Western Australia is the world’s largest lithium producer and a significant producer of other battery minerals.

Western Australia accounted for 52% of global lithium production in 2019, followed by Chile (23%), China (10%) and Argentina (8%).

Western Australia also ranked among the top 5 global producers for cobalt (4% global share), rare earths (10%) and nickel (7%) in 2019.

China was the world’s largest producer of graphite (64%), rare earths (63%) and vanadium (55%) in 2019, and a significant producer of all other battery minerals.

In 2019, the world’s largest producer of:
- Nickel was Indonesia (30%),
- Cobalt was Congo (71%),
- Manganese was South Africa (29%),
- Copper was Chile (28%).

Lithium-ion batteries are made from mostly lithium, graphite, nickel, cobalt and manganese.

World lithium-ion battery manufacturing capacity rose 54% to 335 gigawatt hours (GWh) in 2018.

China accounted for 74% of global lithium-ion battery manufacturing capacity in 2018, followed by the United States (9%), Japan (8%), South Korea (4%) and Europe(a) (3%).

Roskill forecasts global lithium-ion battery manufacturing capacity will quadruple to 1,340GWh by 2028, led by China.

By 2028, Roskill forecasts 65% of global lithium-ion battery manufacturing capacity will be in China, followed by the United States (10%), Europe(a) (9%), Japan (8%) and South Korea (5%).

Lithium and other battery minerals prices have started to ease because of slowing electric vehicle demand in China and an oversupply of battery minerals.

Western Australia exports lithium as spodumene concentrate, but will begin exporting lithium hydroxide in 2020. Lithium hydroxide prices fell 34% to US$14,257 a tonne in 2019.

In 2018-19, the annual average price of:
- Lithium spodumene concentrate(a) rose 5% to US$608/t.
- Cobalt(b) fell 40% to US$45,368/t.
- Nickel(c) fell 1% to US$12,339/t.
- Copper(d) fell 9% to US$6,155/t.
**Western Australia’s Competitiveness**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Unit</th>
<th>WA</th>
<th>Aust.</th>
<th>World</th>
<th>WA share of world</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>Mt</td>
<td>19.0</td>
<td>20.0</td>
<td>89</td>
<td>21%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Mt</td>
<td>1.1</td>
<td>1.2</td>
<td>7</td>
<td>16%</td>
</tr>
<tr>
<td>Lithium</td>
<td>Mt</td>
<td>2.7</td>
<td>2.8</td>
<td>17</td>
<td>16%</td>
</tr>
<tr>
<td>Vanadium</td>
<td>Kt</td>
<td>2.7</td>
<td>4.0</td>
<td>22</td>
<td>12%</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mt</td>
<td>36.0</td>
<td>100.0</td>
<td>810</td>
<td>4%</td>
</tr>
<tr>
<td>Rare earths</td>
<td>Mt</td>
<td>2.3</td>
<td>3.3</td>
<td>120</td>
<td>2%</td>
</tr>
<tr>
<td>Copper</td>
<td>Mt</td>
<td>5.2</td>
<td>87.0</td>
<td>870</td>
<td>1%</td>
</tr>
<tr>
<td>Graphite</td>
<td>Mt</td>
<td>1.3</td>
<td>7.1</td>
<td>300</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

*Estimated from Australia’s battery minerals reserves. Source: US Geological Survey, Mineral Commodity Summaries; and Geoscience Australia.*

**Total cash cost1 of seaborne lithium exports: 2019**

<table>
<thead>
<tr>
<th>Country</th>
<th>Cash Cost/LCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zimbabwe</td>
<td>US$1,812/LCE</td>
</tr>
<tr>
<td>Western Australia</td>
<td>US$2,486/LCE</td>
</tr>
<tr>
<td>Portugal</td>
<td>US$2,800/LCE</td>
</tr>
<tr>
<td>Argentina</td>
<td>US$4,237/LCE</td>
</tr>
<tr>
<td>Brazil</td>
<td>US$4,889/LCE</td>
</tr>
<tr>
<td>Chile</td>
<td>US$6,127/LCE</td>
</tr>
<tr>
<td>USA</td>
<td>US$6,792/LCE</td>
</tr>
<tr>
<td>China</td>
<td>US$10,712/LCE</td>
</tr>
</tbody>
</table>

*Production costs for different lithium products and grades are adjusted to a benchmark product (lithium carbonate equivalent). Source: S&P Global Market Intelligence, Mine Economics Model.*

**Battery minerals1 export markets (selected)**

- Western Australia has globally significant battery minerals reserves of a quality suitable for battery manufacturing.
- In 2019, Western Australia accounted for 21% of the world’s nickel reserves.
- Western Australia accounted for over 10% of the world’s cobalt, lithium and vanadium reserves in 2019.
- Western Australia had 5% or less of the world’s manganese, rare earths, copper and graphite reserves in 2019.
- Western Australia’s estimated battery minerals exploration expenditure rose 67% to $466 million in 2019.
- Western Australia’s lithium producers are among the world’s lowest cost seaborne lithium exporters.
- The average total cash cost¹ of Western Australia’s lithium exports was US$2,486 a lithium carbonate equivalent (LCE) in 2019, well below the world average of US$4,084/LCE.
- In 2019, the average total cash cost of Western Australia’s exports of:
  - Nickel was US$8,554/t (world average was US$8,395/t).
  - Copper was US$3,990/t (world average was US$3,497/t).
- Around 59% of Western Australia’s battery minerals exports went to China in 2018-19, with the value of exports up 21% to $3.6 billion.
- In 2018-19, Western Australia’s battery minerals exports to:
  - Japan rose 20% to $670 million.
  - Europe¹⁶ rose from $165 million to $497 million.
  - South Korea rose from $177 million to $448 million.
  - India rose 6% to $136 million.
  - United States rose from $13 million to $52 million.
- Western Australia’s lithium and cobalt exports are mostly for battery manufacturing, as well as some nickel exports.
- New processing investment in Western Australia will see more nickel and other battery minerals exported for battery manufacturing.

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¹ Includes copper, lithium, nickel and graphite. Excludes rare earths, cobalt and vanadium, and manganese from 2015-16. (a) Includes the larger European markets for Western Australia’s nickel exports only. Source: ABS 5368.0 International Trade in Goods and Services, and WA Department of Mines, Industry Regulation and Safety, Resource Data Files.
CONTRIBUTION TO WESTERN AUSTRALIA’S ECONOMY

Battery minerals sales

- Battery minerals accounted for 5% of the value of Western Australia's minerals and petroleum sales in 2018-19.
- The value of Western Australia’s battery minerals sales fell 0.4% to $6.7 billion in 2018-19.
- In 2018-19, the value of sales for:
  - Spodumene (lithium) fell 2% to $1.5 billion.
  - Nickel rose 1% to $2.7 billion.
  - Copper fell 2% to $1.3 billion.
  - Other battery minerals(a) rose 1% to $1.2 billion.

Battery minerals royalties

- Battery minerals accounted for 4% of Western Australia's royalty revenue1 in 2018-19.
- Battery minerals royalty revenue rose 15% to $268 million in 2018-19.
- In 2018-19, the royalty revenue from:
  - Lithium rose 6% to $83 million.
  - Copper(c) rose 8% to $76 million.
  - Nickel rose 16% to $66 million.
  - Other battery minerals(b) rose 58% to $43 million.

Direct battery minerals industry employment1

- Battery minerals(d) accounted for 14% of direct employment in Western Australia’s minerals mining industry in 2018-19 (excluding exploration) on a full-time equivalent basis.
- Direct employment in Western Australia’s battery minerals(d) industry rose 21% to 14,192 in 2018-19.
- In 2018-19, direct employment in the industry of:
  - Nickel(d) rose 12% to 6,234.
  - Lithium(d) rose 47% to 4,893.
  - Copper(d) rose 5% to 2,265.
  - Manganese rose 31% to 497.
  - Rare earths rose 3% to 298.

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1 Includes North West Shelf Grants. (a) Includes lead and zinc. (b) Includes rare earths, manganese, cobalt, vanadium and graphite. (c) Includes tin and tantalum. (d) Includes graphite. Source: Western Australian Department of Mines, Industry Regulation and Safety, Resource Data Files.

1 Includes North West Shelf Grants. Source: WA Department of Mines, Industry Regulation and Safety, Resource Data Files.

Includes the production and exports/sales of battery minerals not exclusively for battery manufacturing.
Includes the production and exports/sales of battery minerals not exclusively for battery manufacturing.