That, and a nickel, will get you a ... battery

Growing awareness of the pivotal role that storage technology could play towards reducing global carbon emissions and facilitating a more circular economy, has resulted in a burgeoning battery manufacturing sector.

Several key and progressive innovations depend on the creation of better batteries. This has also led to a renewed intensity of research, by scientists and engineers, into novel manufacturing methods to yield higher quality precursor materials derived from graphite, cobalt, lithium, manganese and nickel. Cobalt and nickel are critical raw materials in the production of cathodes for lithium and alkaline batteries.

However, as the world distances itself from the “blood cobalt” produced in the DRC - the proportion of nickel has subsequently increased. The Biden administration conducted a 100-day review of critical supply chains and earmarked class-1 nickel as a critical strategic mineral. Annual global demand for nickel in lithium-ion batteries alone was 150 000t in 2019 and is forecasted to be 500 000t by 2025. The lithium-ion battery market has grown at a 20% compound annual growth rate over the last 10 years due to demand for laptops, smartphones and most recently electric vehicles of which the global fleet has grown from 3.7 million in 2019 to almost 20 million in 2022.

This demand is a main cost driver in the sector, exacerbated by the fact that the hydrated nickel sulphate, used in lithium-ion batteries, are a niche product produced from class-1 nickel which has a 99% purity and demands a considerable premium in comparison to spot nickel prices.

Traditionally, battery nickel would be sourced from an ore concentrate which is smelted into nickel matte and heavily refined through leaching, solution purification and further pyrometallurgical processes. These methods are multi-stepped, complex, energy intensive and time-consuming with the resulting slurry requiring wet grinding and dispersion applications to fulfil size and shape requirements. Furthermore, additional parameters such as pH, temperature and stirring speed within the slurry effect the quality of the product and must be strictly controlled.

Novel and cost-effective alternatives to the traditional processes for the production of precursor battery materials involve chemical vapour deposition, known as vapour phase refining or vapour metallurgy. Chemical vapour deposition techniques include advanced carbonylation through the bonding of carbon monoxide to individual atoms of nickel powder within a reagent followed by a relatively moderate thermal decomposition resulting in the extraction of pure metal. There have also been theoretical improvements to the carbonyl process that purport to utilize no carbon monoxide and less thermal energy, however these methods are yet to be fully tested.
From an ESG perspective, these novel processes are waterless and amenable to the use of renewable energy due to their lower thermal requirements, furthermore the required facilities would occupy very small surface areas amplifying their low environmental impacts.

The health and environmental credentials of nickel itself is a contentious subject with the EU classifying is as a category 3 suspected carcinogen, while the American Congress of Government Hygienists deem it safe. It is important to also note that the natural modal abundance of environmental nickel is high and humans are regularly exposed to it through the food chain regardless of extractive and productive activities. However, nickel dusts produced from these activities, like any other metal dusts could present an increased safety risk. Science and technology develop so fast that future battery chemistry developments are uncertain, however one can safely assume that future cathodes would still contain any combination of the current battery minerals.

It is thus important when considering sustainable investment portfolios to prioritize the investment in companies concerned with the production of such minerals, particularly those investing in innovations towards novel green processing methods.

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