Ni FACT SHEET

Nickel's Role in the Energy Transition

SUPPORTING A NET ZERO, LOW CARBON FUTURE

The Drive for Nickel Today

The push for energy efficiency and decarbonization commitments have reached a global scale. Governments, institutions and businesses across the world are taking decisive action to significantly reduce the carbon footprint, with the ultimate intention of achieving a net zero future of greenhouse gas emissions.[1] This has given considerable rise in demand for renewable energy technologies and, in particular, battery production, with aggressive steps to replace internal combustion engines in order to meet the mandates of zero-emission vehicles within the next decade.[2]

Among the critical minerals, nickel stands to benefit as one of the key elements used in batteries for electric vehicles (EVs).

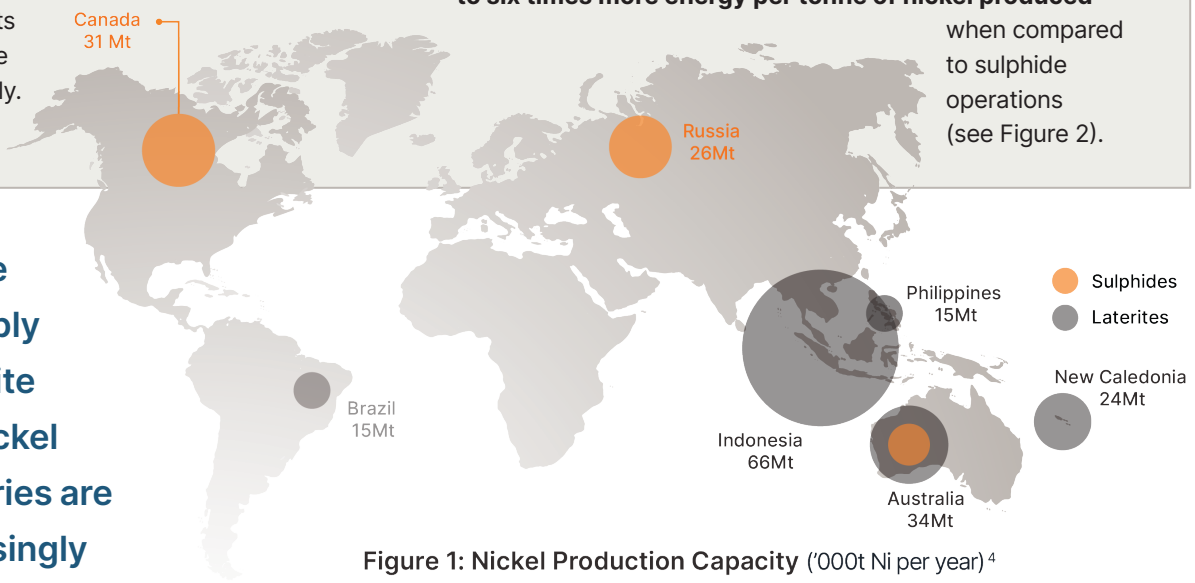
> "As a key element in EV batteries, nickel is critical in the scaling up of clean energy and a more sustainable future."

Understanding Nickel Ore Types

Currently, two-thirds of the world's nickel resources come from Australia, Indonesia, South Africa, Russia, and Canada.[3] **However, not all nickel is created equal.** Nickel ore is mined from two main types of deposits: sulphides and laterites, of which the latter can have a dramatically higher carbon footprint depending on the processing route taken.

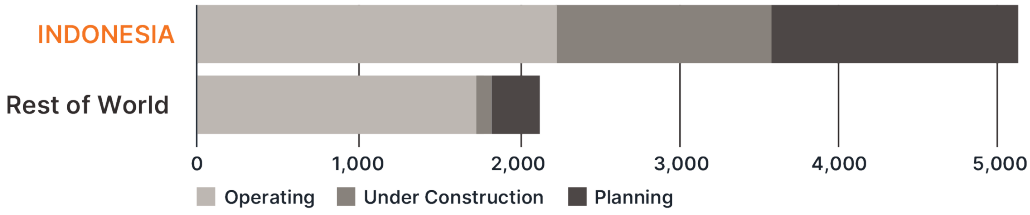
Nickel sulphide deposits tend to be higher grade and often form vertically. Accordingly, sulphide deposits are amenable to underground mining with minimal surface disturbance. **Nickel sulphides have the lowest carbon emission intensity,** as the ore can be concentrated using comparatively simple flotation techniques.

Nickel laterites are typically large, lower grade deposits found closer to the surface. The ore is strip mined and must be completely smelted or acid-leached to enable nickel extraction. **Major laterite operations require anywhere from two to six times more energy per tonne of nickel produced** when compared to sulphide operations (see Figure 2).



Today, 70% of the global nickel supply comes from laterite resources.[4] As nickel sulphide discoveries are becoming increasingly scarce, the demand for nickel is being filled by new laterite projects, mainly from Indonesia.[5]

Figure 1: Nickel Production Capacity ('000t Ni per year)[4]



[1] The Paris Agreement 2015.
[2] 100% zero-emission vehicle sales by 2035. Gov't of Canada News Release June 2021.
[3] The Nickel Institute.
[4] Macquarie Group December 2022.
[5] MineSpans, McKinsey & Company July 2021.
[6] Wood Mackenzie December 2022.
[7] Canada Energy Regulator: www.cer-rec.gc.ca.
[8] Wood Mackenzie Principal Analyst, Nickel, Angela Durrant, April 2023.
[9] Mighty Earth www.mightyearth.org "Sourcing Responsible Nickel for EV's"
[10] S&P Capital IQ database.
[11] Net Zero Roadmap to 2050 for Copper & Nickel Mining Value Chains (2022). Excludes transport emissions.

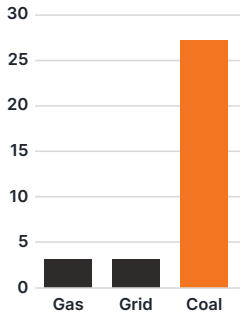
The Class Divide

Refined nickel can be broadly divided into two main categories based on metal content. Class 1 (nominally pure nickel of >99.8%) and Class 2 (<99.8% purity). However, the amount of nickel in Class 2 products can differ drastically; for example, nickel pig iron (NPI) generally contains less than 5% nickel. **Batteries for EVs require Class 1 nickel.**

Historically, nickel sulphide deposits have provided the majority of Class 1 nickel production, but as demand will soon outrun supply,[6] the paradigm is changing. In 2022, global nickel production increased by ~20%, with almost all of this increase accounted for by laterite projects in Indonesia. To address the impending supply shortage, producers have been prompted to convert laterite ore – of which there is plenty – into Class 1 battery-grade materials.

Depending on the mineralogy, laterite ore can be processed using one of two methods: rotary kiln electric furnace (RKEF) or high pressure acid leaching (HPAL). RKEF uses roasting methods that are carbon intensive, with energy sourced from coal-fired power stations built close to the mines. This is particularly prevalent in Indonesia, as the world's third largest producer of coal. Conversely, Ontario's power grid is more than 90% powered by zero-carbon sources.[7]

Average Mine Emissions by Power Source[5]
(tCO_2 /t Ni)



It is estimated that for every tonne of nickel produced via HPAL, around 1.4–1.6 tonne of waste is also produced.[8]

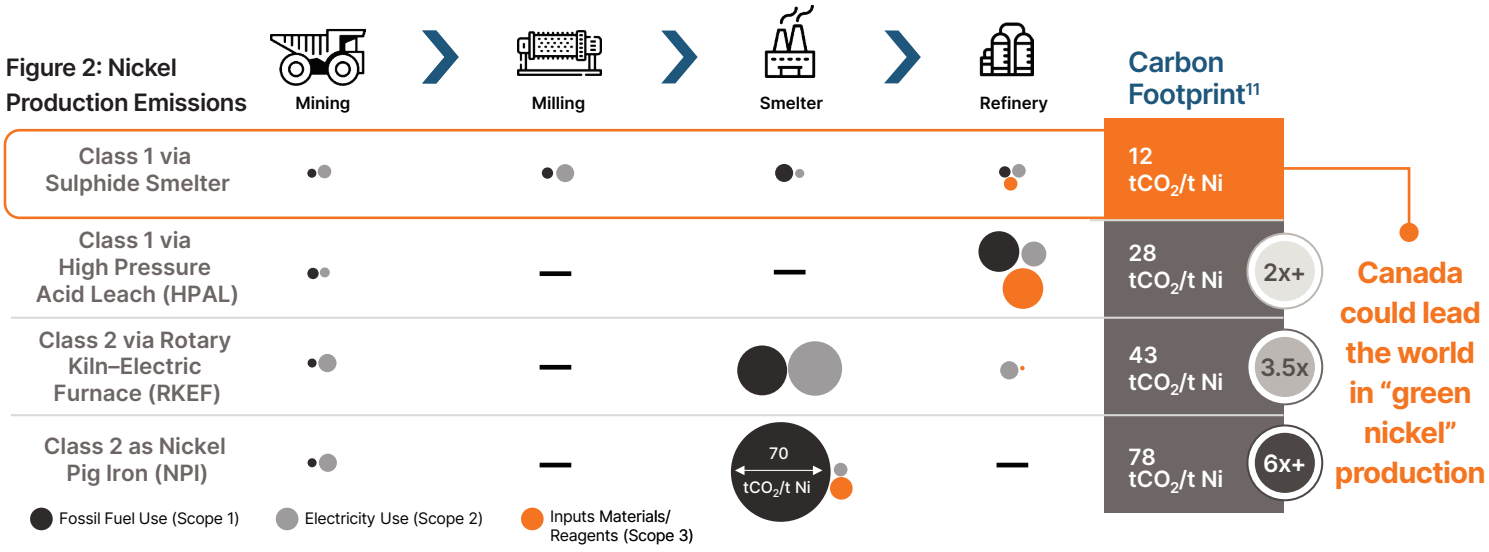
HPAL is a method whereby ore is placed under high pressure and mixed with sulphuric acid in order to strip the nickel. While the process does not require high temperatures, HPAL produces large amounts of tailings, acid slurry and waste effluent that must be neutralized and impounded properly. In the case of Indonesia, tailings disposal is particularly challenging with limited space for large dams due to the topography, thick vegetation, high rainfall and vulnerability to earthquakes.

'Dirty' Nickel for a Clean Future?

Over the past two decades, at least 76,000 hectares (about the size of New York City) of forest have been lost due to nickel mining concessions in Indonesia, with an impending threat looming over an additional 500,000 hectares.[9] However, understanding the full environmental impact of laterite production is unknown: very few Indonesian producers disclose information to the public and the majority (almost 80%) of Indonesian mines and processing plants are under ownership by companies in China.[10]

Given Indonesia's dominant share of the nickel market and known processing methods (RKEF + HPAL) for its current and planned operations, any efforts towards a decarbonized future will not be a simple or quick endeavour. And as the demand for EVs grow, consumers, investors and manufacturers are becoming increasingly wary of where the components are coming from – ensuring it is ethically sourced and implementing high environmental standards. The question then remains: is it clean nickel?

Figure 2: Nickel Production Emissions



Canada could lead the world in "green nickel" production

Wyloo is committed to enabling a safe supply of high-grade critical materials from extraction to processing, using the highest standards of environmental sustainability that make our operations the benchmark for mines of the future. We will achieve this in partnership with local and First Nation communities, ensuring our success means progress for everyone. We have producing assets in Australia, mining projects in Canada, a downstream integrated battery materials project in Western Australia, and a strong growth pipeline with exploration across both countries.

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