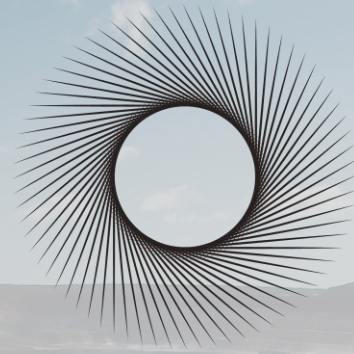


# **A Critical Juncture:** *Australia's Opportunities and Challenges in Nickel*

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MANDALA

Prepared by Mandala and commissioned by The Chamber  
of Minerals and Energy of Western Australia

**Final report – February 2024**



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Mandala is a research firm with offices in Melbourne, Canberra, Sydney and Brisbane. Mandala specialises in combining cutting-edge data and advanced analytical techniques to generate new insights and fresh perspectives on the challenges facing businesses and government.

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# Australian nickel has significant opportunities, however strong headwinds are placing its future viability at risk

## Australia is well placed to capture growing opportunities in nickel...



### +9% demand growth

forecasted annually for nickel up to 2030 due to demand for EVs<sup>1</sup> and ESS<sup>2</sup>



### 18% of global reserves

of nickel are currently situated in Australia



### 6x fewer emissions

are produced from refining Australian nickel relative to other countries, including Indonesia, China and Brazil

## ...however, strong headwinds are impacting the industry...



### -51% decline in prices

since 2022 as nickel supply has significantly increased due to Indonesia



### 28% cost disadvantage

that Australian nickel producers are facing relative to Indonesian producers



### 5 nickel mines closed

since September 2023, taking 33% of domestic production offline, with another 31% of production at risk

## ...putting the future viability of Australia's nickel industry at risk



### 10,000 jobs

supported by Australia's nickel industry, 99% of which are in WA



### \$1.8 billion

of direct economic activity is generated from Australia's nickel industry



### Battery future at risk

with the loss of a domestic nickel industry threatening Australia's battery ambitions, and the economic payoff and resilience these ambitions promise

<sup>1</sup> Electric vehicles.

<sup>2</sup> Energy storage system.

Source: Mandala analysis.

# Executive summary

## **The energy transition offers significant opportunities for Western Australia's resources industry and minerals exports such as nickel.**

The significance of Western Australia's minerals and energy resources has underpinned Australia's strong economic growth with important effects on job creation, infrastructure investment and government revenue

However, as the world accelerates efforts aimed at electrification and moves away from fossil fuels, Western Australia and Australia will need to capture growing opportunities in battery minerals, such as nickel, lithium, and cobalt. Batteries are pivotal in the worldwide shift towards sustainable energy and are now essential for nations striving to meet their decarbonisation goals.

Battery demand is expected to increase by 24 per cent annually over the coming decade as consumers switch to electric vehicles and energy storage system requirements increase. This surge in demand for batteries will drive the need for battery minerals.

This includes nickel, a key input in four out of five batteries today, and is expected to be in nine out of ten batteries by 2030 due to its chemical properties. Australia, and Western Australia in particular, is positioned to play an important role in the global battery value chain. Australia holds 18 per cent of global nickel reserves while also having (1) strong ESG practices and (2) global policy tailwinds. Australia's strong ESG practices can cater to the rising demand for low-carbon, environmentally sustainable minerals. Australia nickel is six times less emissions intensive relative to Indonesian and Chinese nickel. There are global policy tailwinds that may favour Australian nickel in the

medium-term. In 2022, Australian nickel was made eligible for battery and electric vehicle manufacturing subsidies under the United States' Inflation Reduction Act.

More recently, Australia was added as a 'domestic' source of critical minerals under the United States' Defence Production Act, which will encourage investment in Australian nickel. Australian nickel will also benefit from carbon tariffs, such as the European Union's Carbon Border Adjustment Mechanism, due to its lower emissions profile relative to Indonesian and Chinese nickel.

## **The Western Australian nickel industry is facing strong headwinds, and its future viability is at risk.**

The global nickel industry has undergone rapid transformation in recent years, marked by a sharp 51 per cent decline in prices since 2022.

Today, Indonesia accounts for nearly half (49 per cent) of global nickel production, while Australia only accounts for 5 per cent. Recent investments from China have enabled Indonesia to produce significantly cheaper nickel at scale from laterite deposits, placing Australia at a 28 per cent cost disadvantage. The rapid increase in cheap Indonesian nickel has coincided with lower-than-expected demand for battery minerals due to global electric vehicle sales falling 3 per cent short of forecasts in 2023. Western Australian nickel producers are also facing growing cost pressures. This is primarily in the form of higher labour costs, which account for a significant portion of overall production costs.

Consequently, five Western Australian nickel producers, constituting 33 per cent of annual domestic production, have announced closures, with many other producers at risk.

Western Australia is the already the world's largest supplier of lithium, is a global top 5 producer of class 1 nickel and hosts almost all the minerals on Australia's critical minerals list. It also hosts many of the minerals on the critical minerals lists of the world's manufacturing economies, together with other commodities that will support the energy transition.

## **The nickel industry is strategically vital in supporting Australia's sovereign capability, economic resilience, and resource security.**

The nickel industry is an important source of employment for Australians. The decline of Western Australia's nickel industry puts nearly 10,000 jobs at risk. Recent announced closures at Savannah, Ravensthorpe, Flying Fox, Kambalda and Odysseus have already created some job losses. Further closures will compromise our sovereign capabilities in nickel processing and threaten future opportunities through the loss of highly specialised skills. The loss of Australia's nickel industry would directly impact \$1.8 billion of annual economic activity. This would also impact the nickel industry's supply chain, reducing demand for intermediate goods and services used in nickel mining and processing, as well as affecting other vital sectors, such as construction and manufacturing, which rely on nickel as a critical input. With ambitions of building a domestic battery manufacturing sector, the nickel industry is of strategic importance to Australia.

Nickel is a key material required in battery manufacturing, specifically cathode and cell production. Without a domestic nickel industry, Australia will miss out on significant opportunities in the global battery value chain. Recent studies have estimated these opportunities could be worth up to \$17 billion in economic activity and 61,400 jobs for Australia.<sup>1</sup>

<sup>1</sup> Accenture (2023) *Charging Ahead: Australia's battery powered future.*

**1** The energy transition offers significant opportunities for Western Australia's resources industry and minerals exports such as nickel

**2** The Western Australian nickel industry is facing strong headwinds, and its future viability is at risk.

Appendix



# While iron ore and coal exports have been key drivers of Australia's economic growth, critical and battery minerals represent a significant opportunity

**Exhibit 1: Current value of Australian exports of selected minerals versus future growth of global market size**

Y-axis: Current value of Australian exports (\$AU millions), 2022-23; X-axis: Future global growth<sup>1</sup> (CAGR %), 2022 – 2030



Note: Selected minerals are based on the minerals with the highest mined exports in Australia (excluding uranium).

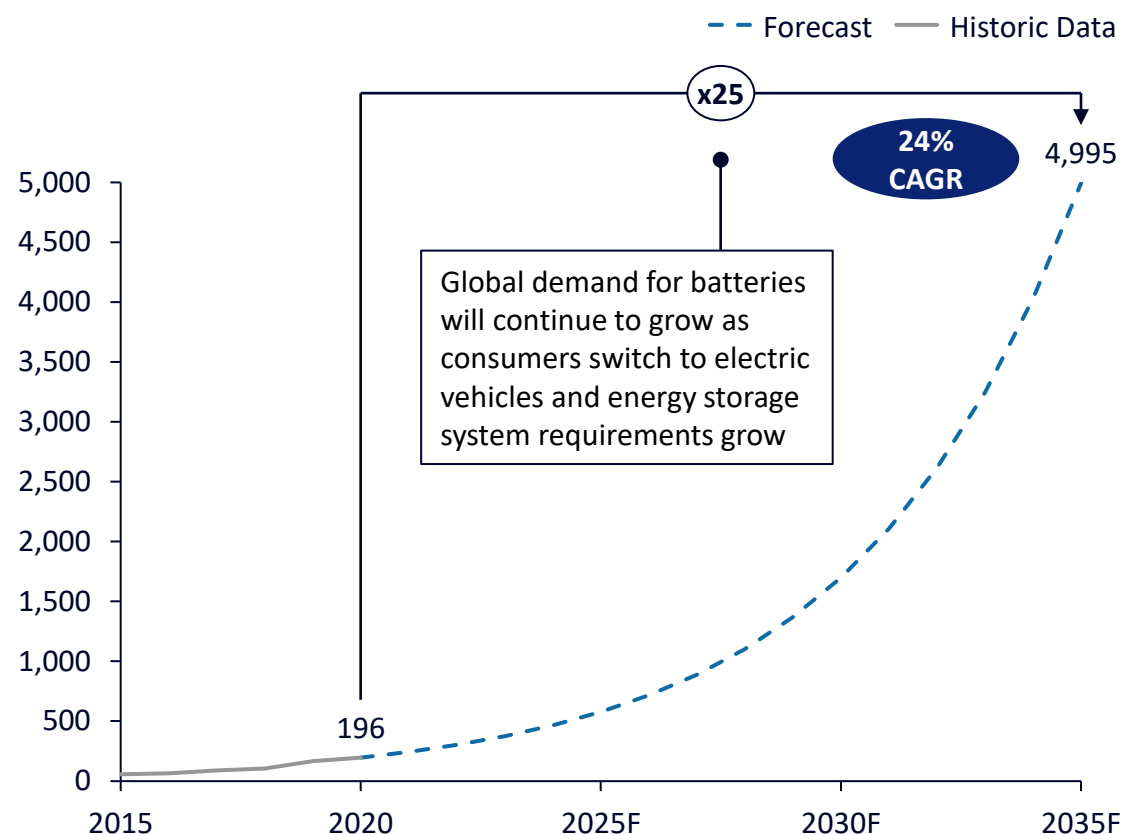
<sup>1</sup> Future growth is based on the volume of global demand between 2022 and 2030.

Source: IEA (2023) *Critical Minerals Demand Dataset*; DISR (2023) *Resources and energy quarterly: December 2023*; International Aluminium (2022) *Opportunities For Aluminium In A Post-Covid Economy*; Wood Mackenzie (2023), (2021); Minerals Council of Australia (2022); European Commission (2023) *2023 Foresight report on raw materials and strategic supply chains Commodity Outlook 2030*; Geoscience Australia (2023) *Critical minerals at Geoscience Australia*; Mandala analysis.

# As a key mineral in batteries, demand for nickel will continue to increase with global battery demand forecasted to grow exponentially

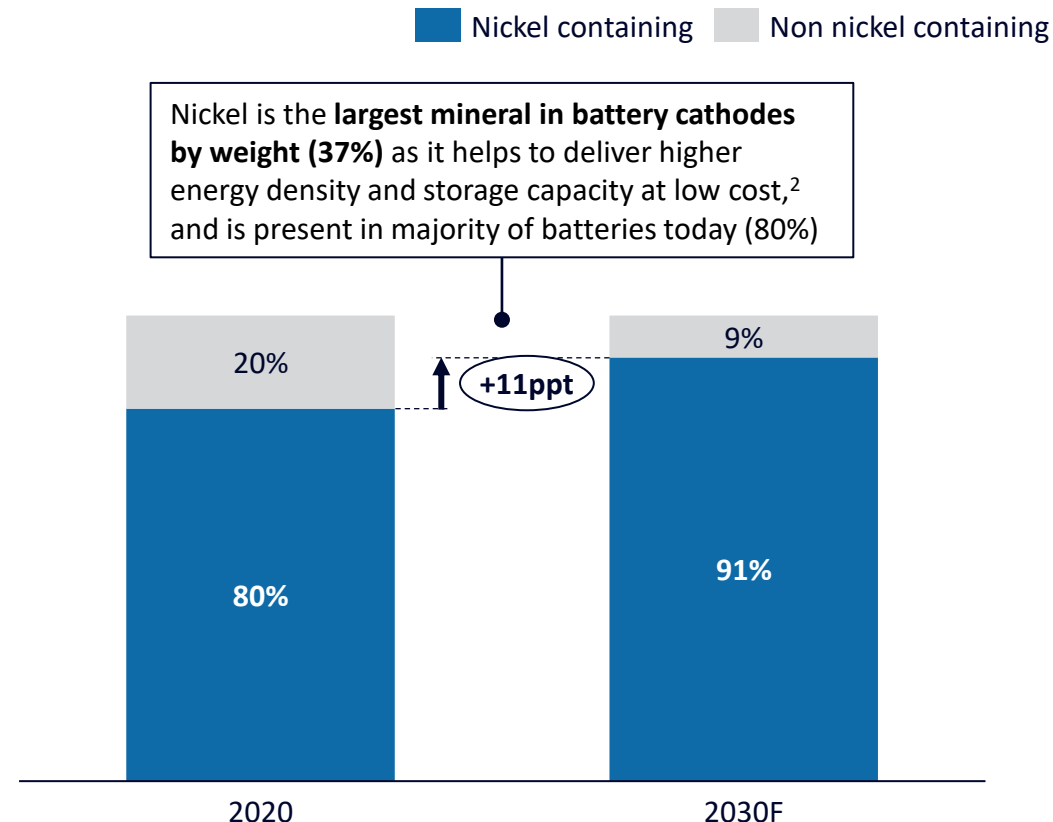
**Exhibit 2: Global battery demand**

Gigawatt hour (GWh), 2015 – 2035F



**Exhibit 3: Use of nickel in lithium-ion batteries<sup>1</sup>**

% of lithium-ion battery sector, 2020 – 2030F



<sup>1</sup> Nickel containing batteries were defined as lithium-ion batteries with the following cathodes: NCA, NMC111, NMC532, NMC622, NMC811, LMNO. Non-nickel containing batteries were defined as lithium-ion batteries with the following cathodes: LFP, LMO.

Source: Accenture (2023) Charging Ahead: Australia's battery powered future; Benchmark Minerals (2023) Australia looks to boost domestic mineral processing industry with \$676 million fund; BloombergNEF (2022) Electric Vehicle Outlook 2022; McKinsey (2022) Lithium mining: How now production technologies could fuel the global EV revolution; IEA (2022) Annual EV battery demand projections; IEA (2023); Mandala analysis.

# Australia is positioned to be a key nickel player, given it holds 18% of global reserves, has leading ESG practices and faces global policy tailwinds in the medium term

Exhibit 4: Global reserves of nickel

% of total known nickel deposits by weight, 2023

Lower % of global reserves  Higher % of global reserves

1 ESG practices

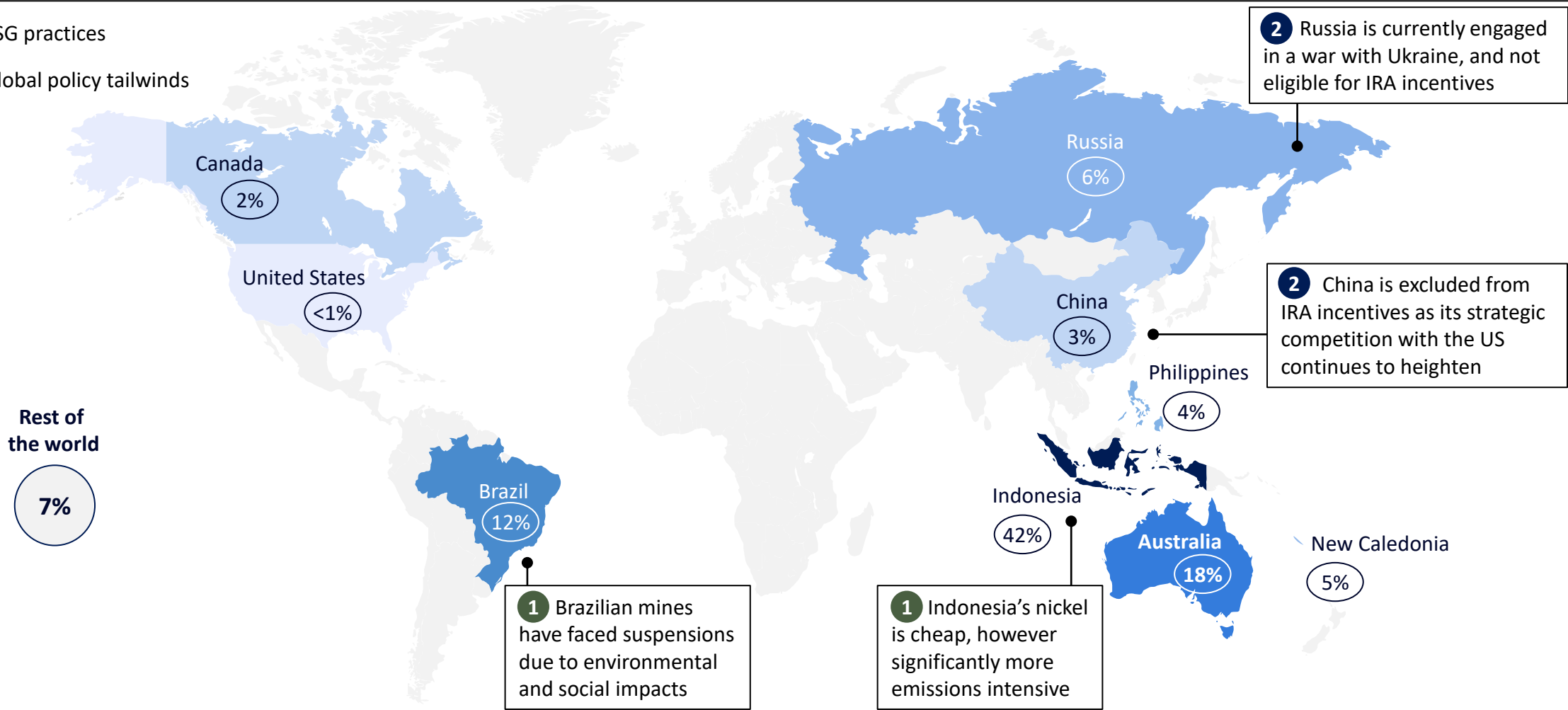
2 Global policy tailwinds

2 Russia is currently engaged in a war with Ukraine, and not eligible for IRA incentives

2 China is excluded from IRA incentives as its strategic competition with the US continues to heighten

1 Brazilian mines have faced suspensions due to environmental and social impacts

1 Indonesia's nickel is cheap, however significantly more emissions intensive



Source: USGS (2024) *Nickel Statistics and Information*; Geoscience Australia (2023) *Nickel*; Business & Human Rights Resource Centre (2021); Mandala analysis.



# Australia's nickel can cater to growing demand for low-carbon and environmentally sustainable minerals

Australia's natural ore deposits can create battery grade nickel with significantly lower emissions than competitor countries.

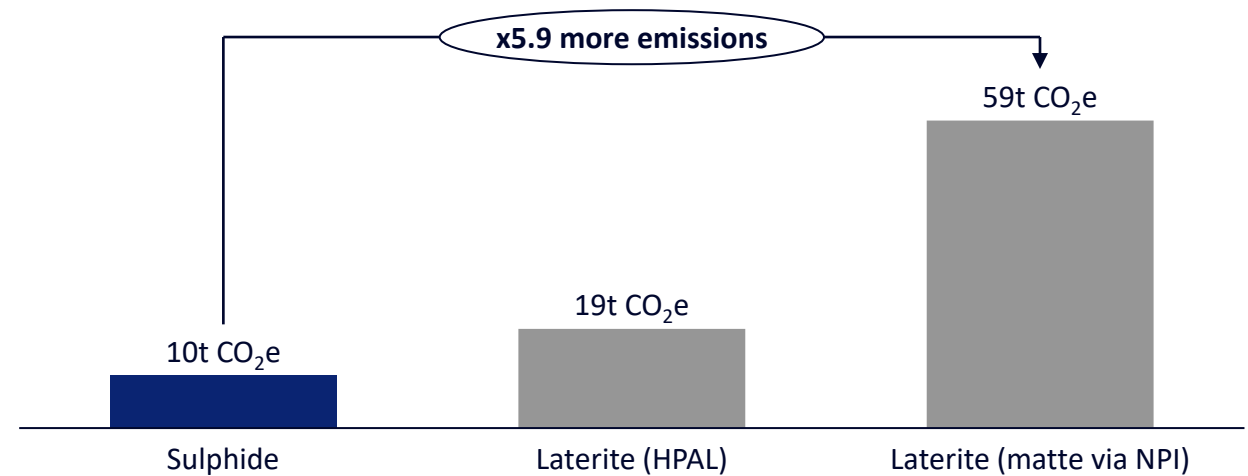
Most of the mined nickel occurs in one of two types of ore deposits: laterites and sulphides. Laterites represent 60 per cent of known reserves and are typically mined in Indonesia, Brazil, New Caledonia and China. Sulphides represent the remaining 40 per cent of known reserves and are typically mined in Australia, Canada, Russia and the United States.

Battery grade nickel can be refined from either laterite or sulphide deposits, however nickel refined from laterite is six times more carbon intensive. Nickel refined from laterite can be done in one of two ways: (1) through high pressure acid leaching (HPAL); or (2) converting nickel pig iron (NPI) to matte. HPAL is typically used in the Philippines, Brazil, New Caledonia, while matte via NPI was pioneered by Chinese firms in Indonesia in recent years.

## 1 ESG practices

**Exhibit 5: Emissions required to produce one tonne of battery grade nickel by deposit type and method**

*Tonnes of CO<sub>2</sub> (equivalent) per tonne of nickel*



### Description

- Deposits are formed through the crystallisation of magma flows.
- They are extracted through crushing, chemical processing and smelting.
- Deposits are typically located in the tropics, near the surface and formed by weathering. It is typically refined using HPAL which utilises sulphuric acid at high pressure and temperatures.
- Recently, large Chinese and Indonesian producers have utilised high temperature furnaces to produce refined nickel matte from unrefined nickel pig iron at significantly cheaper costs.

### Countries with deposits



# There are global policy tailwinds that Australian nickel will likely enjoy in the medium-term

Australia is strategically positioned to emerge as a significant player in the global nickel industry. Alongside its strong ESG practices, Australian nickel stands to benefit in the medium-term from strong global policy tailwinds. This includes the US' Defence Production Act (DPA), the US' Inflation Reduction Act, and potential Carbon Border Adjustment Mechanisms (CBAMs) to be introduced in various regions, such as the European Union (EU).

In 2022, Australia, being an FTA country with the US, became a beneficiary of the US' Inflation Reduction Act (IRA). The IRA is expected to increase demand for Australian nickel due to the Clean Vehicle Credit and the Advanced Manufacturing Production Tax Credit (*see page 11 for more detail*).

More recently, Australia was added as a domestic source within the meaning of the US' Defence Protection Act. This is anticipated to increase US investment in the production and purchase of Australian critical minerals, including nickel.

While there is currently no distinct market for 'green' nickel, global policies, such as CBAMs, will help to forge them. For example, the European Union's CBAM will take effect from 2026, which will add a tariff of U\$4,165 per tonne to Indonesia nickel. This will likely help create demand for Australian nickel in the medium-term.

## 2 Global policy tailwinds

Exhibit 6: Policy settings of countries with largest nickel reserves

Country	Nickel reserves <i>Millions of tonnes, 2023</i>	IRA eligibility <sup>1</sup>	DPA eligibility <sup>2</sup>
 Indonesia	55	✗	✗
 Australia <sup>1</sup>	24	✓	✓
 Brazil	16	✗	✗
 Russia	8	✗	✗
 New Caledonia (France)	7	✗	✗
 Philippines	5	✗	✗
 China	4	✗	✗
 Canada <sup>1</sup>	2	✓	✓
 United States <sup>1</sup>	0.4	✓	✓

<sup>1</sup> Eligibility is based on whether the country has a Free Trade Agreement with the US.

<sup>2</sup> Eligibility is based on whether the country is classified as a 'domestic source' under the Defence Protection Act.

Note: This survey occurred prior to the invasion of Ukraine by Russia and the sanctions that followed.

Source: USGS (2024) *Nickel Statistics and Information*; Geoscience Australia (2023) *Nickel*; Fraser Institute (2021) *Annual Survey of Mining Companies*; Mandala analysis.

# While aspects of the US' IRA may increase demand for Australian nickel, it undercuts our downstream industry

While there is some uncertainty over its longevity due to the upcoming US election, the IRA presents a significant opportunity for Australia's nickel industry, with demand expected to pick up in the medium term.

Since its introduction in 2022, the IRA has spurred a surge in investments in US clean energy technologies. With the US battery sector currently in a construction phase, demand for Australian nickel, which is eligible for IRA subsidies, is expected to increase as the US battery sector moves into a production phase.

The IRA introduces two key measures benefiting Australia's nickel industry: the Clean Vehicle Credit and the Advanced Manufacturing Product Tax Credit. These measures incentivise sourcing critical minerals from the US or FTA partners like Australia. Effectively, the IRA is likely to increase demand for upstream nickel products from Australia.

However, the IRA also puts at risk Australia's downstream processing opportunities due to the lower costs of processing in the US.

## 2 Global policy tailwinds

Exhibit 7: The IRA's Clean Vehicle Credit and AMPTC will likely stimulate demand for the Australian nickel industry, while also putting at risk our downstream processing opportunities



### Clean Vehicle Credit

- The IRA introduced a Clean Vehicle Credit of up to \$7,500 to promote the shift to electric vehicles. To qualify, the electric vehicle batteries must meet certain requirements related to the sourcing of critical minerals and the manufacturing of components.
- For critical minerals, at least 40% must come from the U.S. or its free trade partners, or be recycled in North America, with this requirement increasing to 80% by 2027. These escalating baselines aim to stimulate domestic production and processing, supporting energy transition goals and the U.S. economy.



### Advanced Manufacturing Production Tax Credit

- The IRA introduced the Advanced Manufacturing Production Credit to boost domestic production of critical minerals and components used in renewable energy and associated manufacturing.
- This tax credit amounts to 10% of the production cost for a defined list of critical minerals, including lithium, nickel, vanadium and rare earths.
- The provision for the critical mineral production credit takes effect in 2023 and notably, it is not subject to the phaseout scheduled for other components starting in 2030, signaling a long-term commitment to fostering domestic mineral production in the US.



This is **beneficial for Australia's nickel mining industry** as a supplier of minerals that meet the sourcing requirements.



This is also a **negative for Australia's nickel processing industry** as it undercuts our domestic downstream processing industry.

1 The energy transition offers significant opportunities for Western Australia's resources industry and minerals exports such as nickel

2 **The Western Australian nickel industry is facing strong headwinds, and its future viability is at risk.**

Appendix



# Volatile market conditions are disrupting the Western Australian nickel industry, threatening future opportunities

Exhibit 8: Changing market conditions in the nickel industry are creating significant volatility for Australian producers



## Indonesia is producing cheap nickel that is driving down global prices

- Indonesia has developed a new technology that enables them to process nickel laterite at a significantly cheaper cost, making Australian nickel 28 per cent more expensive to produce
- Australia has a stricter regulatory approval process for developing new mines than Indonesia, which has attracted significant investment to grow production capacity
- Indonesia is by far the world's largest nickel producer and increased production by 54 per cent between 2021 and 2022



## Lower than anticipated EV sales has lowered prices for battery minerals temporarily

- While demand for electric vehicles has increased substantially over the past few years, recent sales have fallen short of market forecasts
- The recent slowing in demand for electric vehicles in 2023 was driven by rising interest rates and China's slow recovery post COVID-19
- Lower-than-expected sales have reduced demand for battery minerals. However, global electric vehicles sales are forecasted to increase nearly three-fold by 2030, which will reignite the demand for battery minerals in the future



## Growing production costs are creating pressures for Australian nickel producers

- While global nickel prices have been falling, production costs for Australian producers have increased 49% since 2019
- Rising wages in mining have been a key driver of growing cost pressures, constituting almost 40 per cent of production costs today
- Today, many Australian nickel producers are facing these growing pressures, with five Western Australian mines announcing closures as of January 2024, with others still at risk

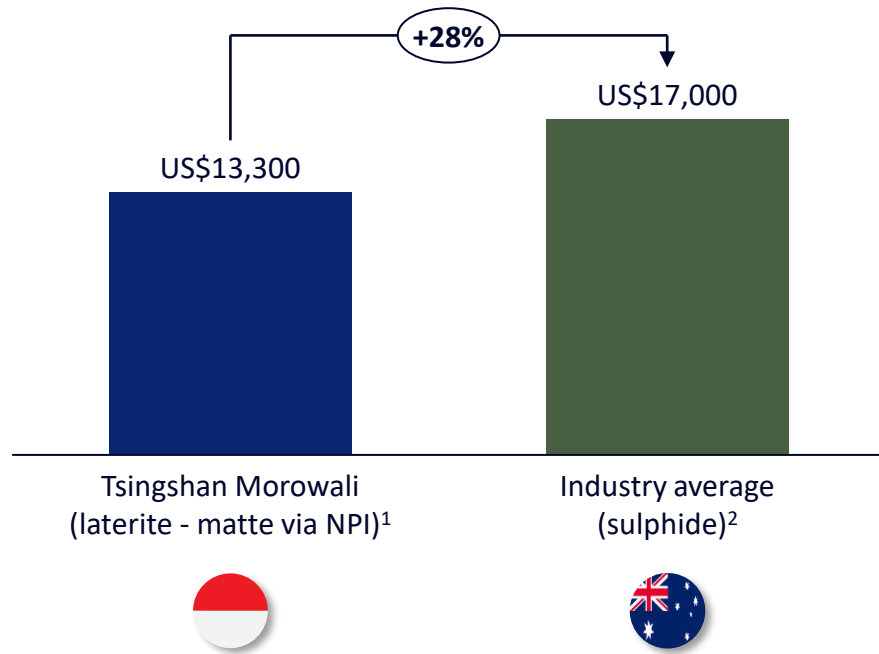
- These conditions are placing the future of Australia's nickel industry and opportunities in the global battery value chain at risk, with five Australian nickel producers announcing mine closures as of January 2024
- Additionally, there are a range of policy and regulatory measures that are creating challenging conditions for the nickel industry, such as Industrial Relations reform, royalties and approval processes

# Despite Australia's advantages, a new Indonesian approach to nickel production has drastically increased the supply of cheaper nickel

**Exhibit 9: Unit cost of production for nickel by country**

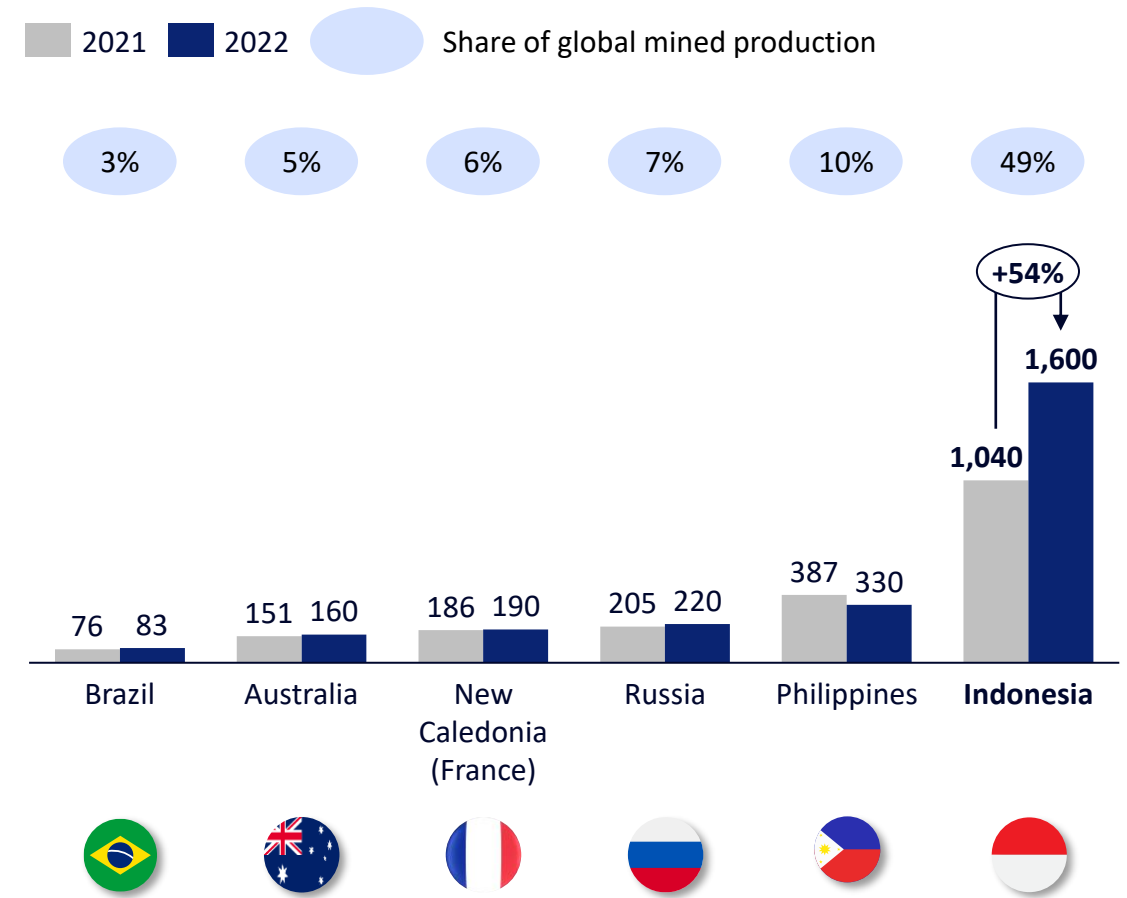
\$US per tonne, 2023

Indonesia's new process for producing nickel has enabled them to operate at a significantly lower cost, facilitated by significant Chinese investment to secure sovereign battery supply chains



**Exhibit 10: Mined nickel production by country**

Kilotonnes, 2021 – 2022



<sup>1</sup> Tsingshan Morowali is Indonesia's largest battery grade nickel producer (as of 2023) and accounts for 23% of Indonesia's total nickel production. Tsingshan Morowali recently deployed a new technology to produce nickel matter via NPI at a very low cost; Wood Mackenzie (2023).

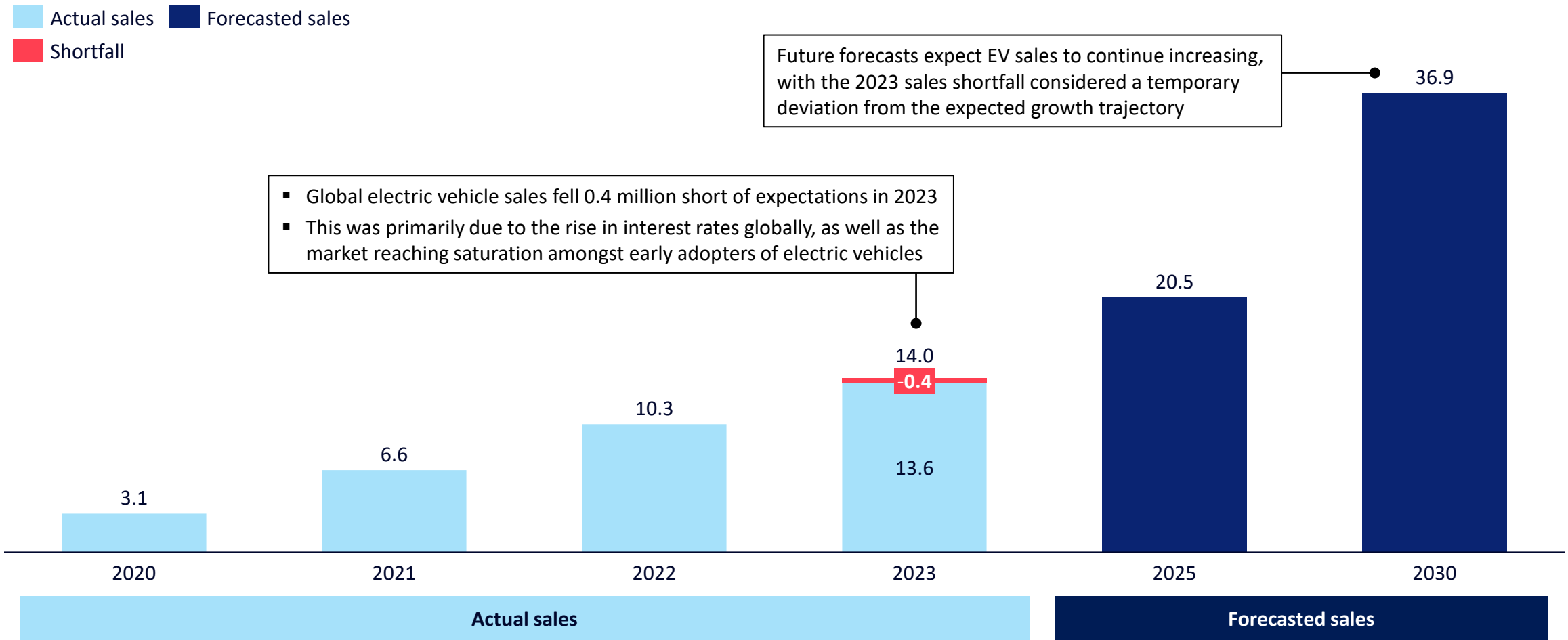
<sup>2</sup> Based on the weighted average cost of production for nickel sulphide for the Australian industry; Wood Mackenzie (2023).

Source: USGS (2023) *Nickel Statistics and Information*; Wood Mackenzie (2023); Mandala analysis.

# This has coincided with lower than forecasted global demand for electric vehicles over the last year, subduing demand for critical minerals

Exhibit 11: Global electric vehicles sales by year

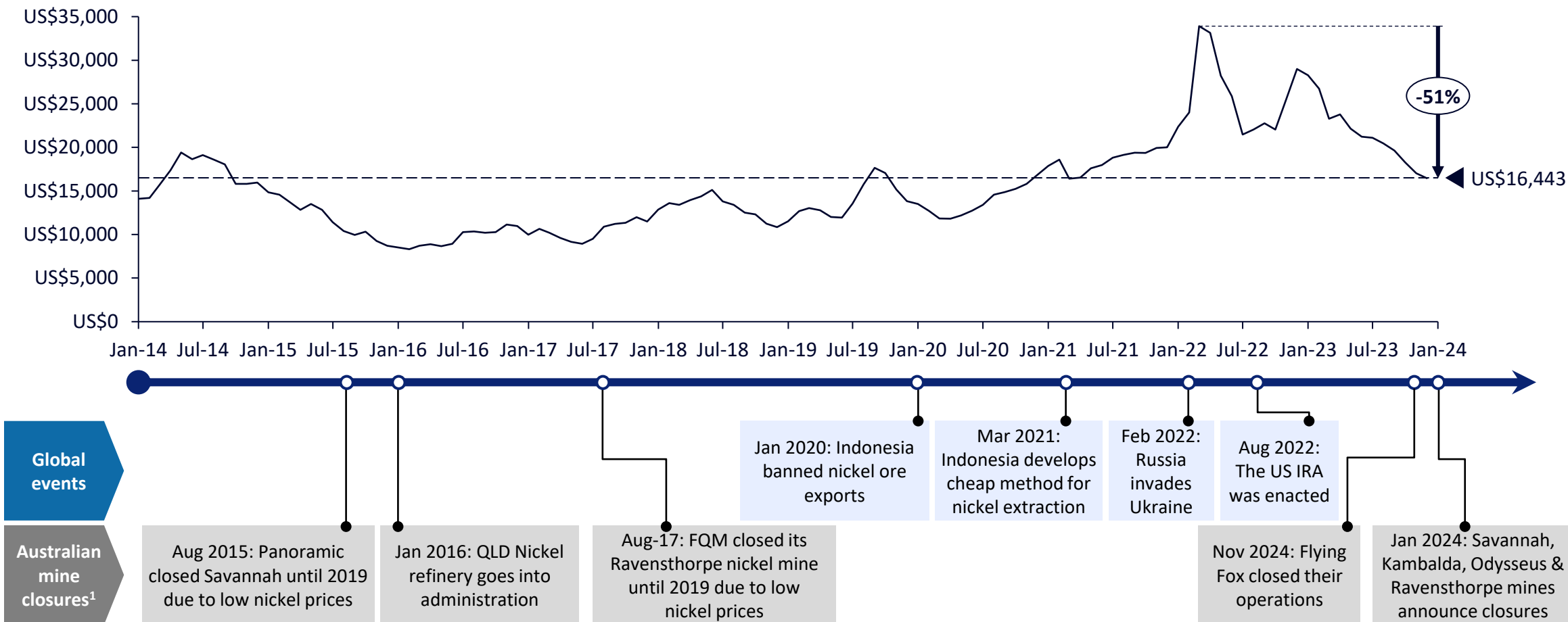
Number of sales, 2020 – 2023



# These market dynamics have driven down nickel prices by 51% from its recent peak in 2022, and has already led to announced closures of five WA producers

Exhibit 12: Global LME nickel spot prices

\$US per tonne, January 2014 – December 2023



<sup>1</sup> Non-exhaustive list of Australian nickel mine closures between January 2014 and January 2024.

Source: Panoramic Resources (2023) *Savannah Nickel-Copper-Cobalt Mine*; IMF (2023) *Primary Commodity Price System*; Desktop research; Mandala analysis.



## Australian nickel producers are facing growing cost pressures, including from higher labour costs

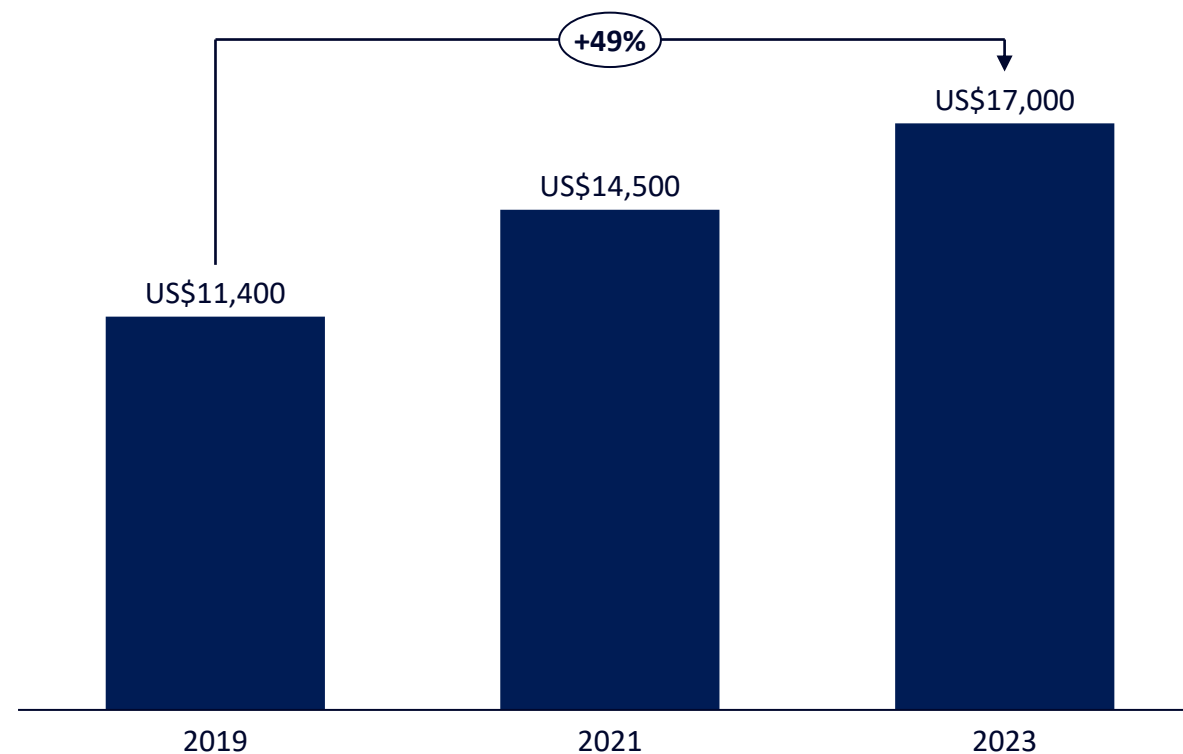
While nickel prices have fallen to levels seen previously in 2019 and 2021, production costs have increased significantly during this time.

Since 2019, the production cost of nickel sulphide mines in Australia have increased by 49 per cent to approximately US\$17,000. This has placed Australian mines at a significant disadvantage to other cost-efficient producers in Indonesia, such as the Tsingshan Morowali nickel laterite mine (see Exhibit 9).

One of the key drivers of higher production costs in Australia is labour costs. Since 2014, mining wages have increased approximately 21 per cent. During this time, labour costs' share of overall production costs has increased from 35 per cent to nearly 40 per cent.<sup>1</sup>

Exhibit 13: Weighted average production cost for Australian nickel sulphide mines

\$US per tonne, 2019 – 2023

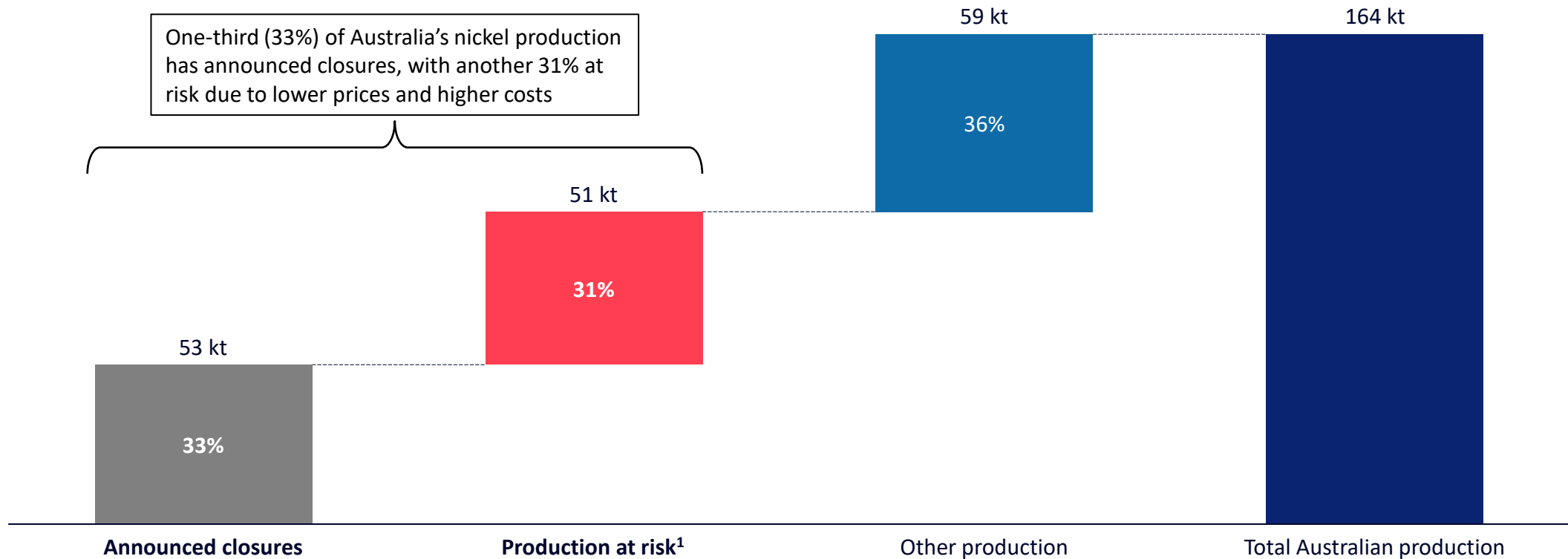


<sup>1</sup> Based on ANZSIC Subdivision 08 Metal Ore Mining; ABS (2023) *Australian Industry*. Source: Wood MacKenzie (2023); ABS (2023) *Australian Industry*; Mandala analysis.

# WA's role as the 5<sup>th</sup> largest global nickel producer is on the line, with nearly two-thirds of production either offline or at risk from lower prices and higher costs

Exhibit 14: Australia's mined nickel production

Thousands of tonnes, 2023



<sup>1</sup> Production at risk is estimated based on the total production capacity of Australian nickel mines that currently have higher production costs relative to Indonesia's Tsingshan Morowali nickel laterite mine; Wood MacKenzie (2023).

Source: Wood MacKenzie (2023); Mandala analysis.

# Further closures in Australia's nickel industry will compromise our future economic prosperity

The nickel industry has a strategically important role to play in Australia's economy and supporting its ambition to become a global leader in renewable energy.

Recent decisions to cease operations of five nickel mines in Australia has put at risk our sovereign nickel processing capabilities. Further closures of nickel mines will have flow on impacts to downstream nickel processing, compromising Australia's opportunities in nickel and other industries, such as battery manufacturing.

As Australia looks to diversify its exports, the domestic nickel industry will have a strategic role in building future economic resilience. With global demand for nickel to grow in the coming years, a domestic nickel industry will attract global investment and move Australia from a 'dig and ship' model into more value-adding downstream activities.

Having access to nickel domestically will enable Australia to support local industries, including infrastructure and battery manufacturing. Without a domestic nickel industry, Australia is also unlikely to unlock downstream opportunities in batteries, specifically cell manufacturing.

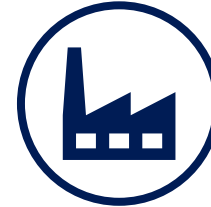
Exhibit 15: The nickel industry has a strategic role in supporting Australia's sovereign capability, future economic resilience and resource security



A

## Sovereign capabilities

- The nickel industry plays a vital role in preserving Australia's sovereign capabilities in downstream nickel processing
- Australia's sovereign nickel processing would take significant time and effort to rebuild, creating barriers to future opportunities



B

## Economic resilience

- Nickel plays a strategically important role in building economic resilience for Australia as it diversifies away from carbon intensive exports, such as coal
- Nickel is also important to attract investment to move away from a 'dig and ship' model and unlock economic opportunities in downstream processing



C

## Resource security

- Resource security, specifically for nickel, is critical for Australia to support its local industries, such as infrastructure and batteries
- Easy access to nickel will ensure Australia can pursue its ambitions in battery manufacturing, and become a global leader in renewable energy

# The decline of Australia's nickel industry puts 10,000 jobs at risk, most of which are in Western Australia

The nickel industry is an important source of employment of Australians. In FY23, the Australian nickel industry directly supported 9,980 workers. This accounts for approximately 11 per cent of employment in Australia's metal ore mining industry.<sup>1</sup> Since FY17, the nickel industry has supported an additional 4,310 jobs (or 76 per cent more jobs).

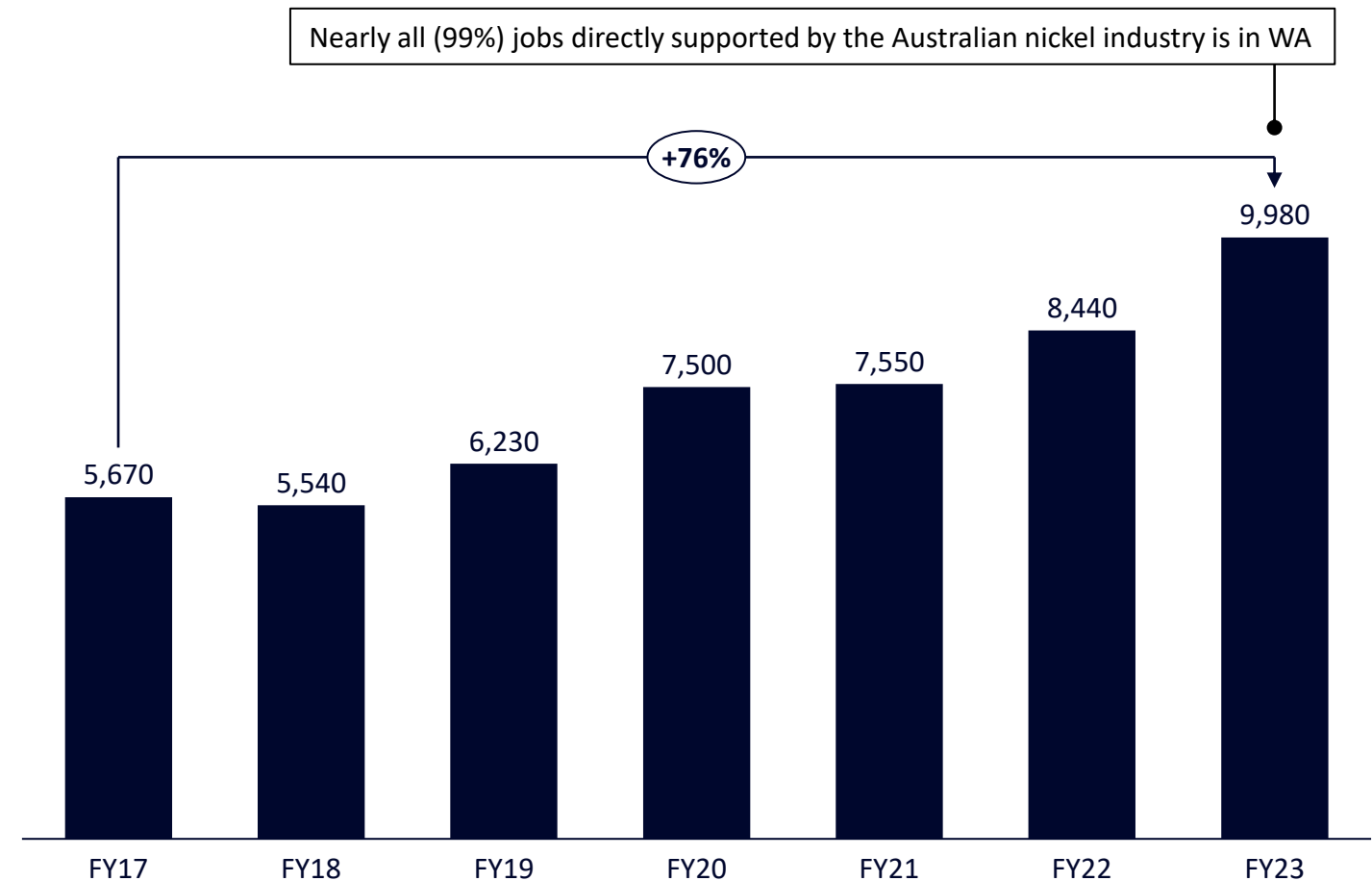
However, recent closure announcements for the Savannah, Ravensthorpe, Flying Fox, Kambalda and Odysseus nickel mines are expected to have an impact on the nickel workforce over the coming months. There are also potential further job losses yet to emerge as other Australian nickel producers struggle to overcome falling prices and growing cost pressures.

These closures compromise Australia's sovereign capabilities in nickel mining and processing, potentially posing challenges for future opportunities in nickel. Abrupt closures in nickel can leave significant workforce scarring. This includes the loss of highly specialised skills such as smelter maintenance and knowledge of complex ore extraction techniques and advanced smelting processes. Restarting operations in the future would require significant investments in retraining, hampering sovereign capability to produce nickel.

## A Sovereign capabilities

### Exhibit 16: Australian jobs supported by nickel mining

Number of full-time employees, FY22



<sup>1</sup> Based on ANZSIC Subdivision '08 Metal Ore Mining'; (2023) *Australian Industry*.

Source: Wood Mackenzie (2023) *Avebury restart nickel operation*; Government of Western Australia – Department of Mines, Industry, Regulation and Safety (2023) *2022-2023 Economic Indicators*; Mandala analysis.

# This also puts at risk \$1.8 billion of economic activity generated each year from Australia's nickel industry

In FY23, nickel mining directly contributed \$1.8 billion of activity to the Australian economy. Majority of this activity was in Western Australia (98 per cent), which is currently the 5<sup>th</sup> largest producer of nickel globally. The remainder of the economic activity is in Tasmania (2 per cent). Further closures will put at risk this activity as well as Western Australia's global position.

This contribution is comparable with the Australian wine, spirits and tobacco industry and is twice the size of the aquaculture industry.<sup>1</sup> Overall, nickel mining represents 0.4 per cent of Western Australia's economic activity, with opportunities to grow over the next decade. This has made Western Australia the 5<sup>th</sup> largest producer of nickel globally.

In recent years, nickel's contribution to economic activity has increased. Between FY17 and FY21, the economic activity of nickel grew by \$0.3 billion to \$1.4 billion. This was driven by moderate increases in nickel prices. The contribution of nickel increased again by \$0.4 billion between FY22 and FY23 to \$1.8 billion, driven once again by significant increases in prices.

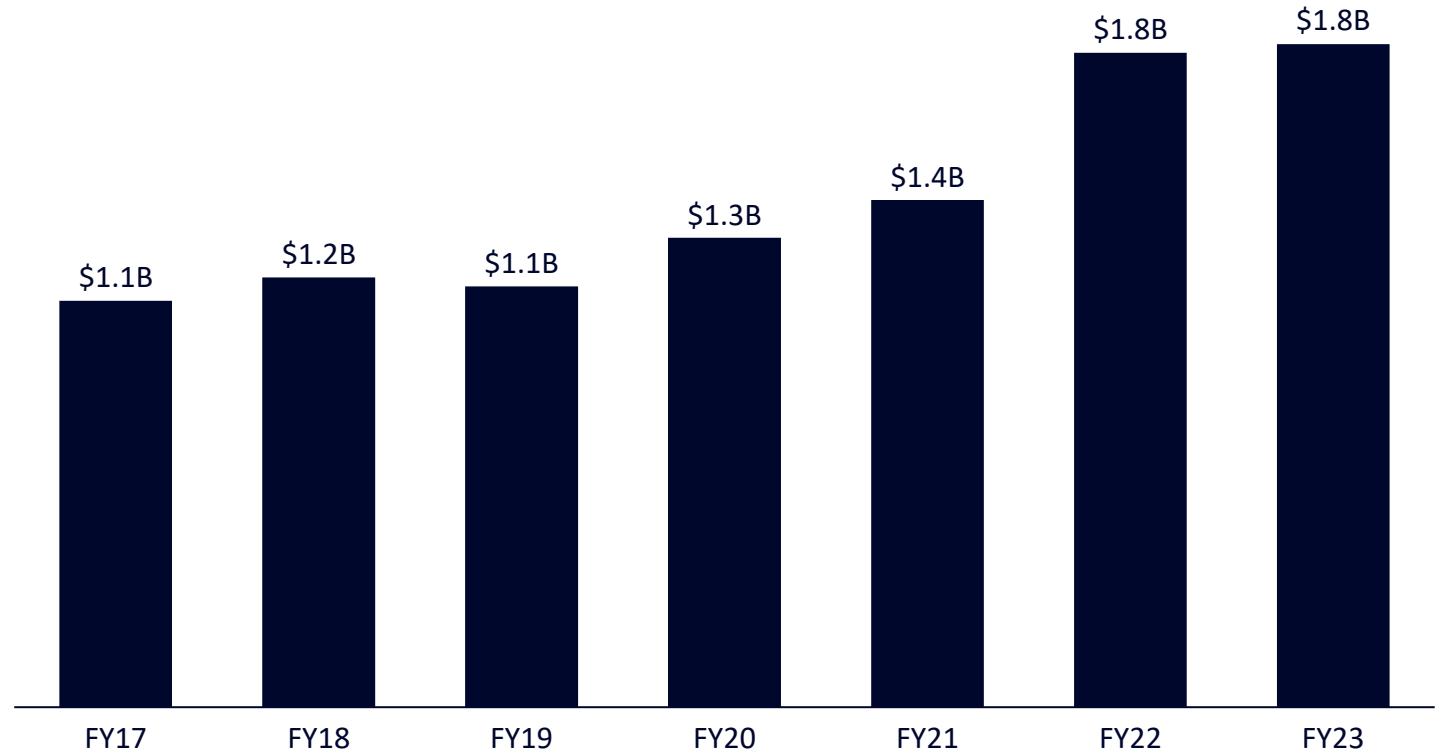
The nickel industry is also an important input to support activity in other key industries, and will be critical for future and emerging industries, such as batteries.<sup>2</sup>

## B Economic resilience

### Exhibit 17: Gross value added of nickel ore and concentrates industry in Australia

\$AU billions, FY17 – FY23

The Australian nickel industry contributes \$1.76 billion to Western Australia's economy, while the remaining \$0.04 billion is captured by Tasmania



<sup>1</sup> ABS (2023) *Australian Industry*.

<sup>2</sup> The indirect economic activity supported by the nickel industry was not estimated in this report.

Source: ABS (2023) *Australian Industry*; ABS (2023) *Australian National Accounts: Input-Output Tables*; Mandala analysis.

# Without a domestic nickel industry, Australia is unlikely to unlock downstream opportunities in batteries

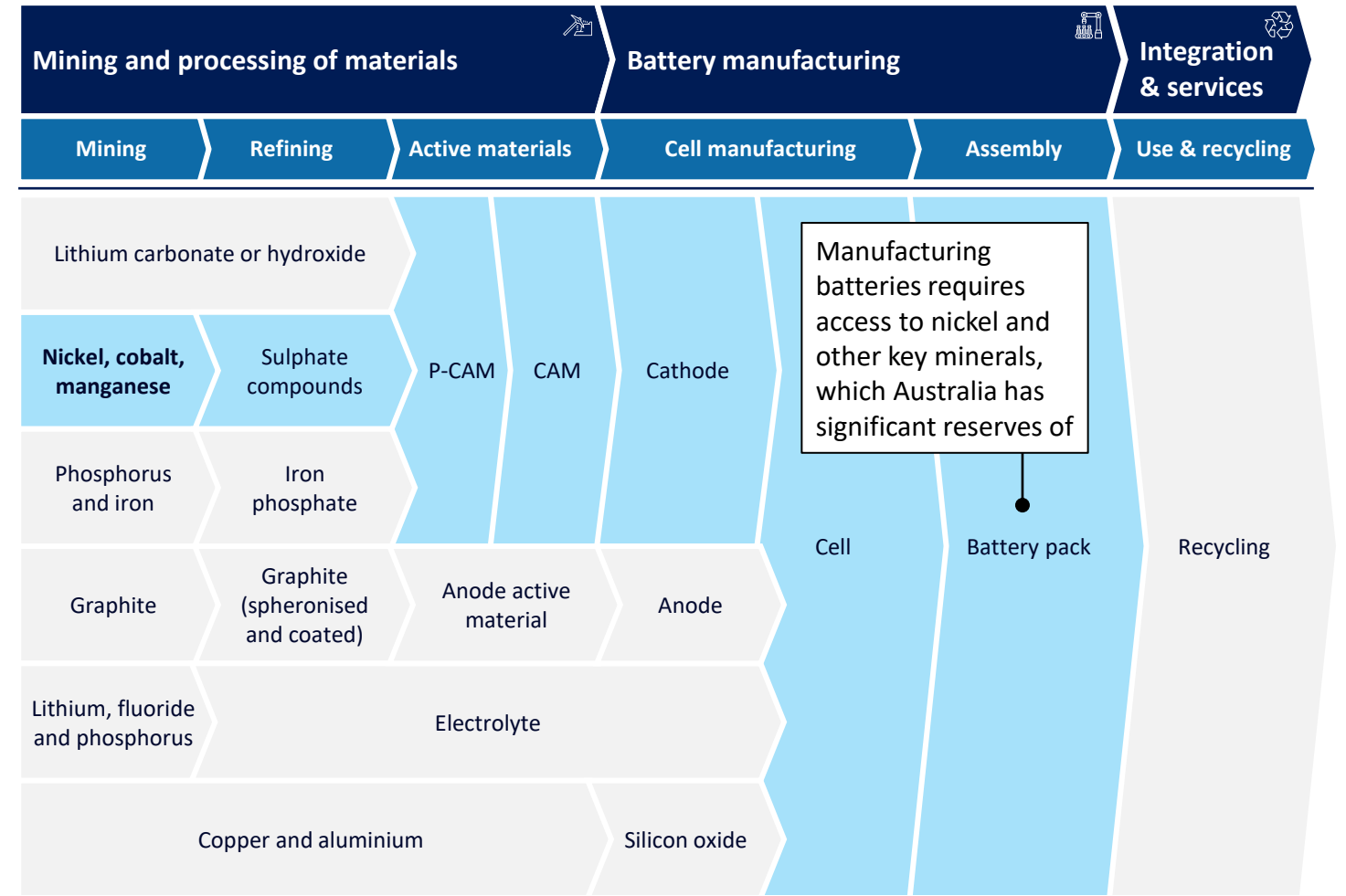
The nickel industry is strategically important to Australia maintaining its resource security and unlocking opportunities in the battery value chain.

Recent studies estimate capturing downstream opportunities in the battery value chain could add up to \$17 billion in economic activity in 2030, majority of which is in mining and refining battery minerals, such as nickel.<sup>1</sup>

To achieve the Federal Government’s objective of establishing a domestic battery industry, it is important for Australia to have access to low-cost battery materials, such as nickel. As shown in Exhibit 22, nickel is a precursor to manufacturing batteries. Without a domestic nickel industry, Australia’s downstream processing sector will likely falter or shutdown. This would lead to limited investment and create challenges to establish a domestic battery industry.

## C Resource security

Exhibit 18: Nickel is a key mineral required to support a domestic battery manufacturing sector



<sup>1</sup> Accenture (2023) *Charging Ahead: Australia’s battery powered future*; Accenture (2021) *Future Charge: Building Australia’s Battery Industries*.  
Source: CSIRO (2021) *Critical Energy Minerals Roadmap*; Mandala analysis.

1 The energy transition offers significant opportunities for Western Australia's resources industry and minerals exports such as nickel

2 The Western Australian nickel industry is facing strong headwinds, and its future viability is at risk.

## Appendix

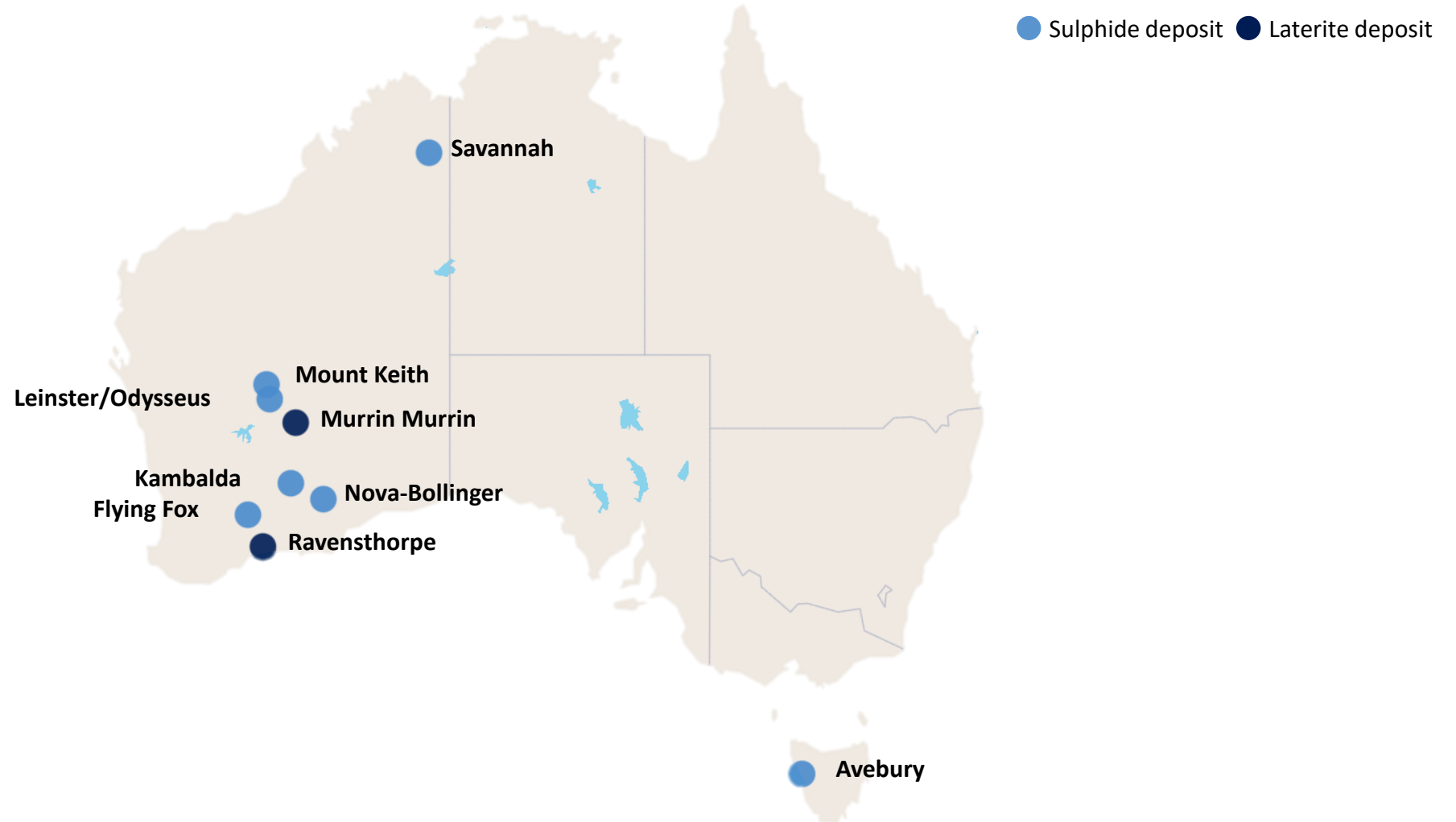
A: Supplementary analysis

B: References



# Majority of Australia's nickel mines contain nickel sulphide and are in WA

Exhibit A1: Location of Australia's nickel mines

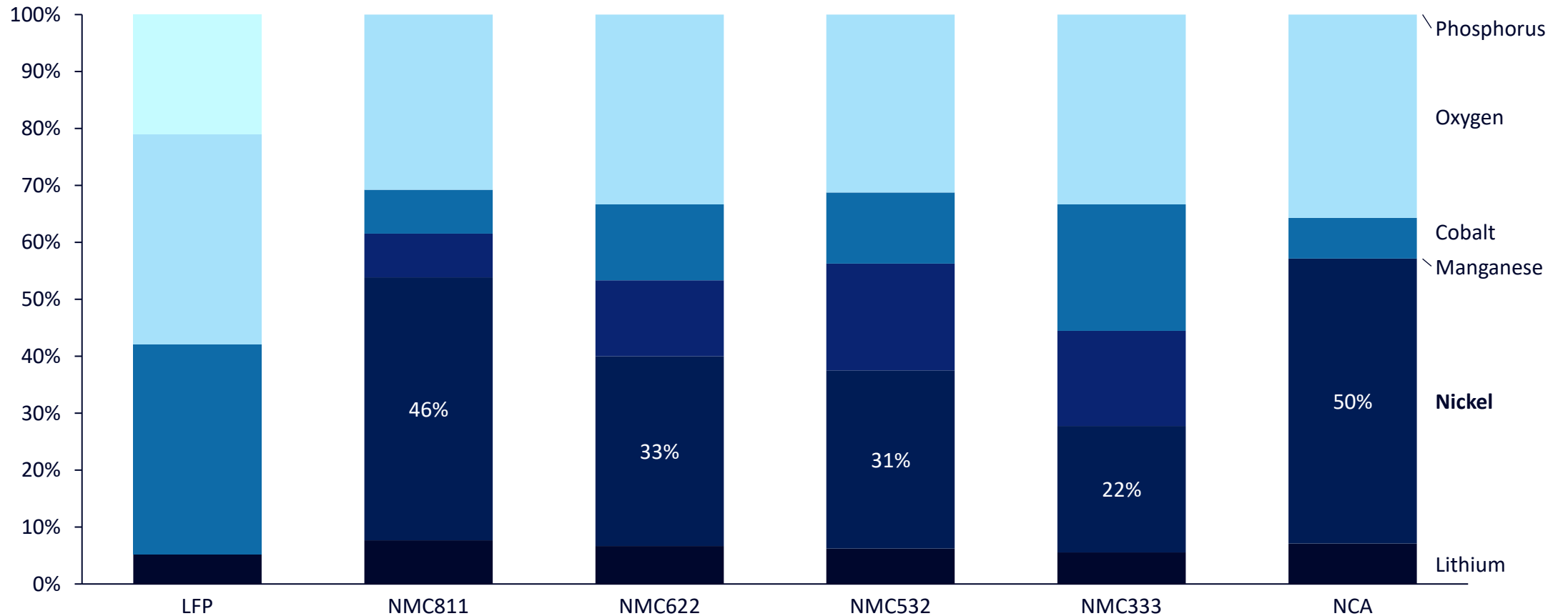




# A large portion of commonly used batteries are made from nickel

**Exhibit A2: Material content of commonly used cathodes**

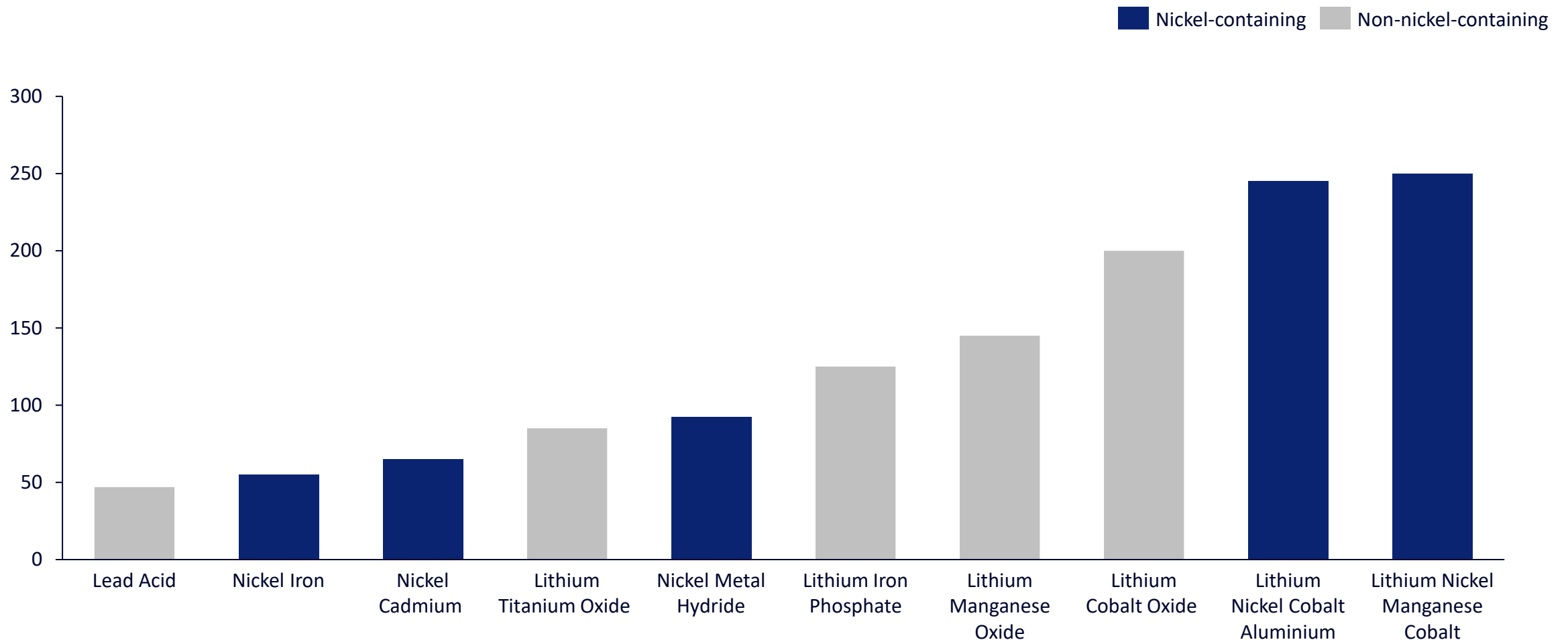
*% of cathode weight required to produce a kilowatt-hour of energy, 2023*



# Batteries containing nickel offer the highest energy density when combined with lithium

Exhibit A3: Energy density of batteries by chemistry type

Watt-hour per kilogram, 2021



1 The energy transition offers significant opportunities for Western Australia's resources industry and minerals exports such as nickel

2 The Western Australian nickel industry is facing strong headwinds, and its future viability is at risk.

## Appendix

A: Supplementary analysis

**B: References**



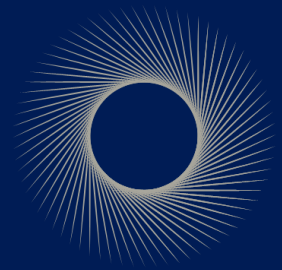
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