Phytomining: Growing Nickel for the Metals Supply Chain

How Bio-Sourced Nickel Could Reshape Low-Carbon Metals Supply Chains

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Three key takeaways:

- **Phytomining — using hyperaccumulator plants to extract nickel from metal-rich soils — has moved from academic curiosity to commercial-scale implementation,** with active joint ventures, ARPA-E grants, and venture capital backing the technology in the U.S. and Europe.
- **U.S. nickel supply security is weakening.** With the Eagle Mine in Michigan expected to reach end-of-life later this decade, the country faces increasing dependence on imported nickel for stainless steel, EV batteries, and specialty alloys.
- **Phytomining will not replace conventional mining at scale, but it opens a low-carbon, capital-light supply path** that fits naturally into Scope 3 reduction strategies for stainless producers and downstream manufacturers willing to pay a green premium.

What Is Phytomining

Phytomining uses plants — specifically hyperaccumulators — to draw metals from soil into harvestable biomass. Certain species, such as *Alyssum murale* and *Phyllanthus rufuschaneyi*, can concentrate nickel at levels thousands of times higher than ordinary vegetation. The plants are grown on metal-rich soils that are typically unsuitable for food crops, harvested, dried, and then ashed. The resulting "bio-ore" is processed through smelting or acid leaching to produce nickel metal or high-purity nickel sulphate. The energy released during ashing is recovered for electricity.

Current commercial phytomining systems generally yield tens to low hundreds of kilograms of nickel per hectare annually. Modest by mining standards, but the energy input, water use, and surface disturbance per ton of metal are dramatically lower than conventional pyrometallurgical processing of laterite or sulphide ores. A meaningful additional benefit: phytomining aligns naturally with land remediation on ultramafic or previously disturbed mining lands, creating dual-use environmental value that conventional extraction cannot match.

Why It Matters Now

Three forces are pushing phytomining out of the lab.

First, **supply concentration risk.** Indonesia now controls roughly 60% of global nickel supply, and the resulting market oversupply has driven the sharp decline in nickel prices from the extraordinary highs of 2022, making many Western projects increasingly marginal. Rising geopolitical friction, tariffs, and industrial policy measures are pushing buyers to diversify nickel sourcing toward allied jurisdictions. Rising geopolitical friction, tariffs, and industrial policy measures are pushing buyers to diversify nickel sourcing toward allied jurisdictions.

Second, **the U.S. domestic gap.** Over 90% of U.S. nickel is imported, and the expected end-of-life of the Eagle Mine leaves a near-complete dependence on foreign supply for a metal central to stainless steel and battery production.

Third, **Scope 3 pressure on metals buyers.** Nickel is often the single largest alloy cost component in austenitic stainless grades like 304 and 316, and embodied carbon from nickel production materially influences stainless steel EPDs. Pressure is increasingly flowing downstream from automotive, infrastructure, appliance, construction product, and hyperscale data center customers seeking lower embodied-carbon materials — and they are looking for low-carbon nickel the same way they are looking for low-carbon iron units.

Who Is Actually Doing This

The commercial activity is real and accelerating:

- **Botanickel**, a joint venture between Aperam (a leading global stainless steel producer) and Econick (a University of Lorraine spin-off), is developing bio-sourced nickel specifically for the stainless steel supply chain. Harvested nickel is concentrated and transferred to Recyco, Aperam's European recycling unit.
- **Genomines** raised $45 million in September 2025, led by Engine Ventures and Forbion BioEconomy, with Hyundai Motor Group, Lowercarbon Capital, and others participating. Total funding stands at roughly $62 million.
- **Metalplant** combines nickel phytomining with enhanced rock weathering on olivine-based soils, producing both nickel and verified carbon dioxide removal credits.

- **University of Florida**, with Bellus Ventures, received a $1.9 million ARPA-E grant in December 2024 to improve the U.S.-native Milkwort Jewelflower for commercial nickel cultivation. ARPA-E granted $9.9 million across seven phytomining-related projects in 2025.

Realistic Limits

Phytomining is not going to displace Indonesian laterite production. Current yields are only enough nickel for a handful of EV batteries per hectare per year. Scaling to meaningful volumes requires either large land footprints, significantly improved hyperaccumulators through breeding or genetic engineering, or both. The bio-ore also needs downstream refining capacity, which is itself a capital expense.

The economics depend on a green premium. The business case requires customers — EV battery makers, green steel producers, hyperscalers with capital-goods Scope 3 commitments — willing to pay more for verifiably low-carbon nickel. Without that premium or a meaningful carbon price on conventional nickel, phytomined product cannot compete on cost alone.

Where It Fits in the Stainless Supply Chain

Bio-sourced nickel could eventually complement recycled nickel units in stainless production, particularly as mills and OEMs push toward lower embodied-carbon melt mixes. EAF-based stainless producers already lead on recycled content; adding a verifiably low-carbon primary nickel input rounds out the carbon story for the residual virgin units that scrap alone cannot cover.

Stainless steel producers, service centers, and processors that handle nickel-bearing product should be watching three things: which producers establish verified bio-sourced nickel offtake, how that nickel gets traced and claimed through the supply chain (EAC-style book-and-claim mechanisms are an obvious fit), and whether U.S. ARPA-E-backed efforts produce a domestic native-plant supply within the decade.

For metals supply chain leaders, the significance of phytomining is less about volume today and more about optionality: an emerging domestic, low-carbon nickel pathway that may become strategically valuable as carbon accounting, supply security, and procurement transparency continue converging.