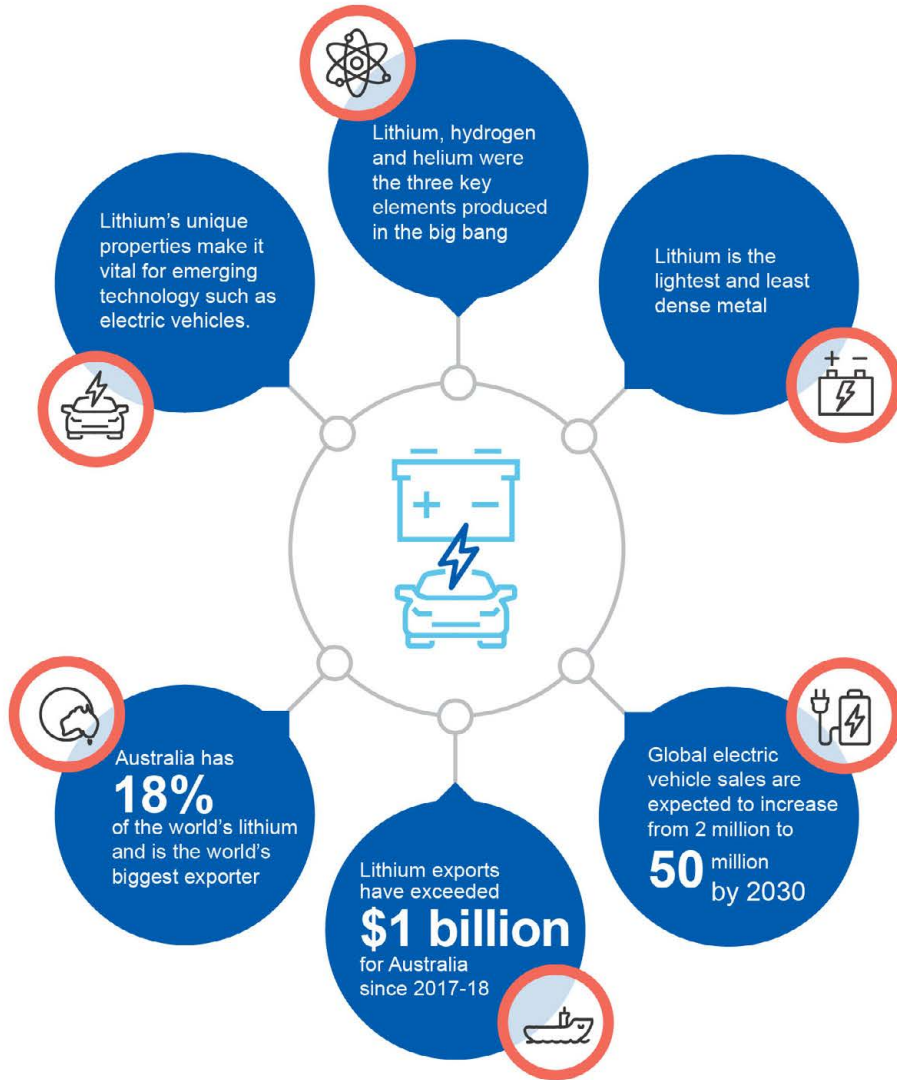


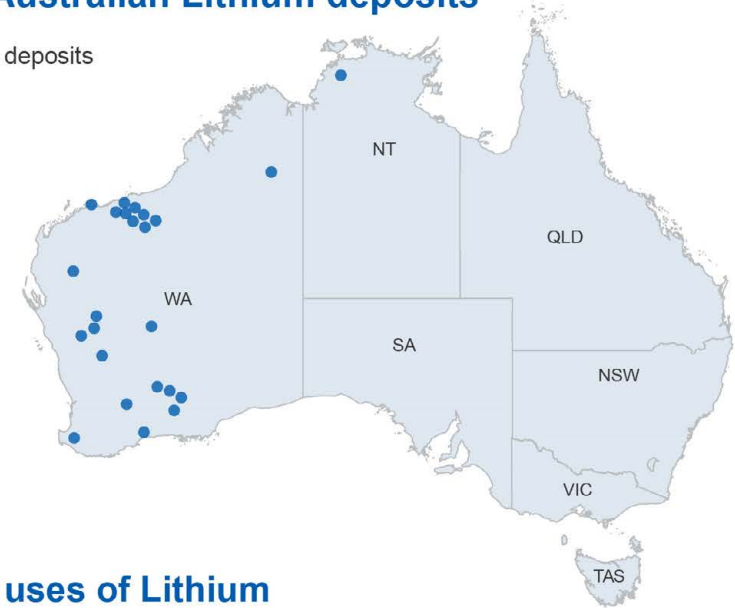
Lithium

Resources and Energy Quarterly September 2019

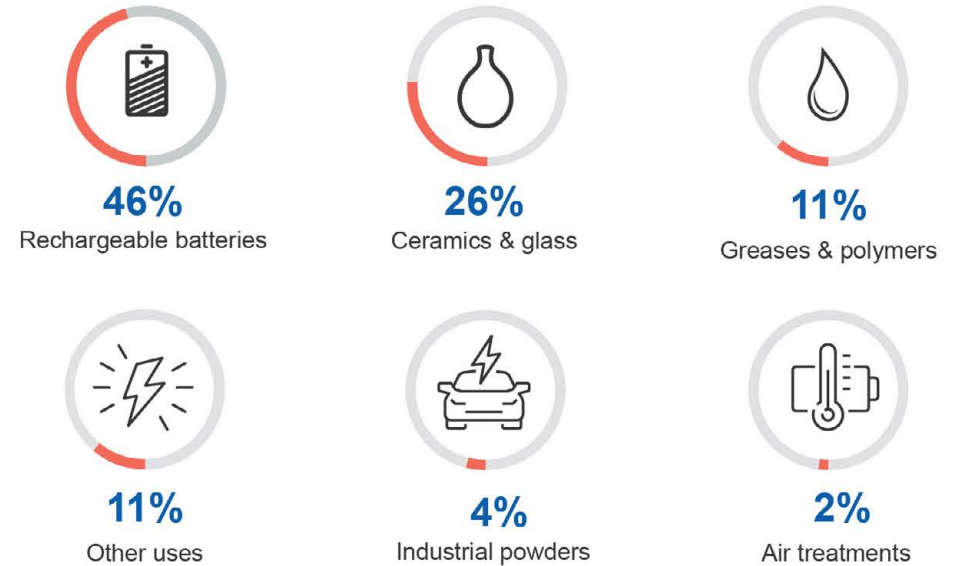


Major Australian Lithium deposits

● Lithium deposits



Global uses of Lithium



15.1 Summary

- Surging supply has seen the price of lithium hydroxide fall 33 percent year on year — from \$US18,000 a tonne in 2018 to around US\$12,000 a tonne in 2019. Further falls are expected over the outlook period.
- Australian lithium production is expected to increase from an estimated 288,000 tonnes in 2018–19 to around 358,000 tonnes by 2020–21, as the Greenbushes mine is upgraded and several newer mines ramp up.
- Export values hit an estimated record high of \$1.4 billion in 2018–19 but are forecast to fall to \$1.3 billion by 2020–21 due to lower prices.

15.2 Prices

Lithium prices are expected to keep falling

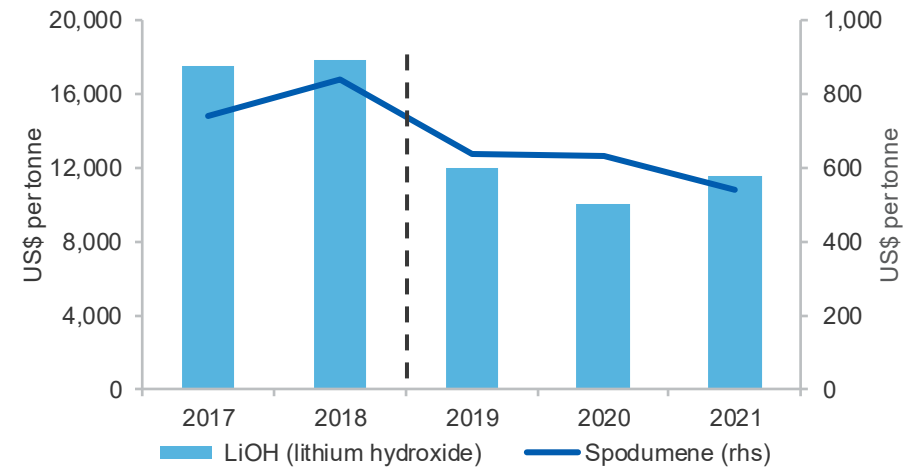
Lithium hydroxide prices have been trending down since their peak in late 2018, particularly in major market China. In recent months, spot prices have fallen more sharply than contract prices, with the latter responding more slowly to growing evidence of oversupply — such as stock gains.

Lithium hydroxide prices are projected to fall by around 33 per cent in 2019, as oversupply persists. Over the outlook period, the supply surplus is projected to gradually decline, with the price rebounding after 2020 (Figure 15.1). Spodumene ore — the precursor material for lithium hydroxide — is expected to face a longer period of oversupply, with prices forecast to remain soft through the whole outlook period.

The present lithium oversupply is challenging for market participants but not wholly unintended — the long term goal of investment in new and expanded mines has been to position businesses to meet future demand. Recent lithium consumption growth has been stellar, with compound annual growth of over 10 per cent a year. A major driver of future growth will be rising sales of electric vehicles (EV).

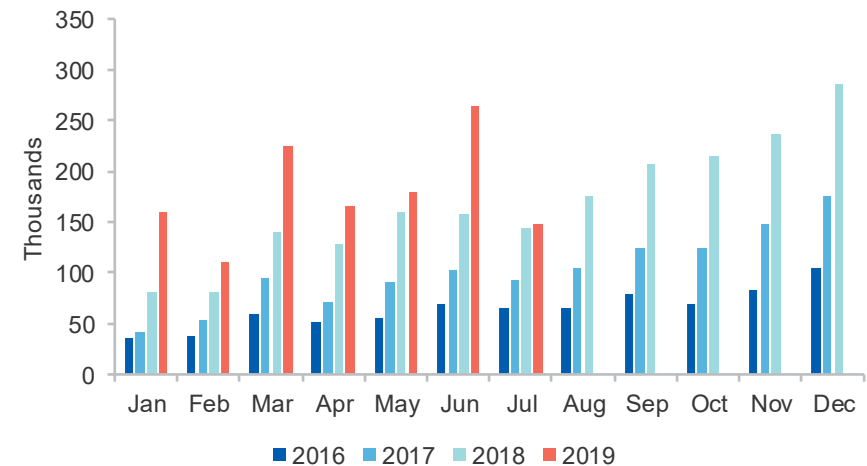
EV sales over the first half of 2019 were 50 per cent higher than the same period in 2018, and the rate of growth is accelerating (Figure 15.2).

Figure 15.1: Price of spodumene ore and lithium hydroxide



Source: Roskill (2019); Department of Industry, Innovation and Science (2019)

Figure 15.2: Monthly worldwide electric vehicle sales



Notes: Based on reconciled monthly or quarterly total sales data reported by major plug-in electric vehicle manufacturers.

Source: Inside EVs (2019) Monthly Sales Scorecard.

With the pricing of EVs expected to become increasingly competitive with internal combustion engine vehicles over the next few years, lithium consumption volumes are expected to catch up with production volumes (based on currently planned mines) as soon as 2021.

15.3 World consumption

A difficult year for lithium, but supply chains continue to mature

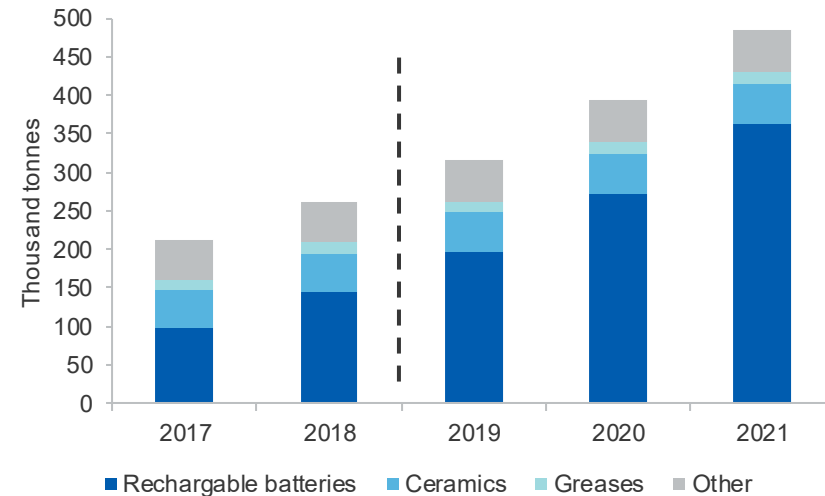
Consumption of lithium in 2018 was almost 12 per cent higher than estimated in the June 2019 *Resources and Energy Quarterly*. Despite short term macroeconomic headwinds, overall world lithium consumption continues its rapid growth of recent years, with an expected increase of 21 per cent in 2019 relative to 2018 levels (Figure 15.3). This growth is primarily supported by increasing EV sales — expected to increase at an annual rate of over 30 per cent during the outlook period, from 2.9 million vehicles in 2018 to 6.6 million vehicles in 2021 (Figure 15.4).

Recently, the growth in world lithium consumption has slowed in response to challenging economic conditions and policy changes in China. Overall vehicle sales have been contracting in China for at least a year, and the Chinese manufacturing sector continues to slow (see section 2.3 and Figure 2.6 in *Macroeconomic* chapter).

Chinese sales of EVs continue to grow, but the growth is slower than 2018. EV sales in July 2019 fell below July 2018 levels due to the cessation or winding back of some Chinese government subsidies for EVs. Lithium use in the Chinese residential housing sector (uses include glass, ceramics and cooking appliances) is also expected to be weak for the time being.

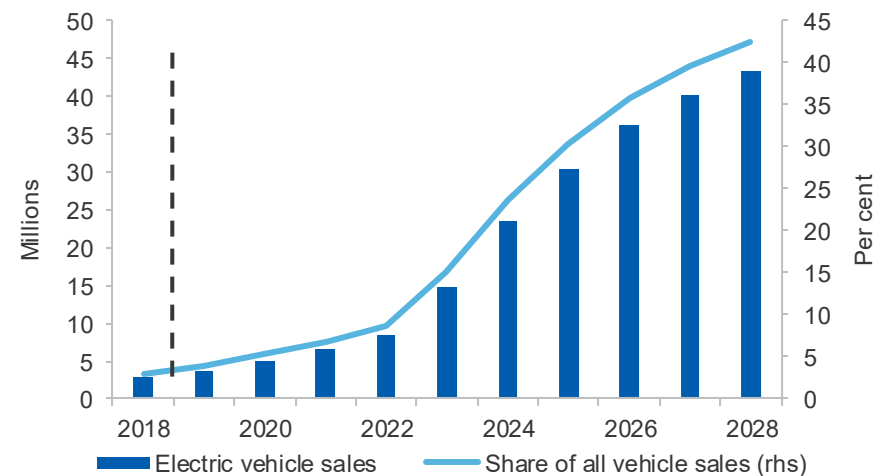
In the face of a shortage of buyers, Chinese companies that convert hard rock lithium into battery chemicals are increasing their levels of stock on hand. China's biggest lithium producer, Ganfeng Lithium Co, recently announced a 59 per cent fall in its first half profit expectations, reflecting weak sales growth and declining margins.

Figure 15.3: Lithium usage by product



Notes: 'Other' includes polymers, glass, powders, primary batteries, and air treatments.
Source: Roskill (2019); Department of Industry, Innovation and Science (2019).

Figure 15.4: Long-term electric vehicle sales projection



Source: Department of Industry, Innovation and Science (2019)

15.4 World production

Production chains are growing in volume and complexity

World lithium production ramped up much faster than anticipated in 2018, growing by 22 per cent year on year to 447,000 tonnes (in lithium carbonate equivalent terms). In the June 2019 *Resources and Energy Quarterly*, the estimate was for a 2018 growth rate closer to 5 per cent.

Lithium production chains are evolving rapidly, with a shift in the market towards the use of hard rock deposits. Lithium hydroxide produced from hard rock is more amenable to high-temperature sintering, which makes it more suitable for use in high-nickel products such as batteries. Hard rock production involves pulverising the ore to extract raw material, producing concentrates, and the mixing of concentrates with nickel, manganese and cobalt to produce oxides that combine with electrolytes.

Many countries are investing in facilities to target each of these steps for refining hard rock lithium. European countries have announced an intention to bring as many of these production stages as possible into the EU, with China following a similar path. These investments should reduce the risk of future bottlenecks, and support a more stable and integrated lithium market.

Hard rock lithium production is also benefiting from new problems with brine production, an alternative way of producing lithium. Although large reserves of lithium exist in brine in Chile and China (Figure 15.5), exploitation requires high volumes of water, which has made it contentious in some South American regions. SQM — a large brine producer — has recently been required to submit a \$US25 million environmental compliance plan, and has shut down a well that was found to be impacting desert trees and vegetation. Albermarle has also been forced to halt engineering work at its La Negra project in Chile, due to concerns over water usage.

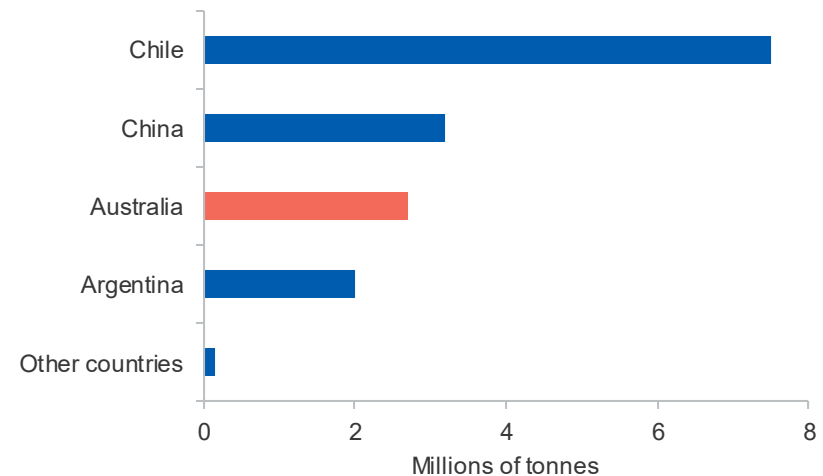
Some brine facilities have progressed in recent months, with SQM receiving environmental approval for construction at Salar de Atacama and Salar del Carmen in Chile. However, final approvals will take more time,

and hard rock production is expected to dominate global growth over the outlook period, accounting for virtually all of the projected expansion — from 447,000 tonnes in 2018 to 489,000 tonnes by 2021 (Figure 15.6).

In the longer term, lithium recycling is likely to start substituting for mined production, if technological and cost barriers are overcome. Volkswagen Group plans to start a pilot plant in 2020 at its Salzgitter facility to develop a cost-effective battery recycling process to recover nickel, manganese, cobalt and lithium. This year, the US Department of Energy announced funding of US\$15 million to start a research centre to examine lithium-ion battery recycling.

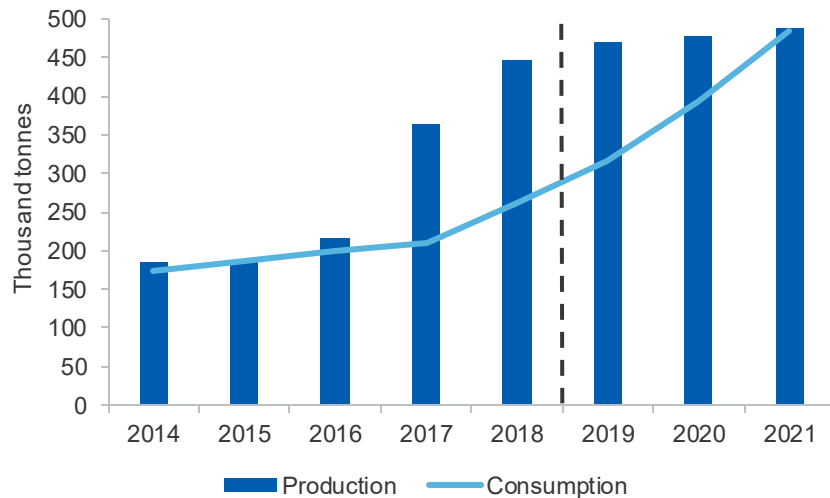
Large-scale lithium recycling is unlikely to occur much before 2030, when batteries start reaching end-of-life in large quantities. However, recycling plants may prove crucial in the long-term; not just as a means to reduce the material and energy cost of electric cars, but also to ensure long-term matching between lithium supply and demand.

Figure 15.5: World lithium reserves



Source: US Geological Survey (2018); Department of Industry, Innovation & Science (2019).

Figure 15.6: Lithium production and use



Source: Roskill (2019); Department of Industry, Innovation and Science (2019).

15.5 Australia

Rapid growth in output from Australian lithium producers

Australia remains the largest producer of mined lithium, producing 58 per cent of total world output in 2018. The Australian mining sector has invested heavily in new mining opportunities, and its output increase amounted to 56 per cent of additions to world production in 2018.

In 2018, production commenced at several sites in Western Australia. These include Pilbara Minerals' Pilgangoora mine, Altura Mining's Pilgangoora mine, and Alliance Mineral Assets' Bald Hill operation. But the largest volume growth in that year came from the expansion of Talison Lithium's existing Greenbushes mine, with an extra 20,000 tonnes.

With spodumene prices falling, most exchange-listed Australian producers during 2019 have cut their revenue forecasts and experienced dramatic falls in their share prices — with some down over 50 per cent since January 2019. Producers are reassessing expansion plans, to minimise

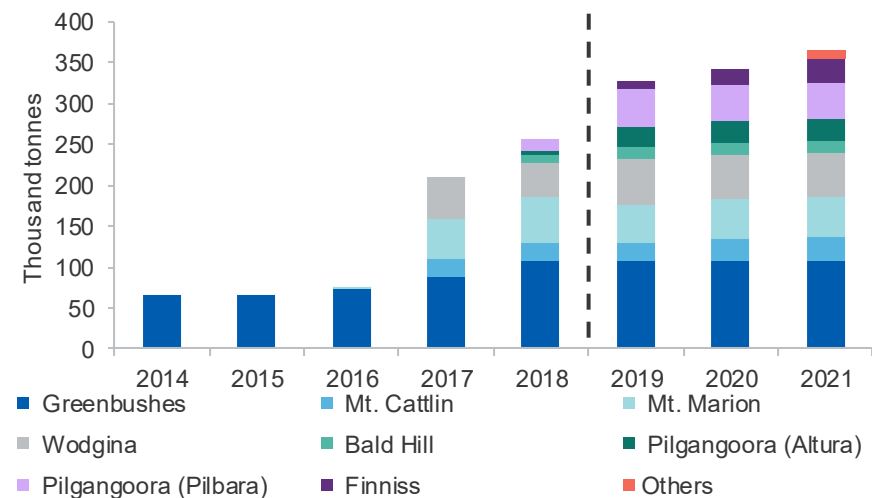
their risks in the face of declining prices. Even if expansion plans are delayed, the ramp up from mines which started operating in 2018 is expected see output rise over the outlook period (Figure 15.7). Australian lithium production (in lithium carbonate equivalent terms) was 288,000 tonnes in 2018–19, and is forecast to hit 358,000 tonnes by 2020–21.

The surge in production is expected to contribute to growing levels of stock, both in Australia and elsewhere. World stock levels are expected to peak at levels equivalent to almost two years' consumption in 2021.

Exports volumes set to grow strongly over the outlook period

Export volumes are projected to track with production, since Australia currently has no domestic use of spodumene. Falling prices will create headwinds for export values in the short-term, though construction of hydroxide refineries should add to export values late in the outlook period. Export values hit an estimated \$1.4 billion in 2018-19 and are forecast to fall to \$1.3 billion by 2020–21 (Figure 15.8).

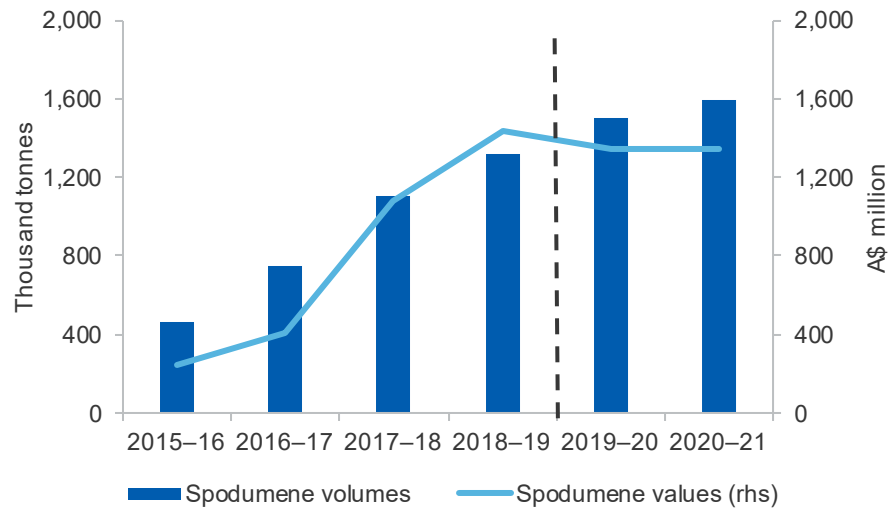
Figure 15.7: Australian spodumene ore production



Notes: Production measured as lithium carbonate equivalent.

Source: Company reports, Roskill (2019); Dept. of Industry, Innovation and Science (2019)

Figure 15.8: Australian spodumene concentrate exports



Source: Roskill (2019); Department of Industry, Innovation and Science (2019).

Revisions to the outlook

Australia’s export earnings forecasts have been revised significantly from those in the June 2019 *Resources and Energy Quarterly*, based on updated volume and price data. The 2018–19 export estimate is higher by \$107 million, as a result of higher prices (in Australian dollar terms) than expected, the impact of which has been partly offset by lower export volumes. The 2019–20 export forecast has been lowered by \$170 million, due to lower prices and a small decrease in volumes.

Table 15.1: Lithium outlook

World	Unit	2018	2019 ^f	2020 ^f	2021 ^f	Annual percentage change		
						2019 ^f	2020 ^f	2021 ^f
Lithium production ^a	kt	447	470	479	489	5.0	2.0	2.0
Consumption	kt	261	315	393	485	20.6	24.8	23.5
Stocks	kt	638	793	879	883	24.2	10.8	0.4
– weeks of consumption		127.0	130.9	116.3	94.6	3.1	-11.2	-18.7
Spodumene price								
– nominal	US\$/t	839	638	630	540	-24.0	-1.2	-14.3
– real ^b	US\$/t	857	639	616	517	-25.5	-3.6	-16.1
Lithium hydroxide price								
– nominal	US\$/t	17,817	12,000	10,000	11,500	-32.6	-16.7	15.0
– real ^b	US\$/t	18,206	12,030	9,775	11,001	-33.9	-18.7	12.5
Australia	Unit	2017–18	2018–19	2019–20 ^f	2020–21 ^f	2018–19	2019–20 ^f	2020–21 ^f
Mine production ^a	kt	255	288	342	358	13.2	18.6	4.5
Export volume ^c	kt	1 105	1 324	1 504	1 593	19.7	13.6	5.9
– nominal value	A\$m	1,081	1,434	1,349	1,339	32.7	-5.9	-0.7
– real value ^d	A\$m	1,125	1,469	1,349	1,307	30.6	-8.1	-3.1

Notes: **a** Lithium Carbonate Equivalent. This is a measure of the quantity of refined product produced from spodumene ore; **b** In 2019 calendar year US dollars; **c** Spodumene concentrates; **d** In 2019-20 financial year Australian dollars; **f** Forecast

Sources: Department of Industry, Innovation and Science (2019); Company reports; Roskill (2019); Government of Western Australia Department of Mines, Industry Regulation and Safety (2019)