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| **WORLD BATTERY MINERALS MARKET** |

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| Major global battery minerals mine production: 2019 | * 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%).
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| (a) Lithium content of brine, spodumene, other hard rock or clay mine production. (b) Excludes China.Source: US Geological Survey, Mineral Commodity Summaries; Office of the Chief Economist, Resources and Energy Quarterly; and Geoscience Australia. |

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| World lithium-ion battery manufacturing capacity forecast1 | * 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 (3%).
* Roskill forecasts global lithium-ion battery manufacturing capacity will quadruple to 1,340GWh by 2028, with 65% of this capacity in China, followed by the United States (10%), Europe(9%), Japan (6%) and South Korea (5%).
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| 1 Large-sized cells. (a) Sweden, Hungary, Germany, Poland, United Kingdom and France.Source: Roskill, Lithium-ion Batteries Outlook to 2028 (April 2019). |

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| Battery minerals price indexes1 (annual average) | * Lithium and other battery minerals prices fell in 2019 because of slowing electric vehicle demand in China and an oversupply of battery minerals.
* Lithium hydroxide prices fell 44% to US$10,559 a tonne in 2019. Western Australia will begin exporting lithium hydroxide when Tianqi Lithium commissions the first stage of its Kwinana plant.
* In 2019, the annual average price of:
	+ Lithium concentrate (spodumene) fell 18% to US$580/t.
	+ Cobalt fell 59% to US$31,463/t.
	+ Nickel rose 6% to US$13,914/t.
	+ Copper fell 8% to US$6,010/t.
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| 1 Prices in nominal US dollars a tonne (price index reference year is 2008-09 = 100.0). (a) Western Australia’s unit prices of spodumene concentrate sales converted to US dollars using annual average exchange rates. (b) Minimum 99.80% purity. (c) Minimum 99.80% purity, cathodes. (d) Minimum 99.9935% purity, cathodes and wire bar.Source: World Bank, Commodity Markets; and Western Australia Department of Mines, Industry Regulation and Safety, Resource Data Files. |

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| **WESTERN AUSTRALIA’S COMPETITIVENESS** |

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| Estimated1 battery minerals reserves: 2019 | * 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 31% to $443 million in 2019-20.
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| **Commodity** | **Unit** | **WA** | **Aust.** | **World** | **WA share of world** |
| Nickel | Mt | 19.0 | 20.0 | 89 | 21% |
| Cobalt | Mt | 1.1 | 1.2 | 7 | 16% |
| Lithium | Mt | 2.7 | 2.8 | 17 | 16% |
| Vanadium | Kt | 2.7 | 4.0 | 22 | 12% |
| Manganese | Mt | 36.0 | 100.0 | 810 | 4% |
| Rare earths | Mt | 2.3 | 3.3 | 120 | 2% |
| Copper | Mt | 5.2 | 87.0 | 870 | 1% |
| Graphite | Mt | 1.3 | 7.1 | 300 | 0.4% |

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| 1 Estimated from Australia’s battery minerals reserves. Source: US Geological Survey, Mineral Commodity Summaries; and Geoscience Australia. |

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| Total cash cost1 of seaborne lithium producers: 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).
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| 1 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. |

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| Battery minerals1 export markets (selected) | * Around 55% of Western Australia’s battery minerals exports went to China in 2019, with the value of exports up 7% to $4.1 billion.
* In 2019, Western Australia’s battery minerals exports to:
	+ Japan fell 11% to $655 million.
	+ Europe rose from $307 million to $491 million.
	+ South Korea rose from $197 million to $474 million.
	+ India fell 3% to $155 million.
	+ United States rose from $61 million to $232 million.
* While battery minerals have many uses, Western Australia’s lithium, cobalt and nickel exports are now largely used in battery manufacturing. New processing investment in Western Australia will result in more battery minerals exported specifically for battery manufacturing.
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| 1 Includes copper, lithium, nickel and graphite. Excludes rare earths, cobalt and vanadium, and manganese from 2015. (a) Includes the larger European markets for Western Australia’s nickel exports only.Source: ABS 5368.0 International Trade in Goods and Services, and Western Australia Department of Mines, Industry Regulation and Safety, Resource Data Files. |

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| **CONTRIBUTION TO WESTERN AUSTRALIA’S ECONOMY** |

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| Battery minerals sales | * Battery minerals accounted for 4% of the value of Western Australia’s minerals and petroleum sales in 2019.
* The value of Western Australia’s battery minerals sales fell 0.4% to $6.8 billion in 2019.
* In 2019, the value of sales for:
	+ Lithium (spodumene) fell 16% to $1.3 billion.
	+ Nickel rose 19% to $3.1 billion.
	+ Copper rose 5% to $1.4 billion.
	+ Other battery minerals fell 25% to $1 billion.
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| (a) Includes cobalt, manganese, vanadium and rare earths (and other minerals). (b) Excludes vanadium, rare earths and graphite.Source: Western Australia Department of Mines, Industry Regulation and Safety, Resource Data Files. |

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| Battery minerals royalties | * Battery minerals accounted for 3% of Western Australia’s royalty revenue1 in 2019.
* Battery minerals royalty revenue fell 2% to $267 million in 2019**.**
* In 2019, royalty revenue from:
	+ Lithium fell 8% to $82 million.
	+ Copper fell 3% to $74 million.
	+ Nickel rose 10% to $73 million.
	+ Other battery minerals fell 5% to $38 million.
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| 1 Includes North West Shelf Grants. (a) Includes lead and zinc. (b) Includes rare earths, manganese, cobalt, vanadium and graphite.Source: Western Australian Department of Mines, Industry Regulation and Safety, Resource Data Files. |

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| Direct battery minerals industry employment1 | * Battery minerals accounted for 14% of direct employment in Western Australia’s minerals mining industry in 2019 (excluding exploration) on a full-time equivalent basis.
* Direct employment in Western Australia’s battery minerals industry rose 9% to 14,322 in 2019.
* In 2019, direct employment in the industry of:
	+ Nickel rose 24% to 7,097.
	+ Lithium fell 8% to 4,151.
	+ Copper rose 5% to 2,285.
	+ Manganese rose 9% to 509.
	+ Rare earths fell 14% to 274.
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| 1 Full-time equivalent. (a) Includes cobalt. (b) Includes tin and tantalum. (c) Includes lead and zinc. (d) Excludes graphite.Source: Western Australian Department of Mines, Industry Regulation and Safety, Resource Data Files. |

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| **CONTRIBUTION TO WESTERN AUSTRALIA’S ECONOMY** |

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| * Western Australia’s Greenbushes mine has produced lithium since 1983 when it was mainly used in glass and ceramics manufacturing. More recently, the mine has expanded production and other lithium mines were developed to meet the growing demand from lithium-ion battery manufacturers. Lithium-ion batteries are used in consumer electronics, clean energy storage and electric vehicles.
* Western Australia exports lithium as spodumene concentrate for further processing, mainly in China. Western Australia will start exporting lithium hydroxide when Tianqi Lithium commissions the first stage of its Kwinana plant. The COVID‑19 pandemic has led Tianqi Lithium to postpone commissioning the first stage of its Kwinana plant to 2021. Tianqi Lithium stopped building the second stage of the plant in September 2019 to focus on commissioning the first stage. Associated expansions of the Greenbushes mine were placed on hold prior to the COVID-19 pandemic due to market conditions. Albemarle has also slowed construction on its lithium hydroxide plant at Kemerton.
* New investment in lithium projects will be reliant on a recovery in Chinese demand, which had weakened significantly pre-COVID-19. This resulted in Alita Resources’ Bald Hill mine entering care and maintenance and reduced production across other mines.
* Northern Minerals has temporarily ceased operation at its Browns Range pilot plant. Other major battery mineral companies continue to operate during the COVID‑19 pandemic and have implemented measures to reduce the risk of infecting workers, their families and local communities, and adhere to border closures and quarantine requirements on fly-in fly-out workers.
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| Major battery minerals projects1 |
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| **Operator** | **Project** | **Primary commodity** | **Region** | **Capex ($m)** | **Capacity (ktpa)** | **Start-up** |
| **Operating2** |
| ***Lithium*** |  |  |  |  |  |  |
| Talison Lithium^ | Greenbushes mine (includes CGP1-2) | Lithium concentrate | South West | n.a. | 1,340 | 1983 |
| Galaxy Resources | Mt Cattlin mine | Lithium concentrate | Goldfields-Esperance | 250 | 180 | 2016 |
| Mineral Resources | Mt Marion mine | Lithium concentrate | Goldfields-Esperance | 300 | 450 | 2016 |
| Mineral Resources | Wodgina mine [care and maintenance] | Lithium concentrate | Pilbara | 610 | 750 | 2017 |
| Pilbara Minerals | Pilgangoora mine (stage 1) | Lithium concentrate | Pilbara | 274 | 320 | 2018 |
| Altura Mining | Pilgangoora mine (stage 1) | Lithium concentrate | Pilbara | 140 | 220 | 2018 |
| Alita Resources | Bald Hill [care and maintenance] | Lithium concentrate | Goldfields-Esperance | 42 | 155 | 2018 |
| ***Nickel, cobalt*** |  |  |  |  |  |  |
| BHP | Nickel West mines and plants | Nickel concentrate and other\* | Goldfields-Esperance | n.a. | 100 | 1967 |
| Glencore | Murrin Murrin mine and plant | Nickel briquettes, powder\* | Goldfields-Esperance | 2,500 | 45 | 1999 |
| Western Areas | Forrestania mines and plant | Nickel concentrate | Goldfields-Esperance | 387 | 25 | 2006 |
| IGO | Nova-Bollinger mine and plant | Nickel concentrate#\* | Goldfields-Esperance | 443 | 30 | 2016 |
| ***Other*** |  |  |  |  |  |  |
| Sandfire Resources | DeGrussa mine | Copper concentrate | Mid West | 409 | 77 | 2012 |
| Lynas | Mt Weld mine and plant | Rare earth oxide | Goldfields-Esperance | 170 | 27 | 2013 |
| Consolidated Minerals | Woodie Woodie mine (restart) | Manganese ore | Pilbara | 30 | 1,500 | 2017 |
| Northern Minerals | Browns Range pilot plant [care and maintenance] | Rare earths | Kimberley | 89 | 0.05 | 2018 |
| **Under construction or committed** |
| ***Lithium*** |  |  |  |  |  |  |
| Tianqi Lithium | Kwinana plant (train 1) | Lithium hydroxide | Perth | 400 | 24 | 2021 |
| Albemarle | Kemerton plant (trains 1-2) | Lithium hydroxide | South West | 500 | 50 | 2022 |
| Tianqi Lithium | Kwinana plant (train 2) [on hold] | Lithium hydroxide | Perth | 300 | 24 | 2023 |
| Talison Lithium^ | Greenbushes mine expansion (CGP3, debottlenecking & tailings retreatment plant) [on hold except for tailings plant] | Lithium concentrate | South West | 516 | 608 | 2024 |
| Talison Lithium^ | Greenbushes mine expansion (CGP4) [on hold] | Lithium concentrate | South West | 250 | 520 | 2026 |
| ***Nickel, cobalt*** |  |  |  |  |  |  |
| BHP | Nickel West/Kwinana plant expansion (stage 1) | Nickel Sulphate\* | Perth | 60 | 100 | 2020 |
| BHP | Nickel West/Leinster (B11) mine expansion | Nickel ore | Goldfields-Esperance | 190 | 600-1,000 | 2020 |
| Western Areas | Cosmos/Odysseus mine (stage 2) | Nickel concentrate | Goldfields-Esperance | 300 | 13-15 | 2022 |
| Panoramic Resources | Savannah mine restart | Nickel concentrate#\* | Kimberley | 90 | 11 | n.a. |
| ***Other*** |  |  |  |  |  |  |
| Lynas | Kalgoorlie Processing Plant | Rare earths (Neodymium, Praseodymium) | Goldfields-Esperance | 500 | 11 | 2023 |

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| Note – Spodumene concentrate produced from the Greenbushes mine contains around 5% to 7.5% lithium. CGP = Chemical Grade Plant. n.a. – not available or not applicable. ^ Tianqi Lithium and Albemarle Joint Venture. \* Produces cobalt. # Produces copper. 1 Major projects that produce battery minerals as a primary commodity (excludes projects that produce battery minerals as a by-product only, such as copper produced at the Boddington, Telfer and Deflector gold mines). 2 Includes the largest producing projects and projects recently placed under care and maintenance.Source: S&P Global Market Intelligence; and company announcements, reports and presentations. |