1.5 million tonnes in 2022–23. Over the outlook, production is expected to remain relatively flat to 2026–27.
- Australia's zinc export earnings are forecast to increase to around $4.3 billion in 2021–22. Earnings are then forecast to ease to $4.0 billion in 2022–23 (in real terms). Export earnings are then projected to fall over the outlook, to reach $2.8 billion in 2026–27.

14.2 World consumption

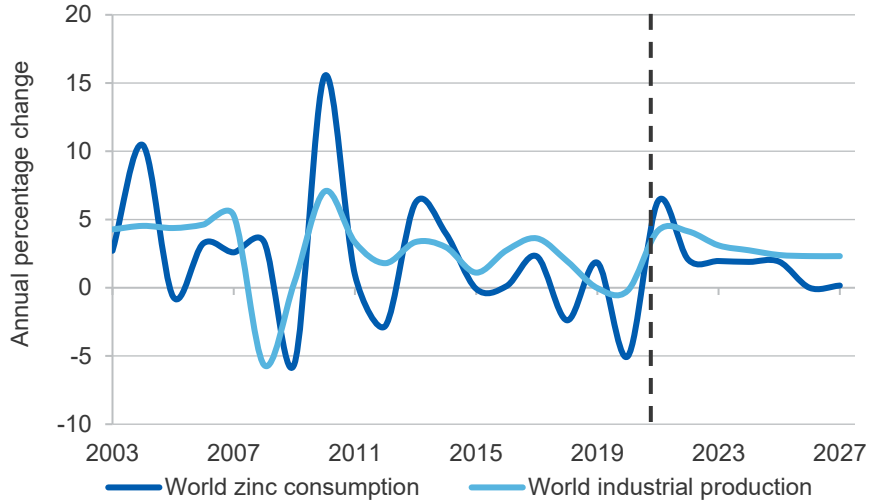
Infrastructure spending providing a boost to world zinc demand

World refined zinc consumption increased by 6.3% year-on-year in 2021 to reach just over 14 million tonnes. This was 1.0% higher than world consumption in 2019 (before global impacts of the COVID-19 pandemic).

This expansion included strong growth for the three largest consumer markets for zinc globally. China's total consumption grew by 4.4% year-on-year in 2021 (to be 3.0% higher compared with 2019), EU consumption grew 11% (to be 3.0% higher compared with 2019), and the rest of Asia (exc. China, Japan, India and South Korea) grew by 15% (to be 8.4% higher compared with 2019).

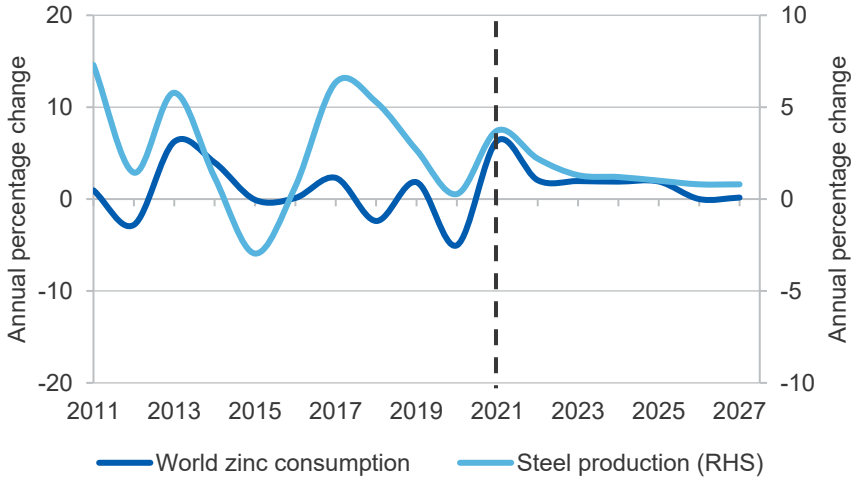
Zinc consumption tends to follow the world industrial production cycle and steel production, given its primary role in galvanising steel (Figures 14.1 and 14.2). In 2021, world industrial production and steel production grew by 4.1% and 3.7% respectively, following the release of pent up demand

Figure 14.1: World zinc consumption vs industrial production



Source: International Iron and Steel Institute (2022); CPB Netherlands Bureau for Economic Policy Analysis (2022); Department of Industry, Science, Energy and Resources (2022).

Figure 14.2: Steel production vs world zinc consumption



Source: International Iron and Steel Institute (2022); Department of Industry, Science, Energy and Resources (2022).

(supported by accommodative government policies) as major economies emerged from the COVID-19 pandemic.

The automotive sector — a major user of steel — was heavily impacted by the ongoing semiconductor chip shortage in 2021, with global car sales in December falling to their lowest levels since the 1990s. However, the construction sector — representing around 50% of global steel demand — saw strong growth over the same period. This follows infrastructure-led fiscal stimulus in many major economies — in response to the pandemic — as well as a growing transition to low emissions infrastructure.

Global zinc demand is expected to see healthy, but lower growth in 2022 compared with the previous year. This follows a slowing pace for the global recovery, as the world returns to longer-run growth levels (see *Macroeconomic Outlook* chapter), with growth of global steel production forecast to be around 2.2% in 2022.

The automotive sector was expected to see improved conditions this year as the current semiconductor shortage receded, boosting production in major markets such as China, the US and Europe. More expansionary fiscal and monetary policies in China should also boost consumption this year.

However, global demand for zinc remains susceptible to downside risks in 2022. This includes the current Russian invasion of Ukraine, and the historically high energy prices seen in Europe in recent months. The Russia Ukraine conflict has the potential to push prices for oil and gas even higher in the near term, which would severely hamper economic and industrial activity. Further weakness in China's residential construction sector could also impact steel (and zinc) demand this year.

Over the outlook, firm economic growth should see zinc consumption grow from 14.0 million tonnes in 2021 to 15.2 million tonnes in 2027 — at an average rate of 1.3% growth per year (Table 14.1). Amongst major economies, the US$1.2 trillion stimulus package and similar infrastructure-focused spending in both China and India is also likely to boost the demand for refined zinc during the outlook period and beyond.

14.3 World production

Global mine production in 2021 back to pre-pandemic levels

World mine production of zinc grew 5.3% in 2021 to reach 12.9 million tonnes. This was also just 0.1% lower than world mine production in 2019.

Of the major producers, China's total mine production was flat for the 2021 calendar year at 4.1 million tonnes. The lack of growth reflects a severely-impacted September quarter, with production down 7.5% year-on-year. However, a recovery in the December quarter (up 4.2% year-on-year) mitigated the net impact for the full year.

Production from Peru increased by 15% year-on-year in 2021 to reach 1.5 million tonnes (this was also 9.1% higher compared with 2019). This followed the re-opening of mines such as Chungar Mining Unit, El Porvenir and Cerro Lindo throughout the year as the country recovered from COVID-related shutdowns in 2020. Stronger production out of Peru's largest zinc mine — Antamina — also contributed to the recovery.

Australia's mined zinc production rose by 1.6% year-on-year in 2021 to reach just over 1.3 million tonnes. However, total output in 2021 remained around 0.3% below 2019 production levels. The result reflects continued near term impacts from the pandemic, with rising labour shortages due to the Omicron variant and related border containment measures.

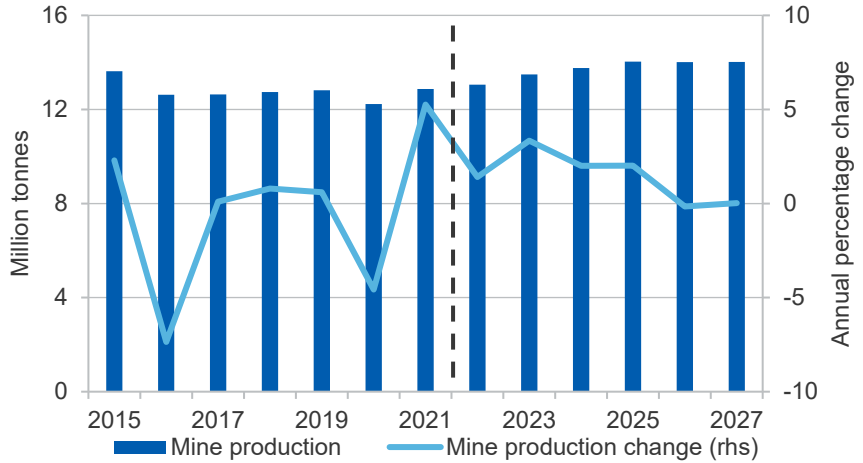
Mine production is expected to rise over the outlook period

World mine output is forecast to grow by 1.4% to reach 13.1 million tonnes in 2022. Output is then forecast to rise by 3.3% in 2023 to reach 13.5 million tonnes by 2023, as new mine capacity comes online (Figure 14.3). Over the outlook, mine production is projected to rise by 1.4% annually, to reach 14 million tonnes by 2027.

New supply over the outlook is expected to come from regions including Central and South America, Eastern Europe, and Africa.

The Aripuana zinc project in Brazil will lift zinc supply by 72,000 tonnes per year once completed, with first production now expected in the September quarter 2022.

Figure 14.3: World zinc mine production, metallic content



Source: International Lead Zinc Study Group (2022); Wood Mackenzie (2022); Department of Industry, Science, Energy and Resources (2022).

The Juanicipio project in Mexico is also expected to start production (25,000 tonnes of zinc initially) in 2022, however, recent delays in connecting to the national grid may push out the start date. The Juanicipio mine is expected to ramp up to 40,000 tonnes a year after 2025.

The Pavlovskoye project in Russia — with an estimated zinc production capacity of 223,000 tonnes a year — is currently undergoing a definitive feasibility study, and is expected to commence operations in 2023. Construction also remains underway for the Ozernoye project in the south east of Russia. Capacity is estimated to be as much 600,000 tons of zinc concentrate per year, with production to start from 2023.

Glencore's Zhairem in Kazakhstan was commissioned in May last year, however ramp up progress has again been delayed, with the company now expecting steady state production in 2023. The project is expected to produce as much as 160,000 tonnes of zinc per year once ramped up, over an initial 14-year mine life.

Vedanta Zinc's Gamsberg mine in South Africa is also ramping up to full production following a temporary closure from November 2020 due to the collapse of a pit wall. Production capacity for Stage 1 of this project is 250,000 tonnes and is expected in 2023. Further stages of this project may also see capacity increase to as much as 600,000 tonnes per year, though this is projected for beyond the outlook period.

World refinery production steady

World zinc refined production increased by 1.1% in 2021 to reach 13.9 million tonnes. This was also 2.2% higher than world refined production in 2019. Of the major refined producers, China's total production (of both primary and secondary refined zinc) increased 1.0% year-on-year to reach 6.4 million tonnes in 2021. The EU and India grew by 3.1% and 2.8% over the same period, to reach 2.1 million tonnes and 0.7 million tonnes respectively.

In 2022, total refined output is forecast to grow by 2.2% to reach 14.2 million tonnes. This comes despite a more muted outlook for European production this year, with both the Portovesme and Auby smelters suspended earlier this year and likely to resume at reduced operational rates in 2022. Current power prices in Europe and the recent Russian invasion of Ukraine, are expected to further exacerbate the current deficit in refined markets this year.

Over the outlook, total refined production is projected to grow by around 1.5% per year to reach 15.2 million tonnes by 2027. This includes substantial new capacity in China in the Guangxi, Yunnan and Inner Mongolia provinces. New capacity is also projected for both Russia and Norway over the outlook.

Last year saw a significant increase in secondary (recycled) zinc production, with global output growing by 3.8% to reach 1.7 million tonnes. This was around 12% of all refined zinc produced last year. This included 61,000 tonnes of new production in the EU (up 19% year-on-year), 39,000 tonnes in the US (up 48%) and 23,000 tonnes in Japan (up 29%).

Refined output from secondary sources is projected to lift by an average of 1.2% a year over the outlook period, to reach 1.8 million tonnes in 2027.

14.4 Prices

High prices in 2021 and early 2022 reflect global supply-demand mismatch

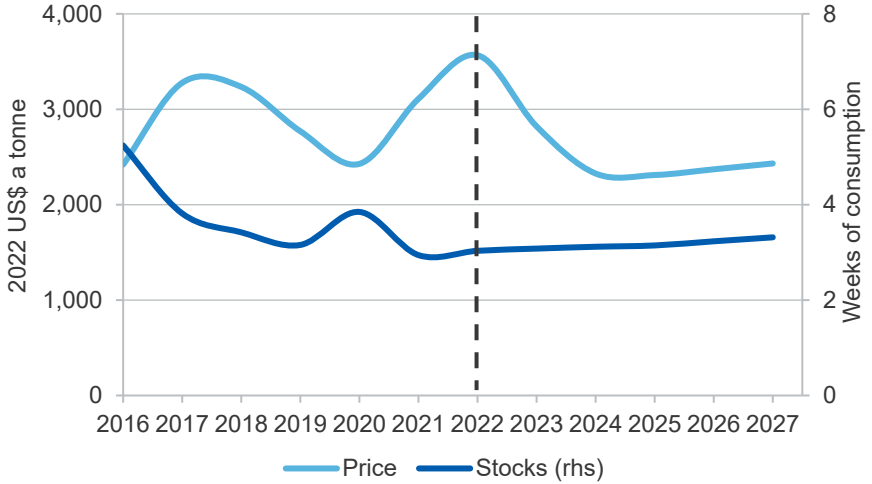
Zinc prices averaged around US$3,100 a tonne in 2021 — an increase of more than 30% compared with 2020. This reflects disrupted supply from a number of major zinc mines due to the COVID-19 pandemic, as well as impacts to refined production due to energy supply issues in both China and Europe. Weakened supply has also come in the midst of quickly-recovering global consumption, as construction activity and new infrastructure investment rebounded from the pandemic.

Price increases have been particularly acute in the second half of the year, following cuts to production of refined zinc, as rising power costs have impacted major refining countries (Figure 14.4). Power rationing — in both Europe and China in the September quarter — saw LME spot prices hit decade highs of close to US$3,800 a tonne in October. This led to the Chinese Government releasing 100,000 tonnes from its strategic reserves over the period in an attempt to ease pressure on prices.

Global inventories have fallen at the end of 2021 to just 232,000 tonnes, or 6 days' worth of global consumption. This follows disruptions to European smelter production — due to recent high energy prices and the current Russian invasion of Ukraine — creating a drawdown in LME stocks (see *LNG* chapter). And while the China's post-New Year inventory build has been underway through the March quarter 2022, continued outbreaks of the Omicron variant, and ongoing pollution curbs are suggesting the build is likely to be lower than recent years.

The LME zinc spot price is forecast to average around US$3,600 a tonne in 2022. Ongoing supply disruptions — such as power shortages at zinc smelters in China, high power prices in Europe, and the current Russian invasion of Ukraine — are expected to prolong elevated prices through much of 2022. Over the outlook, the continued recovery in mine supply and growing refined capacity is expected to see prices fall by around 4.0% annually, to reach US$2,400 a tonne (in real terms) by 2027.

Figure 14.4: Zinc prices and stocks



Source: London Metal Exchange (2022); Department of Industry, Science, Energy and Resources (2022).

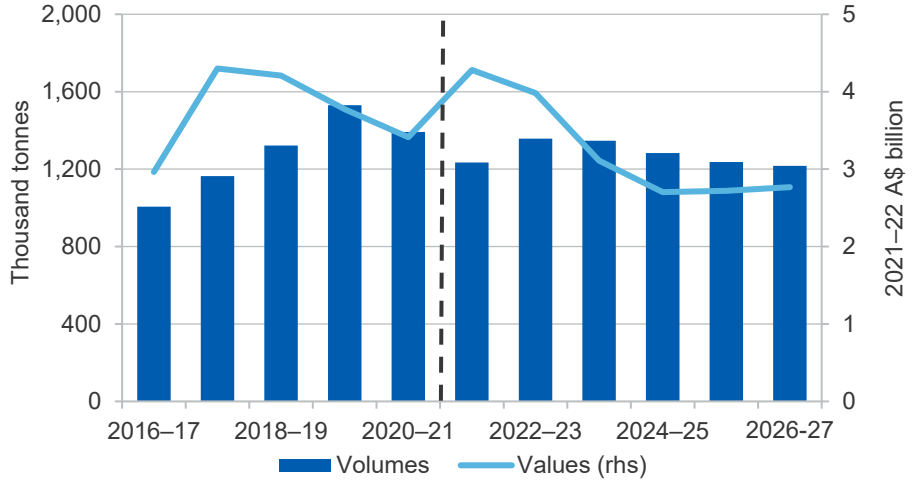
Australia

Export earnings to peak in 2021–22 before new supply lowers prices

Australia's zinc export earnings (for both concentrate and refined metal) are forecast to increase from $3.4 billion in 2020–21 to around $4.3 billion in 2021–22 (in real terms). This primarily reflects the considerable strength in prices seen in recent months, and that are expected to persist through 2022. Easing prices are then forecast to see earnings decrease to $4.0 billion in 2022–23.

Over the outlook, Australia's export earnings are projected to ease to around $2.8 billion in 2026–27, as consumption returns to lower, longer-run levels, and new mine and refined production comes online.

Figure 14.5: Australia's zinc exports, metallic content



Source: ABS (2022) International Trade in Goods and Services, 5368.0; Wood Mackenzie (2022); Department of Industry, Science, Energy and Resources (2022).

Australia's mine production stages recovery in 2021

Australia's mined zinc output is estimated to have risen 1.0% year-on-year in 2021 to reach 1.33 million tonnes. However, this remained close to 0.7% lower than total mine production in 2019.

Glencore's Australian production (including its Mt Isa operation in Queensland and McArthur River operation in the Northern Territory) produced just over 609,000 tonnes in 2021, a 4% fall from previous year. This largely reflected increased production from ore stockpile drawdowns — rather than newly mined supply — at its Mount Isa operation.

Output from MMG's Dugald River in Queensland increased by 1.0% year-on-year to reach 180,000 tonnes in 2021. This reflects a strong recovery in the second half of the year, following technical issues and planned maintenance in the June quarter 2021.

Production at New Century's Century Tailings Reprocessing in Queensland was more than 121,000 tonnes in 2021, around 5.5% lower than the previous year. This reflects a lower-than-expected September quarter 2021 (down 14% year-on-year) due to a ball mill bypass experienced during the quarter.

2021 production at South32's Cannington operation in Queensland increased by around 8.4% year-on-year to reach close to 70,000 tonnes in 2021. Cannington's 2021–22 production guidance has been raised by 5%, to 66,700 tonnes.

Refinery and concentrate exports declined

Australia's refined zinc exports decreased by 23% year-on-year in 2021, to around 990,000 tonnes. Australia's concentrate exports to China decreased by 5.7% year-on-year for the period to reach $385 million, as trade stabilised after the normalising of concentrate imports from Peru to China in the first half of the year.

Australia's mine production is expected to increase

Australia's production is expected to see solid growth to 2023, with zinc mine output expected to increase from 1.33 million tonnes in 2020–21 to 1.45 million tonnes in 2022–23 (Figure 14.5). This rise will be driven by increased production from the McArthur River operation in the Northern Territory, Golden Grove operation in Western Australia, and Century mine in Queensland.

Project development

New Century is examining a number of hard rock resources beyond the current tailings retreatment operation, which is due to end in 2027.

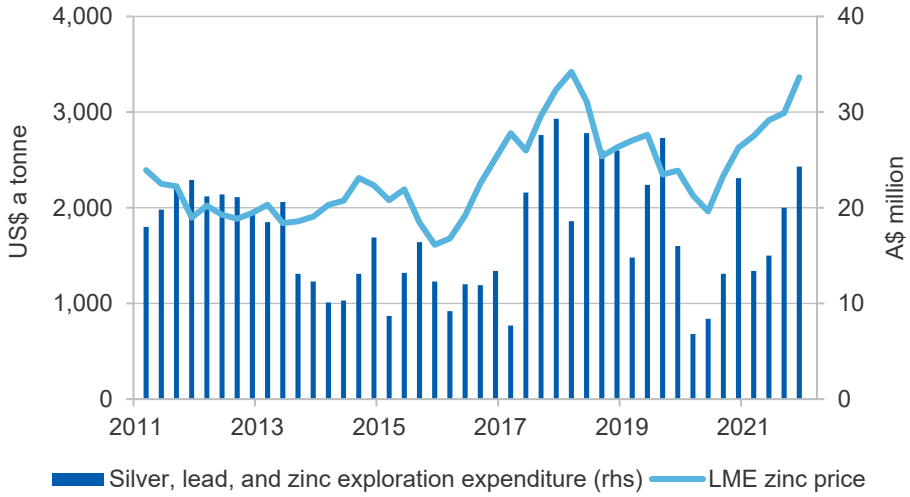
New Century believes hard rock resources have the potential to increase mine life to 2030 and are mostly contained on the existing mining lease. Century Zinc earlier reported positive results to their feasibility study of potential operations at Silver King and East Fault Block. The company is targeting a financial investment decision (FID) in the March quarter 2022 and possible first production in the March quarter 2023. They estimate additional zinc production of 22,000 tonnes a year.

Galena Mining has commenced mining at Abra, with zinc production as a zinc-lead-silver concentrate expected by the company in 2023.

Exploration expenditure increased significantly in 2021

Exploration expenditure for silver, lead and zinc increased by 22% quarter-on-quarter for the December 2021 quarter. This was also 5.2% higher than the same period in 2020 (Figure 14.6). For the calendar year 2021, exploration expenditure for these minerals was close to $73 million, more than 40% higher than the previous year. This increase in exploration is likely related to ongoing zinc price appreciation, and is expected to see ongoing strength in exploration in 2022.

Figure 14.3: Quarterly exploration expenditure and zinc price



Source: ABS (2022) Mineral and Petroleum Exploration, Australia, 8412.0; Company reports; Department of Industry, Science, Energy and Resources (2022).

Revisions to the outlook

Forecast export earnings for 2021–22 have been revised upward by 4.7% from the December 2021 *Resources and Energy Quarterly* to $4.3 billion in this edition. This reflects stronger prices seen over the second half of 2021, now expected to persist through 2022. This has also resulted in an upward revision to forecast Australian export earnings for 2022–23, which increased by around 16% to $4.1 billion.

Compared with the March 2021 *Resources and Energy Quarterly*, forecast Australian earnings in 2025–26 (in real terms) have been revised down by 23% to $2.7 billion. This reflects a downward revision in projected export volumes over the outlook period.

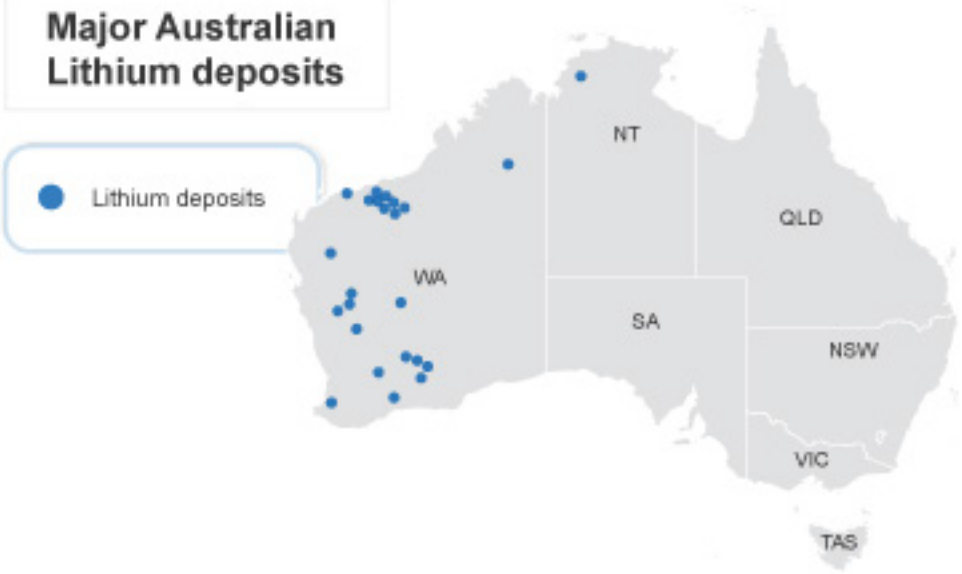
Table 14.1: Zinc outlook

World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Production									
– mine	kt	12,901	13,053	13,487	13,758	14,036	14,014	14,017	1.4
– refined	kt	13,905	14,154	14,589	14,868	15,155	15,155	15,178	1.5
Consumption	kt	14,049	14,338	14,618	14,895	15,180	15,180	15,204	1.3
Closing stocks	kt	793	834	863	891	916	941	967	3.4
– weeks of consumption		2.9	3.0	3.1	3.1	3.1	3.2	3.3	2.0
Price									
– nominal	US$/t	3,005	3,566	2,896	2,451	2,495	2,619	2,750	-1.5
	USc/lb	136	162	131	111	113	119	125	-1.5
– real [a]	US$/t	3,109	3,566	2,821	2,327	2,311	2,371	2,432	-4.0
	USc/lb	141	162	128	106	105	108	110	-4.0
Australia	**Unit**	**2020–21[f]**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Mine output	kt	1,335	1,356	1,449	1,439	1,355	1,309	1,289	-0.6
Refined output	kt	461	493	506	506	506	506	506	1.6
Export volume									
– ore and concentrate [b]	kt	2,118	2,049	2,156	2,134	1,994	1,892	1,850	-2.2
– refined	kt	408	296	372	371	371	371	371	-1.6
– total metallic content	kt	1,392	1,234	1,357	1,347	1,283	1,236	1,217	-2.2
Export value									
– nominal	A$m	3,301	4,280	4,107	3,292	2,935	3,027	3,157	-0.7
– real [c]	A$m	3,413	4,280	3,982	3,109	2,703	2,720	2,768	-3.4

Notes: **a** Includes secondary refined zinc; **b** In 2021 US dollars; **c** Quantities refer to the gross weight of all ores and concentrates; **d** In 2021–22 Australian dollars; **f** Forecast; **r** Compound annual growth rate; **s** estimate; **z** Projection
Source: ABS (2022) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Company reports; Department of Industry, Science, Energy and Resources (2022); International Lead Zinc Study Group (2022); Wood Mackenzie (2022); LME (2022).

3 Li 6.94 Lithium

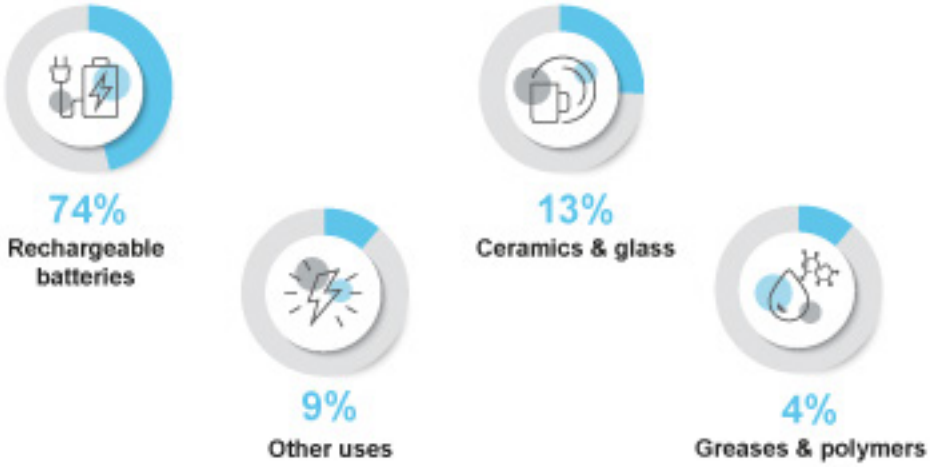
Major Australian Lithium deposits



Lithium facts

- Lithium metal is **so light it floats on water**
- **Electric vehicle sales** are expected to increase tenfold by 2030
- Australian lithium exports are tipped to **triple** by 2026–27
- In August 2021 Australia began **producing lithium hydroxide**

World consumption



Australia's lithium

- **Biggest exporter** in the world
- Produced 49% of the **world's lithium** in 2020
- **Production ramp up** planned for 2 refineries in 2022/23

15.1 Summary

- Spodumene prices are projected to rise from an average US$660 a tonne in 2021 to US$1,325 a tonne in 2022, before moderating to around US$800 a tonne in 2027 (in real terms). Lithium hydroxide prices are projected to rise from US$17,970 a tonne in 2021 to US$27,620 a tonne in 2022, before easing to around US$13,140 (in real terms) by 2027.
- Australia's lithium production is projected to more than triple over the outlook period, rising from 224,000 tonnes of lithium carbonate equivalent (LCE) in 2020–21 to 692,000 tonnes of LCE in 2026–27.
- Australia's lithium export earnings are projected to rise from $1.0 billion in 2020–21 to $6.7 billion in 2026–27 (in real terms), as lithium hydroxide production rises. A further 5 lithium hydroxide refining operations are projected to commence operations in Australia by 2026–27.

15.2 World demand

Surging lithium demand as electric vehicles gain market share

The demand for lithium continues to be driven by the trend toward battery usage for numerous portable electrical appliances and in electric vehicles (EV). Demand for lithium batteries accounted for almost 75% of all lithium use in 2021, and is expected to reach around 90% by the end of the outlook period as EVs gain market share in the world passenger car market.

EV uptake continues to be driven by a combination of falling EV prices, growing choice of models, and ongoing government measures, though government incentives are being wound back in some countries.

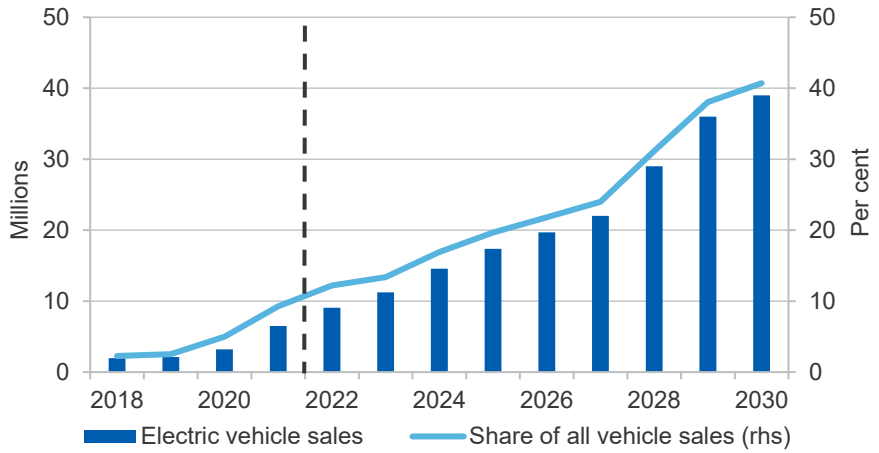
Despite EVs requiring around twice as many microchips as equivalent conventional vehicles carmakers have maintained rapid growth in production of EVs despite a chronic shortage of semi-conductor chips around the world over the past eighteen months. EVs use more modern, higher value chips than conventional vehicles and hence were prioritised by chip manufacturers. Some EV makers have been able to re-design their vehicles to cope with the shortage.

Key global automakers have accelerated targets to shift towards battery electric vehicles (BEV). In particular, Toyota lifted its 2030 BEV sales target from 2.0 million units to 3.5 million units. Toyota is expanding its battery capacity to 280GWh, up from 200GWh previously, with its Lexus brand expected to be fully electric by 2035.

Global sales of electric vehicles doubled in 2021

Global light electric vehicle (EV) sales surged in 2021, rising steadily in each quarter, with an estimated 2 million EVs sold in the December quarter 2021. Total EV sales for the year increased from 3.2 million in 2020 to an estimated 6.5 million vehicles in 2021 (Figure 15.1). Global EV sales are expected rise by a further 3 million units in 2022, pushing up total sales to over 9 million EVs. Global market share for EVs has tripled over the past two years, with EV sales now representing close to 9% of the global car market. Strong underlying demand and EV manufacturers' declarations of further increases in production imply that EV sales could reach around 40% of vehicle sales annually by 2030.

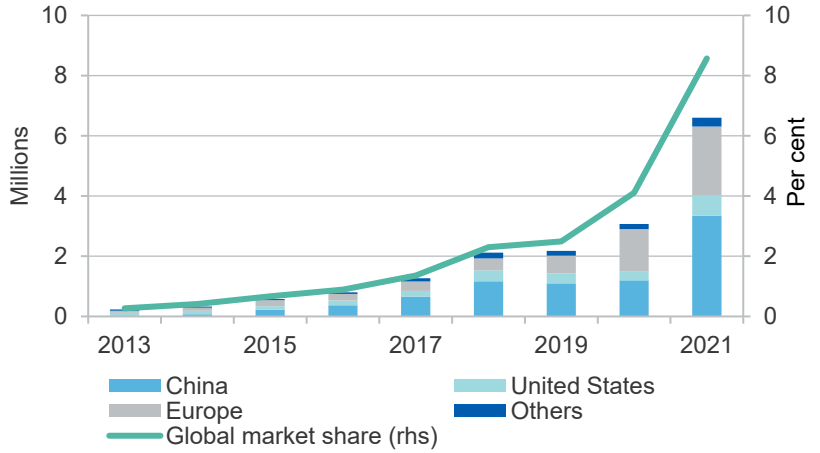
Figure 15.1: Long term electric vehicle sales projections



Source: Department of Industry, Science, Energy and Resources (2022); Wood Mackenzie (2022); BloombergNEF (2021).

However, EV uptake continues to vary greatly between countries, with growth driven largely by growth in China and Europe, where automakers are pushing to meet fuel economy regulations (Figure 15.2). China accounted for over half of global EV sales in 2021 and sales of EVs now represent around 15% of total light vehicle sales in China. European EV sales accounted for around 20% of passenger vehicle sales by the end of 2021. EV market penetration in the US lags that of Europe, with EVs accounting for around 5% of light vehicle sales in the September quarter 2021. However, US EV sales are growing rapidly, at around 30% last year.

Figure 15.2: Electric vehicle sales by country



Source: IEA (2022).

Surging global EV sales have implications for a range of critical minerals and metals. In addition to using about 9kg of lithium, the average light EV takes about 200kg of other key minerals and metals to produce — about 6 times the amount used in a car with an internal combustion engine (ICE).

World demand for lithium is estimated to increase from 526,000 tonnes of lithium carbonate equivalent (LCE) in 2021 to 636,000 tonnes in 2022 (Table 15.1). Demand is then forecast to more than double over the following 5 years, as global electric vehicle (EV) uptake continues to grow, with world demand forecast to reach 1.5 million tonnes by 2027.

Annual growth in lithium demand over the outlook period is forecast at almost 20%. Asia remains the major source of demand for lithium, despite the diversification of battery factories into Europe and the US.

A potential downside risk to EV forecast growth is the 30% cut to China's EV subsidy program for passenger vehicles in January 2022, with the program to be terminated by 2023. Another issue affecting the outlook is the increasingly challenging supply chain environment facing auto makers. A number of EV makers have pushed delivery timeframes for various models out to 2023. Tesla and Volkswagen have publicly announced that they are experiencing supply chain issues. Access to key non-lithium materials, including nickel, graphite and cobalt, will put pressure on overall battery costs. Benchmark Mineral Intelligence, for example, estimates that if lithium prices remain at the peaks seen in China in early 2022 (see price discussion below) that could boost the cost of a new EV by US$1,000.

15.3 World production

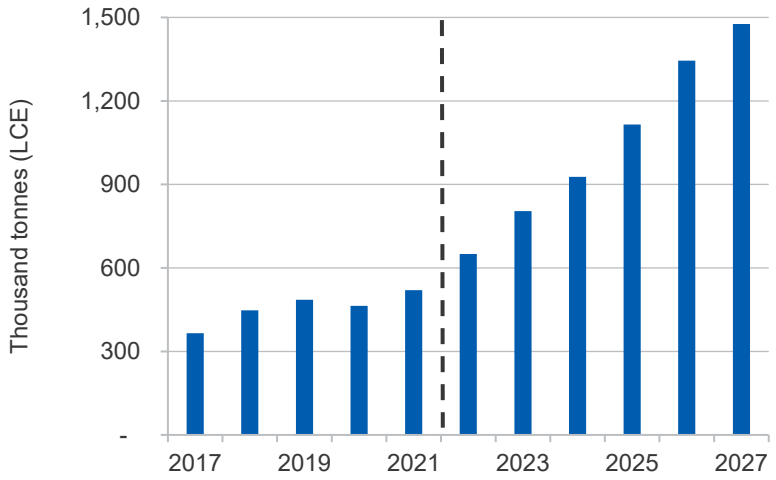
Concerns continue to grow around the security of supply

World output is estimated at 520,000 tonnes LCE in 2021, and is forecast to reach 650,000 tonnes in 2022 and 1,476,000 tonnes in 2027 (Figure 15.3). Growth is forecast to be met by increases in output among most producing nations. The primary source of ex-Australian growth over the next two years is expected to come from South America. Albemarle is commissioning an expansion at its Salar de Atacama project in Chile, while SQM has also signalled higher volumes at its Chilean operations. Strong growth in production is also expected in Argentina through new and expanded brine operations by Livent, Allkem and Minera Exar. Over the 5 year outlook, key sources of additional forecast supply include China, Brazil, Canada, DRC and Mali.

Total supply from mine and brine operations is currently unable to meet demand. While project development is underway, it will take time to close the supply gap. Stockpile size is difficult to determine, with some estimates of 4–8 weeks for spodumene. With such tight supply conditions, and given delays associated with shipping times and ongoing supply chain

challenges, it is unsurprising that some lithium processors and battery manufacturers are currently securing supplies at record high prices.

Figure 15.3: Global lithium production



Source: Department of Industry, Science, Energy and Resources (2022); Wood Mackenzie (2022).

Some greenfield projects accelerate while others face headwinds

In recent months, some highly publicised reversals of lithium projects have elevated concerns about the ability of lithium production to meet global demand in the next decade and beyond. In January 2022, Serbia revoked lithium exploration licences granted to Rio Tinto's $2.4 billion Jadar lithium project citing environmental concerns. The mine, due to start producing in 2027, was expected to produce 58,000 tonnes of battery-grade lithium carbonate a year, in what would have been Europe's largest lithium mine.

In January 2022, Chile — the world's largest lithium producer after Australia — experienced a setback in plans to bring about a significant new long term supply source. In 2021, the Chilean Government announced it was offering 400,000 tonnes of LCE for extraction via 5 80,000 tonne quotas through a national and international public tender process. Results of the first two quota auctions were announced in January 2022. BYD Chile, a subsidiary of Chinese auto maker BYD, was awarded one of the quotas, with the other awarded to local firm Servicios y Operaciones Mineras del Norte. However, in January 2022, a Chilean court ordered a suspension of the auction while the legal claim is resolved.

On the upside, a number of expansions and new projects have been announced in recent months. Chilean state-owned mining firm Codelco announced it will start lithium exploration in the Salar de Maricunga in March 2022, with drilling expected to be completed in early 2023.

In February 2022, Argentina's Ministry of Production announced that Chinese mining firm Zijin Mining Group Co Ltd will construct a lithium carbonate plant in Argentina via local subsidiary Liex. The plant, to be located in the northern province of Catamarca, will aim to produce 20,000 tons of lithium carbonate a year, with a goal of subsequently doubling production in the medium term. In addition, Livent has announced an additional expansion program to be completed by 2025. This will complement the previously announced capacity expansion to bring its Argentina operations to 60,000 tonnes of lithium carbonate, as well as 9,000 tonnes of lithium chloride.

Portugal, Europe's biggest lithium supplier, plans to launch a licensing auction for rights to mine lithium in 6 areas in April 2022. The auction was initially planned for 2018, but has been delayed due to environmental and social concerns. A feasibility study on James Bay in Canada was finished in December 2021 which indicated an expected 19 year mine life, with construction estimated to begin in the September quarter 2022, with commissioning due in the March quarter 2024. The project is estimated to have an annual output of 321,000 tonnes of spodumene concentrate.

China's Zijin Mining Group recently announced it is launching a lithium exploration project in a partnership with Democratic Republic of Congo's state-owned firm La Congolaise d'Exploitation Minière.

Interest in recycling continues to rise. However, recycling currently only accounts for around 1% of total supply, and will need to increase substantially to make an appreciable contribution to addressing the expected supply shortages over the outlook period. To date, recycling has yet to be established on a large scale. Glencore has announced it plans to build a new plant to recycle lithium-ion batteries in the UK in partnership with battery start-up Britishvolt. The plant will have the capacity to take in at least 10,000 tonnes of batteries a year. Neometals has also confirmed plans to partner with Mercedes-Benz to build a 25,000 tonne a year recycling plant in Germany. Stronger lithium prices, combined with increasing volumes of end-of-life electric vehicle batteries in coming years, should improve the economics of recycling projects.

15.4 Prices

Spot prices soar as a supply crunch hits battery producers

Strong demand is currently resulting in shortages of spodumene, lithium hydroxide and lithium carbonate, which is pushing spot prices for all three commodities to record levels.

Spot spodumene concentrate averaged around US$2,700 per tonne in February–March 2022, compared to US$1,900 in the December quarter and up more than six-fold from US$420 a tonne in January 2021. Surging demand and low inventories saw reports of spodumene trades above US$3,000 a tonne in early 2022.

Spot prices for lithium hydroxide (delivered to China) averaged US$57,000 a tonne in February 2022, with daily prices reaching over US$70,000 by mid-March, a more than eight-fold increase from the US$7,984 average in January 2021.

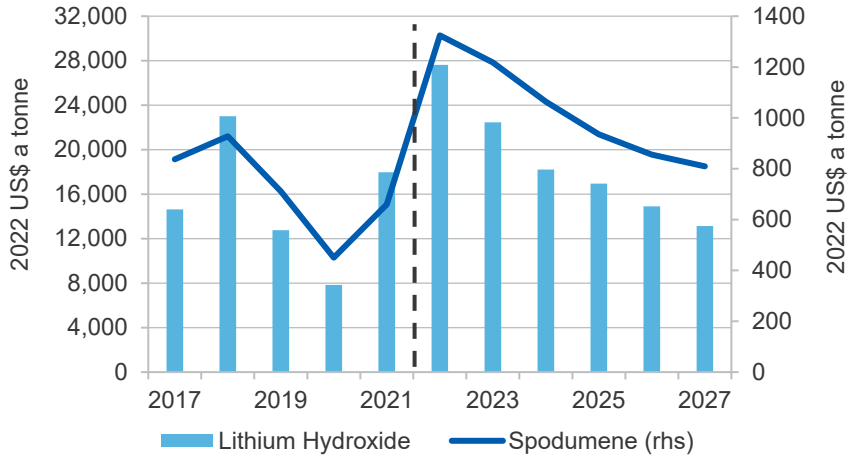
As most Australian producers have historically worked off long term contracts, prices received take time to adjust while changes in spot prices feed through into contract prices. While pricing mechanisms built into long-term contracts vary, they generally include a basket of measures such as trade data and price floor and price ceilings. This results in substantially reduced volatility in contract prices compared with spot prices.

Contract prices for spodumene are expected to increase strongly in 2022, driven by rising EV production and short term supply issues.

Spodumene prices are forecast to rise from an average of US$660 a tonne in 2021 to around US$1,300 a tonne in 2022, as spot and contract prices are renegotiated (Figure 15.4). The price is expected to moderate to around US$800 a tonne (in real terms) by 2027.

Lithium hydroxide prices are forecast to rise from US$17,970 a tonne in 2021 to over US$27,000 a tonne in 2022, before moderating over the outlook period to around US$13,000 in 2027 (in real terms) as global supply steadily rises.

Figure 15.4: Spodumene concentrate/lithium hydroxide prices



Notes: Lithium hydroxide price is for higher priced battery grade product.

Source: Wood Mackenzie (2022); Department of Industry, Science, Energy and Resources (2022).

Risks to the lithium price forecasts are weighted to the upside over the 5 year outlook. If shortages of spodumene and lithium hydroxide are larger and more protracted than expected spot prices will stay higher for longer.

The magnitude and the timing of pass-through of spot prices to contract prices would likely be affected, with the potential for higher realised prices lifting Australia's lithium export revenue over the outlook.

Lithium market could move into ongoing deficit

Despite an anticipated strong supply response, the global lithium shortfall may to be protracted, with shortages in supply expected for several years. The lithium outlook remains subject to considerable uncertainty given recent rapid price movements and the general immaturity of the market.

15.5 Australia

Export values forecast to grow strongly

Record spodumene prices are forecast to lift export revenue from $1.0 billion in 2020–21 to $2.8 billion in 2021–22, with production from lithium hydroxide refineries forecast to steadily add to earnings over the outlook period for a total annual lithium export revenue of $6.7 billion by 2026–27 (in real terms) (Figure 15.5).

Australian production to ramp up over the outlook period

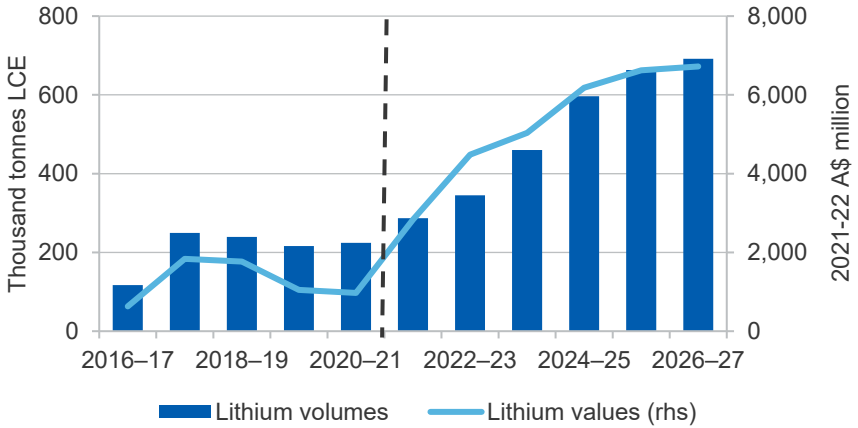
Australian production is now expected to grow strongly over the outlook. Expected annual growth of over 20% a year will see production rise from 224,000 tonnes of LCE in 2020–21 to 287,000 tonnes of LCE in 2021–22, growing to 692,000 tonnes in 2026–27 (Table 5.1, Figure 15.5). Correspondingly, export volumes of spodumene concentrate are forecast to increase from 1.6 million tonnes in 2020–21 to 4.7 million tonnes in 2026–27.

Strong price signals drive production increases

Australian spodumene concentrate output in the December quarter 2021 rose by 33% year-on-year, with further increases in production expected in 2022 as further capacity comes on stream.

Pilbara Minerals production increased by 49% in the six months to December 2021 — 170,228 dry metric tonnes (dmt) — compared to the six months to December 2020 (114,239 dmt). The average selling price achieved was US$1,250 per tonne, lifting revenue for the first half of the financial year to $292m, compared with $59m in the first half of 2020–21. According to the company, production rates were lower than expected due to a combination of plant down-time events (both scheduled and unplanned), a suboptimal ore feed blend due to mining constraints, the integration of a new plant at Ngungaju (which commenced operations in a staged restart) and widespread labour shortage issues and cost inflation in the WA resources sector.

Figure 15.5: Australia's exports of lithium



Notes: Export values include revenue from spodumene concentrate and lithium hydroxide. Lithium volumes include total exports of spodumene concentrate and lithium hydroxide converted to LCE.

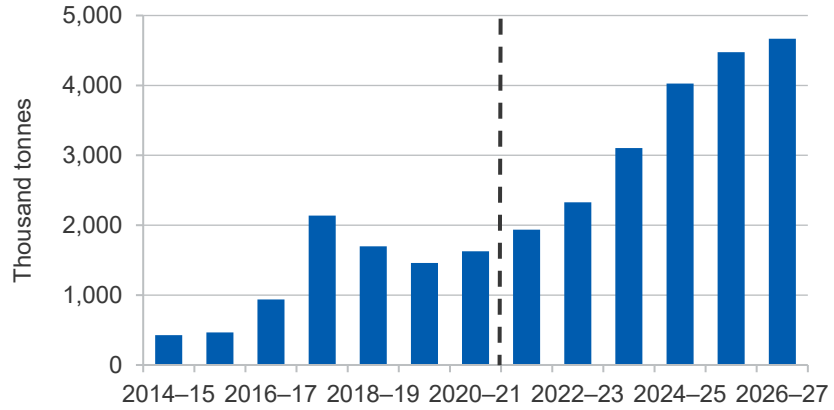
Source: Company reports; WoodMackenzie (2022); Department of Industry, Science, Energy and Resources (2022).

The construction phase of the Pilgan Plant Improvement Project has completed, with commissioning and ramp-up of the facilities now underway and a targeted 10–15% increase in annual production from 330,000 dmt to 360–380,000 dmt. When the Ngungaju Plant is restarted annual production is expected to be 540-580,000 dmt for the combined Pilgangoora operation. According to the company, a Financial Investment

Decision (FID) on the Phase 1 expansion of the Pilgan plant — for an incremental 100,000 tonnes a year of spodumene concentrate — is targeted for the June 2022 quarter. Further studies for subsequent incremental expansions to target 1 million tonnes a year of production will be undertaken, with a FID expected in the December quarter 2022.

Production from Mt Marion (owned 50% by Mineral Resources and 50% by Gangfeng Lithium Co. Limited) totalled 207,000 tonnes of spodumene concentrate in the six months to December 2021 with an average price of US$1,011 a tonne.

Figure 15.6: Spodumene production



Source: Wood Mackenzie (2022); Department of Industry, Science, Energy and Resources (2022).

The three operational plants at Greenbushes — operated by the Talison Joint Venture — produced a total of 526,300 tonnes of spodumene concentrate in the six months to December 2021. High spot prices are expected to lead to a significant increase in the contract price for chemical grade spodumene for the second half of 2021–22 to around US$1,770 a tonne (FOB) compared with US$592 a tonne in the first half of the financial year. Construction of the Tailings Retreatment Plant has continued, with first feed scheduled for the March 2022 quarter.

Lithium hydroxide production is rising in Australia, Korea and Japan

Trial production at the Kwinana lithium refinery (51% Tianqi and 49% ASX-listed Independence Group (IGO)) continued in the December quarter 2022, with the goal being a transition from a batch to continuous operation. IGO has stated it expects battery grade lithium hydroxide production from Train 1 by March 2022 and qualification of product with offtake customers to be completed by the second half of 2021–22. The company expects full recommencement of Train 2 construction in the second half of 2022. Each Train has a capacity of 24,000 tonnes a year.

Mechanical completion of Kemerton's Train 1 was achieved in November (60% US-based Albemarle and 40% ASX-listed Mineral Resources). Spodumene ore has now been introduced into the plant as part of the commissioning process, with commercial production expected mid-2022. Kemerton's Stage II — for an additional 25,000 tonnes a year — has been delayed due to COVID-19 restrictions, with completion and ramp up of both stages to name-plate capacity expected late in 2022–23.

ASX-listed Pilbara Minerals' joint venture with POSCO for the production of 43,000 tonnes a year of refined lithium hydroxide in South Korea is scheduled to commence major construction mid-2022. The joint venture plans to source 315,000 tonnes a year of spodumene concentrate from the Pilgangoora operations, based on existing production capacity.

Construction of the Kwinana lithium hydroxide refinery (50% ASX-listed Wesfarmers and 50% Chile-based SQM) is scheduled to continue to ramp up in the first half of 2022. The refinery will source spodumene from the Mt Holland deposit, with the project expected to begin operating in 2024. Mt Holland is initially expected to produce 400,000 tonnes a year of spodumene concentrate.

ASX-listed Orocobre (Allkem) has stated that pre-commissioning works continue at its Naraha plant in Japan within COVID-19 restrictions. The company plans to convert lithium carbonate into lithium hydroxide using feedstock from their operations in Argentina.

Greenbushes' chemical grade plant (CGP2) has been commissioned, with CGP3 committed. The Wodgina mine (60% Albemarle and 40% Mineral Resources) is to recommence production from one of its three spodumene 250,000 tonne production facilities. First production is expected in the September quarter 2022. The company has stated that it may decide to restart the other two processing trains subject to market demand.

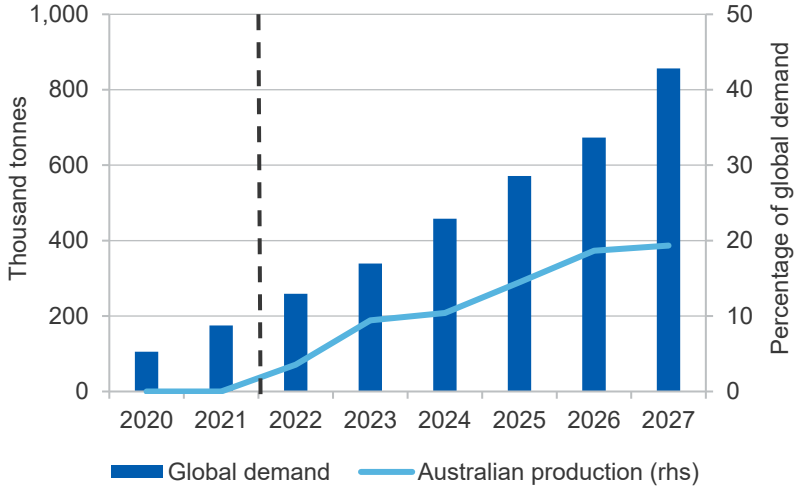
The definitive feasibility study for Liontown's Kathleen Valley deposit near Kalgoorlie was completed in the December quarter 2021. The study indicated a 23-year mine life with start up to deliver 500,000 tonnes a year of spodumene concentrate in the first year, increasing to around 700,000 tonnes a year by year 6. A final investment decision is targeted for the June quarter 2022. Production is expected to commence in the first half of 2024. In February the company signed an agreement with Tesla to supply 100,000 dry metric tonnes of spodumene concentrate, increasing to 150,000 per year in subsequent years.

Site construction and establishment works at Core Lithium's Finniss Project near Darwin commenced in the December quarter 2021. Commissioning of the plant and first production of lithium concentrate are scheduled for the December quarter 2022. Investigations are also underway exploring the long-term potential for additional downstream processing. Gangfeng and Yahua have offtake agreements for 80% of the first 4 years of production, amounting to 75,000 tonnes of spodumene concentrate a year supplied to each company. In February Core announced that recent exploration revealed significant extensions to spodumene bearing pegmatite to the south of the project, with further exploration and resource drilling to ramp-up in the June quarter 2022.

Australian businesses are expected to continue expanding their activities into higher value added activities over the outlook period. Potential avenues include growth up the battery value chain from mining and refining, into precursor chemicals for cathodes, battery anode plants, electrolyte production, battery cell research/production, and battery manufacturing (Figure 15.8).

By 2024, Australia may have around 10% of global lithium hydroxide refining capacity, rising to 19% of global lithium refining by 2027 (Figure 15.7).

Figure 15.7: World and Australian lithium hydroxide output



Source: BloombergNEF (2021); Department of Industry, Science, Energy and Resources (2022).

The robust forecast growth for Australian lithium production over the outlook is subject to a number of risks. Delays to approval and construction of new mine and processing plants, as well as difficulties achieving ramp up to full output, would see slower growth in spodumene production volumes and export values than forecast. Similarly, for Australia's nascent lithium hydroxide refining sector, unanticipated delays or technical challenges associated with achieving required product grade, purity and consistency could also push back forecast production and export growth over the outlook.

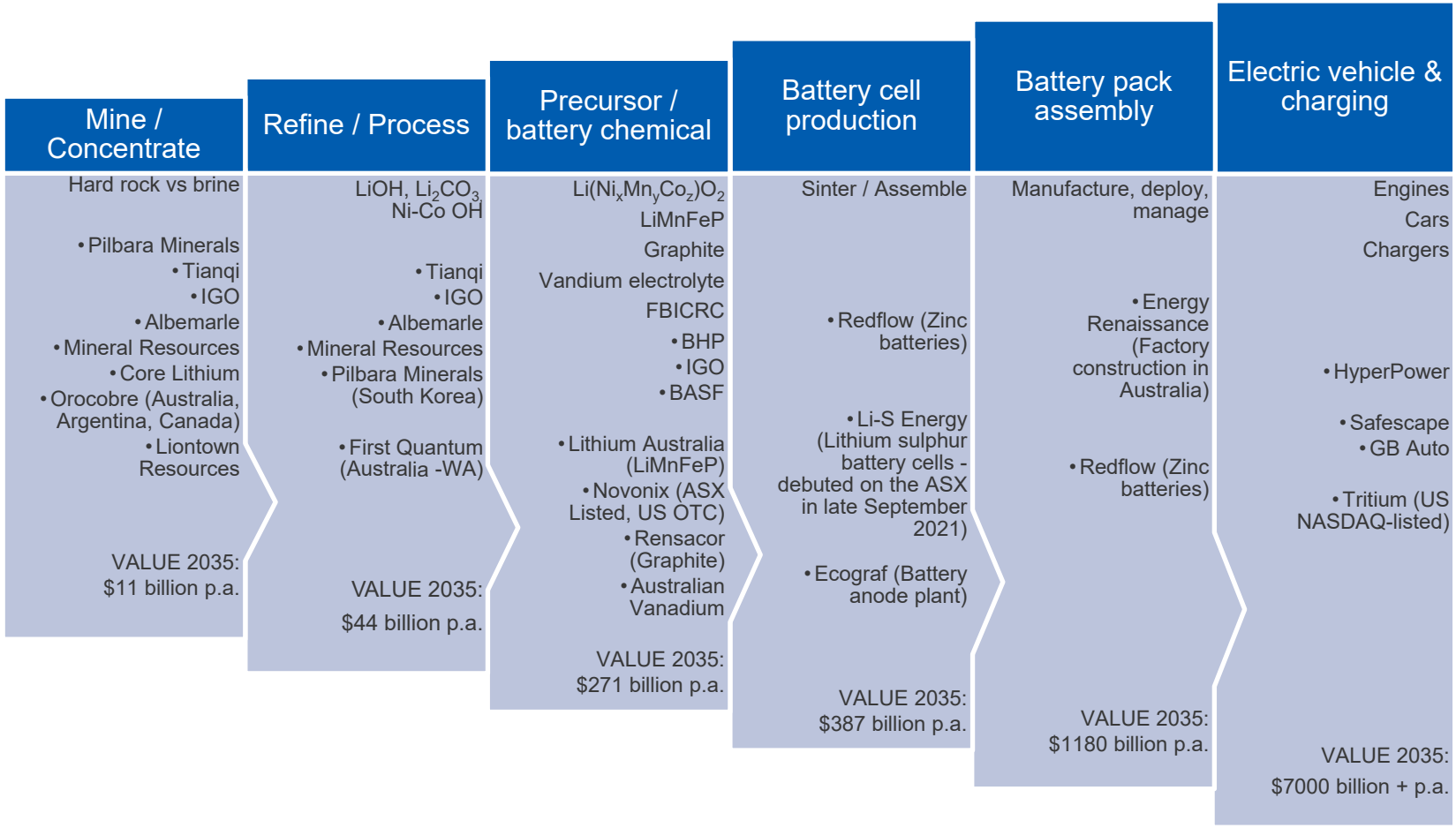
Revisions to the outlook

Forecast export revenue in 2021–22 has been revised down from $3.3 billion in the December 2021 Resources and Energy Quarterly to $2.8

billion, reflecting a downward revision to mine production due to a slower than expected ramp up in production in some operations. Export revenue for 2022–23 has been revised up from $4.2 billion to $4.5 billion (in nominal terms), reflecting the strong gains in the spodumene price rolling through into contract prices.

Compared to the March 2021 Resources and Energy Quarterly, exports in 2025–26 have been revised up from $6.0 billion to $7.4 billion (nominal) reflecting higher expected prices and production volumes.

Figure 15.8: Projected global value of lithium-ion battery value chain (+ zinc and vanadium batteries for large scale storage)



Notes: Redflow is ASX listed and is currently producing zinc batteries offshore. Zinc and vanadium batteries are suitable for large scale storage.

Source: BloombergNEF (2021), *Australasian Institute of Mining and Metallurgy: Thought leadership conference*, September 2021; Future Battery Industry Co-operative Research Centre (2021).

Table 15.1: Lithium Outlook

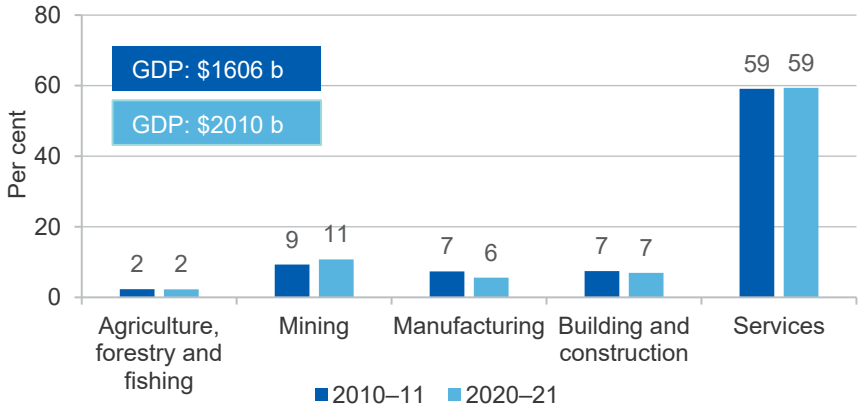
World	Unit	2021	2022[f]	2023[f]	2024[z]	2025[z]	2026[z]	2027[z]	CAGR[r]
Lithium production [a]	kt	520	650	804	927	1,115	1,345	1,476	19.0
Lithium demand [b]	kt	526	636	776	942	1,106	1,294	1,493	19.0
Spodumene price									
–nominal	US$/t	638	1,325	1,250	1,120	1,010	945	915	6.2
–real [c]	US$/t	660	1,325	1,218	1,064	936	855	809	3.5
Lithium hydroxide price									
–nominal	US$/t	17,369	27,620	23,050	19,180	18,300	16,460	14,855	-2.6
–real [c]	US$/t	17,970	27,620	22,451	18,209	16,950	14,898	13,138	-5.1
Australia	**Unit**	**2020–21**	**2021–22[f]**	**2022–23[f]**	**2023–24[z]**	**2024–25[z]**	**2025–26[z]**	**2026–27[z]**	**CAGR[r]**
Mine production [a]	kt	224	287	345	460	597	663	692	20.6
Spodumene export volume[d]	kt	1,628	1,936	2,328	3,104	4,026	4,476	4,668	19.2
Export value									
–nominal [g]	A$m	938	2,833	4,621	5,330	6,708	7,369	7,666	41.9
–real [h]	A$m	970	2,833	4,481	5,034	6,179	6,623	6,721	38.1

Notes: **a** Lithium Carbonate Equivalent — a measure of the quantity of refined product; **b** Demand is ahead of consumption by approximately 12 months due to the lead time required in battery manufacturing; **c** In 2022 US dollars; **d** Includes spodumene concentrates exported — mostly 6 per cent Li_2O concentrate — plus spodumene concentrate used to produce lithium hydroxide for export; **f** Forecast; **g** Revenue from spodumene concentrate as well as lithium hydroxide; **h** In 2021–22 Australian dollars; **r** Compound annual growth rate; **z** Projection.

Source: Company reports; Department of Industry, Science, Energy and Resources (2022); WoodMackenzie (2022); BloombergNEF (2022); Government of Western Australia Department of Mines, Industry Regulation and Safety (2021).

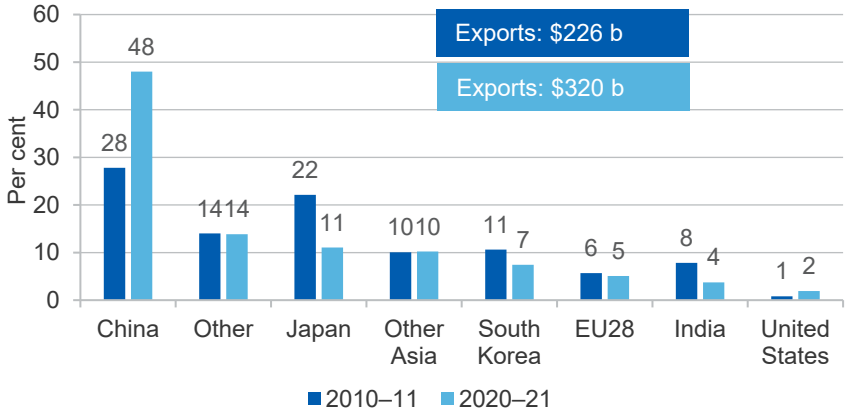
Trade summary charts and tables

Figure 16.1: Industry shares of GDP



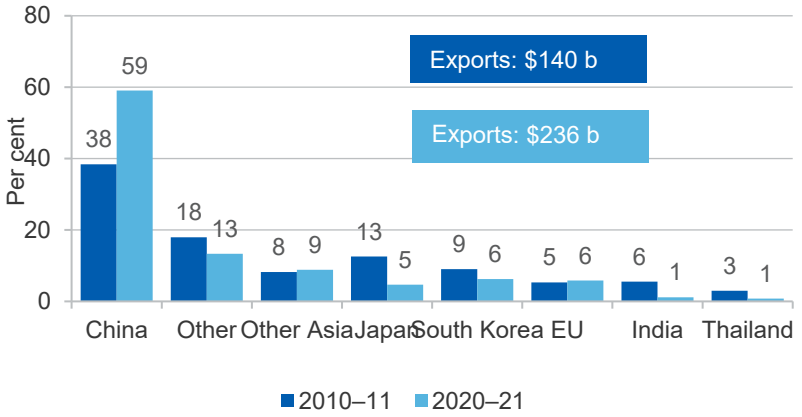
Source: ABS (2021) Australian National Accounts, National Income, Expenditure & Production, 5204.0

Figure 16.2: Principal markets for Australia's resources and energy exports, 2021–22 dollars



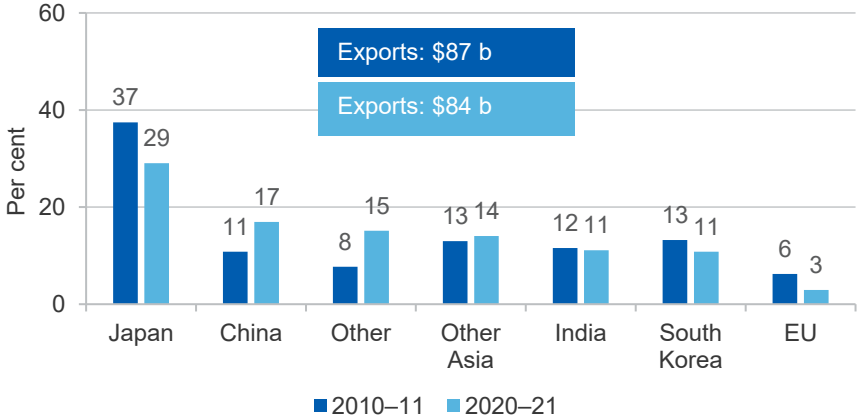
Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.3: Principal markets for Australia's resources exports, 2021–22 dollars



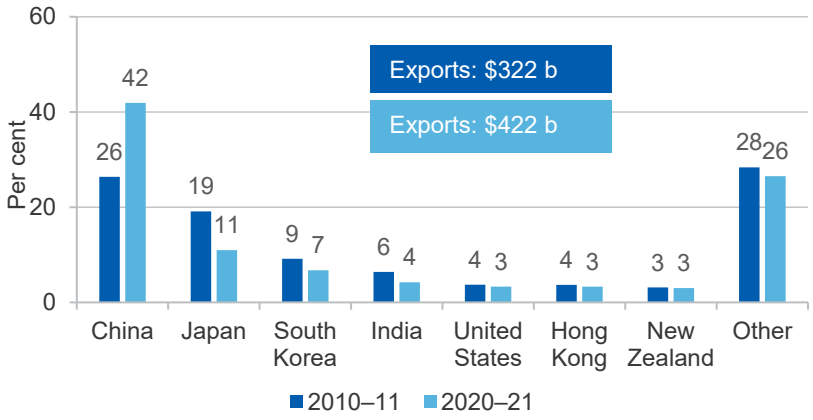
Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.4: Principal markets for Australia's energy exports, 2021–22 dollars



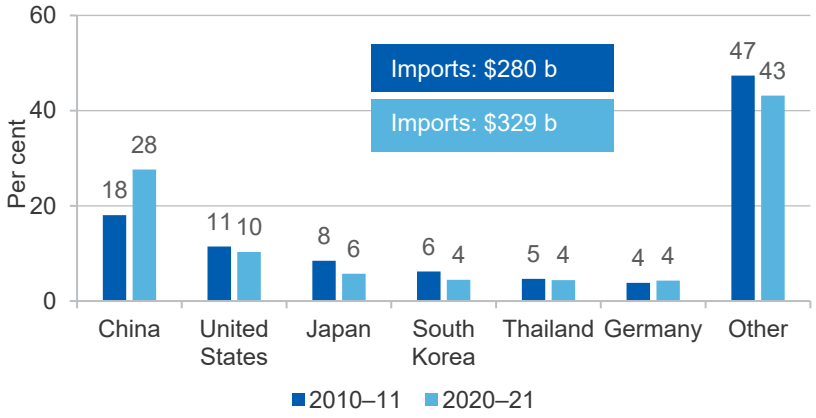
Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.5: Principal markets for Australia's total exports, 2021–22 dollars



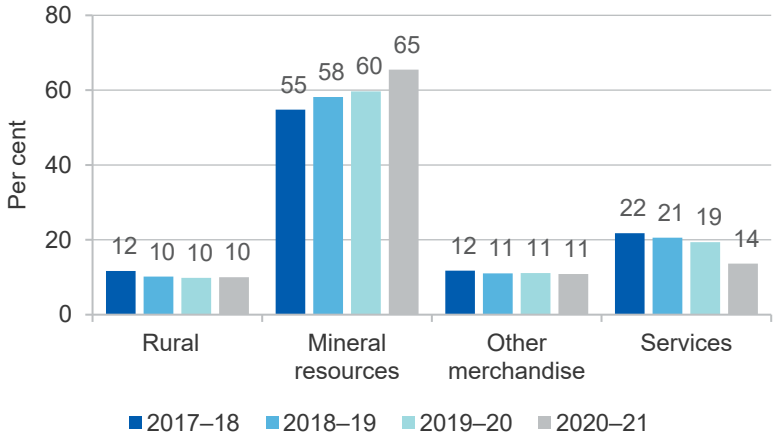
Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.6: Australia's total imports by country of origin, 2021–22 dollars



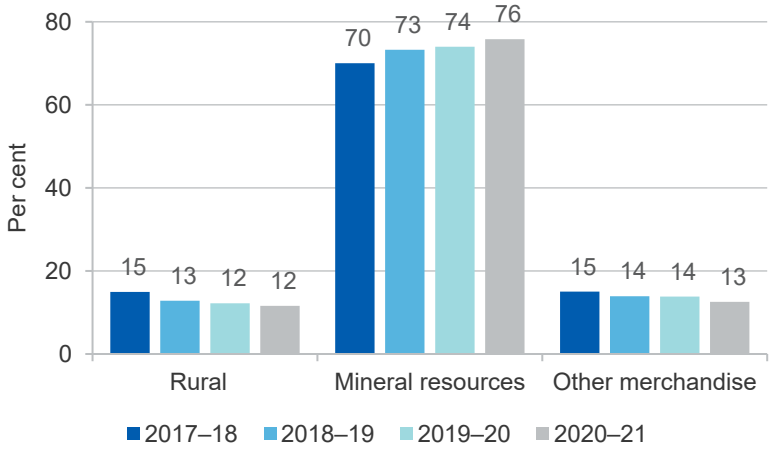
Source: ABS (2022) International Trade in Goods and Services, 5368.0

Figure 16.7: Proportion of goods and services exports by sector



Source: ABS (2022) Balance of Payments and International Investment Position, 5302.0

Figure 16.8: Proportion of merchandise exports by sector



Source: ABS (2022) Balance of Payments and International Investment Position, 5302.0

Table 16.1: Principal markets for Australia's thermal coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	9,083	10,645	12,381	8,769	7,246
South Korea	$m	2,828	3,216	4,058	2,987	2,655
Taiwan	$m	2,492	2,782	3,366	2,506	2,130
Vietnam	$m	161	138	707	1,093	735
Malaysia	$m	710	809	963	562	579
Thailand	$m	321	401	426	454	536
Total	**$m**	**20,849**	**24,441**	**27,635**	**21,406**	**16,550**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.2: Principal markets for Australia's metallurgical coal exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
India	$m	9,231	10,261	11,969	7,868	7,836
Japan	$m	7,654	7,861	8,152	6,392	4,904
South Korea	$m	4,069	3,969	4,283	3,187	2,824
China	$m	8,442	9,065	10,528	10,271	1,725
Taiwan	$m	2,010	2,092	2,765	2,094	1,377
Netherlands	$m	2,081	1,938	1,907	1,304	915
Total	**$m**	**38,974**	**40,897**	**46,455**	**35,976**	**23,970**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.3: Principal markets for Australia's crude oil and refinery feedstocks exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Singapore	$m	1,117	1,270	2,072	1,429	1,717
Malaysia	$m	471	634	1,746	1,064	680
Indonesia	$m	1,012	1,415	690	799	637
Thailand	$m	621	1,248	1,192	650	377
China	$m	780	682	1,073	1,085	167
Japan	$m	393	389	320	144	94
Total	**$m**	**6,040**	**7,529**	**9,657**	**9,464**	**7,685**

Note: Some country details have been confidentialised by the Australian Bureau of Statistics.

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.4: Principal markets for Australia's LNG exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	12,477	15,703	22,580	20,935	12,067
China	$m	6,291	10,346	18,611	17,099	11,771
South Korea	$m	2,818	3,990	5,650	5,422	3,463
Taiwan	$m	280	809	2,495	2,724	2,318
Singapore	$m	1,578	1,229	1,317	1,092	854
Malaysia	$m	231	393	929	1,529	516
Total	**$m**	**24,606**	**33,445**	**52,939**	**49,927**	**31,507**

Notes: Department of Industry, Science, Energy and Resources estimates based on International Trade Centre data, except for 2016–17 where ABS trade data is available.

Source: ABS (2022) International Trade in Goods and Services, 5368.0; International Trade Centre (2022) International Trade Statistics

Table 16.5: Principal markets for Australia's iron ore exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
China	$m	56,845	54,235	67,566	89,072	129,037
South Korea	$m	5,942	5,769	6,129	7,393	9,387
Japan	$m	4,310	3,903	4,968	6,536	9,338
Taiwan	$m	1,579	1,336	1,882	1,971	3,174
Indonesia	$m	48	48	46	29	42
India	$m	6	324	253	22	10
Total	**$m**	**69,067**	**66,434**	**82,562**	**108,061**	**158,144**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.6: Principal markets for Australia's aluminium exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
Japan	$m	1,028	1,486	1,405	1,067	988
South Korea	$m	817	913	817	1,196	936
Taiwan	$m	228	354	312	378	431
Thailand	$m	339	405	417	304	360
United States	$m	141	200	895	259	265
China	$m	56	36	18	31	122
Total	**$m**	**3,493**	**4,343**	**4,435**	**3,879**	**3,890**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.7: Principal markets for Australia's copper exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
China	$m	2,976	4,077	3,839	3,979	2,840
South Korea	$m	492	314	727	684	1,359
Malaysia	$m	948	942	1,321	866	879
India	$m	753	906	473	486	647
Japan	$m	1,496	1,650	1,952	2,233	17
Philippines	$m	438	181	651	379	-
Total	**$m**	**8,348**	**9,145**	**10,401**	**10,724**	**11,827**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Table 16.8: Principal markets for Australia's gold exports, 2021–22 dollars

	Unit	2016–17	2017–18	2018–19	2019–20	2020–21
United Kingdom	$m	4,316	3,537	4,596	13,349	9,235
United States	$m	162	80	135	3,235	4,070
Singapore	$m	337	1,252	1,692	1,495	3,032
China	$m	2,558	3,180	5,399	865	2,097
Switzerland	$m	1,045	1,184	1,236	1,995	1,953
India	$m	452	792	616	70	1,524
Total	**$m**	**20,934**	**20,877**	**20,086**	**25,627**	**26,987**

Source: ABS (2022) International Trade in Goods and Services, 5368.0

Appendices

Appendix A
Definitions and classifications

A.1 Exchange rates

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

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

A.2 Conversion to real dollars

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

A.3 Time periods

The terms 'estimate', 'forecast' and 'projection' refer to different time periods in this report. Estimate refers to a time period that has passed, but for which full historical data is not yet available, while 'forecast' and 'projection' refer to different periods in the future. It is important to distinguish between different future 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 Department of Industry, Science, Energy and Resources' Office of the Chief Economist (DISER OCE) uses different terminology to distinguish between short-term forecasts and medium to long-term projections, as outlined in *Table A2*.

Table A1: OCE terminology for different time periods/horizons

Period	Years	Terminology
Historical	Time period has passed but complete data for the period is not yet available	Estimate
Short-term	1 to 2 years	Forecast
Medium-term	3 to 5 years	Projection
Long-term	Beyond 5 years	n/a

Source: Department of Industry, Science, Energy and Resources (2022)

A.4 Commodity classifications

The DISER 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 A2*. In estimating a total for Australia's resources and energy exports, the remaining commodities, defined as 'other resources' and 'other energy', are forecast as a group.

Table A2: Resources and energy commodities groupings and definitions

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

Notes: The AHECC chapter is the first two digits of the trade code. Groupings are made at the 8-digit level.
Source: Department of Industry, Science, Energy and Resources (2022)

Appendix B Glossary

Term	Description
A$	Australian dollar
ABS	Australian Bureau of Statistics
AHECC	Australian Harmonized Export Commodity Classification
AISC	All-In Sustaining Cost — an extension of existing cash cost metrics and incorporates costs related to sustaining production.
Base metals	A common metal that is not considered precious (includes aluminium, copper, lead, nickel, tin, zinc)
Bbl	Barrel
Bcm	Billion cubic metres
Benchmark	A standard specification used to price commodities.
BF and BOF	Blast furnace and basic oxygen furnace — used in an integrated steelmaking process that uses iron ore and coal.
Bulks	Non-liquid and non-gaseous commodities shipped in mass and loose (iron ore, coal, bauxite)
CAGR	Compound annual growth rate
Capex	Capital expenditure
CFR	Cost and freight — Seller clears exports, and pays freight.
CIF	Cost, Insurance, and Freight
Coal Seam Gas (CSG)	Natural gas found in coal seams. Also known as Coal Bed Methane (CBM)
Coke	Made by heating coal at high temperatures without oxygen, and used to reduce iron ore to molten iron saturated with carbon, called hot metal

Conventional gas	Natural gas that can be produced from reservoirs using traditional techniques. Contrasts with unconventional gas.
COVID-19	2019 Novel Coronavirus
CPB	CPB Netherlands Bureau for Economic Policy Analysis
CPI	Consumer Price Index — measures quarterly changes in the price of a basket of goods and services which account for a high proportion of expenditure by the CPI population group (i.e. metropolitan households).
Crude steel	Steel in the first solid state after melting, suitable for further processing or for sale.
DES	Delivered Ex Ship — price of LNG including shipping and insurance.
DISER	Department of Industry, Science, Energy and Resources
DMO	Domestic Market Obligation — a policy to reserve energy commodities for domestic usage
DRC	Democratic Republic of the Congo
ECB	European Central Bank
Economic growth	An increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It is measured in nominal or real gross domestic product (GDP).
EIA	The United States Energy Information Administration
EAF	Electric arc furnace — a furnace that melts steel scrap using the heat generated by a high power electric arc.
ETF	Exchange Traded Fund — an exchange traded fund that allows investors to invest in gold on the exchange.
EUV	Export unit value — export value/volumes exported
EV	Electric vehicle
f	Forecast — a two year outlook
FEED	Front end engineering design
FID	Final investment decision

FOB	Free on board — seller clears export, buyer pays freight.
GAD	Gross air dried basis — For measuring coal quality.
GAR	Gross as received basis — For measuring coal quality.
GBP	Great Britain Pounds
GDP	Gross Domestic Product — measures the value of economic activity within a country/group.
GFC	Global Financial Crisis — the period of extreme stress in global financial markets and banking systems between mid-2007 and early 2009.
GJ	Gigajoule
GST	Goods and Services Tax — a value-added tax levied on most goods and services sold for domestic consumption.
HCC	Hard coking coal — The best grade of metallurgical coal used in the steel production process. Australian hard coking coal is regarded as the industry benchmark.
IEA	International Energy Agency
IMF	International Monetary Fund — an international organisation that promotes international financial stability and monetary cooperation.
IMO	International Maritime Organisation
IP	Industrial Production — measures the output of the industrial sector that comprises mining, manufacturing, utilities and construction.
IPO	Initial public offering — a process of offering shares of a private corporation to the public in a new stock issuance.
ISM	US Institute for Supply Management
ISM	Institute of Supply Management
JCC	Japan Customs-cleared Crude (or Japan Crude Cocktail) — average price of crude oil imported by Japan and a common price index in long-term LNG contracts.
JFY	Japanese fiscal year
kcal/kg	Kilocalories per kilogram

kt	Thousand tonnes
ktpa	Kilotonnes per annum
LBMA	London Bullion Market Association
LCE	Lithium Content Equivalent
Li OH	Lithium Hydroxide
LME	London Metal Exchange
LNG	Liquefied natural gas
LNY	Lunar New Year
LPG	Liquefied petroleum gas
LVPCI	Low volatile pulverised coal injection — a type of low volatile coal used in the PCI process
m	Million
MMbtu	Million British thermal units
Mt	Million tonnes
mtpa	Million tonnes per annum
MW	Megawatts
Nameplate capacity	The theoretical maximum annual production capacity
NAR	Net as received basis — For measuring coal quality
NDRC	China's National Development and Reform Commission
NEV	New energy vehicle — term used for plug-in electric vehicles eligible for public subsidies (battery electric vehicles and plug-in hybrid vehicles)

OCE	Office of the Chief Economist
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of Petroleum Exporting Countries, a formal alliance of 14 countries to collaborate to manage the world oil market
OPEC+	Informal term for agreements between OPEC and ten other oil-producing countries (which are not members of OPEC)
Oz	Ounce
PCE	Personal Consumption Expenditure — a measure of the changes in price of consumer services and goods.
PCI	Pulverised coal injection — PCI coal is used for its heat value and injected directly into blast furnaces as a supplementary fuel, which reduces the amount of coke required.
PCI	Pulverised coal injection — a process used in blast furnace operations
PM	The afternoon price of gold set at 3.00pm each business day at the London Bullion Market Association
PMI	Purchasing Managers Index — an indicator of economic health for manufacturing and service sectors.
PPP	Purchasing Power Parity — a way of measuring economic variables in different countries that equalise the purchasing power of different currencies
RoW	Rest of world
s	Estimate — Incomplete data or subject to revision
Shale gas	Natural gas found in shales
SDR	Special drawing right
SHFE	Shanghai Futures Exchange
SSCC	Semi-soft coking coal — A type of metallurgical coal used in the steel production process alongside hard coking coal, but results in a lower coke quality and more impurities.
Tariff	A tax on imports or exports that is used by governments to generate revenue or to protect domestic industries from competition.
Tight gas	Natural gas found in low quality reservoirs

TWI	Trade Weighted Index — a measure of the foreign exchange value of the US dollar against a basket of major foreign currencies.
U3O8	Triuranium octoxide — a compound of uranium.
UAE	United Arab Emirates
UK	United Kingdom
Unconventional gas	Natural gas that is more difficult to extract, including coal seam gas, shale gas and tight gas. Contrasts with conventional gas.
US	United States
US$	United States dollar
WEO	The International Energy Agency's World Energy Outlook
WTI	West Texas Intermediate crude oil price
z	Projection a five year outlook