

On a remote island close to where the Pacific meets the Indian Ocean sits one of the first refineries built specifically to support the **world's transition away from fossil fuels**. Rocks unearthed here contain traces of nickel, a key ingredient in [electric vehicle batteries](#). Extracting it, refining it and readying it for export is a gargantuan task. More than \$1 billion has been sunk into the processing facility, the first in Indonesia to use an acid-leaching technology to convert low-grade laterite nickel ore — which the country has in abundance — into a higher-grade material suitable for batteries. Foreign investors and lenders cite the project as evidence of their commitment to fighting climate change. But the sprawling facility, bordered on one side by forest and on the other by blue seas, faces a major challenge: what to do with the roughly **4 million metric tons of toxic waste** produced every year — enough, approximately, to fill 1,667 Olympic-size swimming pools. In 2020, the companies behind the project told the government they had a solution: They would pump the waste into the ocean. They ultimately backtracked in the face of public pressure. But it's not clear that the on-land storage alternative they've offered instead is significantly safer.

[Indonesia](#) is the world's top producer of nickel by a wide margin, according to the U.S. Geological Survey. Along with Australia, the country has the largest nickel reserves left on Earth.

And as global demand for nickel surges, company executives and Indonesian government leaders are turning to a refining technology long considered too risky to embrace, too perilous for the environment and for local communities.

This technology, using acid under conditions of intense heat and pressure to remove nickel from raw ore, has never been tested before in Indonesia, where the frequency of earthquakes, heavy rainfall and landslides can make it especially treacherous to transport and store hazardous waste. The process poses steep environmental costs that have yet to be reckoned with, according to interviews with more than 40 people familiar with the country's nickel industry, visits to six largely isolated mining villages in eastern Indonesia and visual analyses by mining experts.

Indonesian officials say this new refining technology is needed to harness these nickel resources, which they hope will transform the country's future as oil did for Saudi Arabia. At least 10 other projects using this same technology are already under development, according to the Indonesian Nickel Mining Association.

Officials have made it a priority to build a nickel supply chain, banning the export of raw nickel ore for processing abroad and approving the development of acid-based refining facilities as well as additional conventional nickel smelters at a rate unparalleled elsewhere.

Despite official pledges to reduce carbon emissions, the government has approved the construction of coal-fired power plants specifically to support the processing of nickel for the EV industry.

Much of the **nickel** in EV batteries used by automakers such as Tesla, Hyundai and Ford is already sourced from Indonesia by way of battery manufacturers in China. And by 2030, when global nickel demand is forecast to be 52 percent higher than in 2020, Indonesia will probably churn out more than two-thirds of the supply, according to estimates from Macquarie Group, an Australian financial services group with expertise in the mining sector. The surging interest in nickel is part of the global boom in demand for a range of metals used in making EVs, which typically require six times the mineral inputs of their fossil-fuel burning counterparts to make them run. But while the transition to EVs is widely considered essential in addressing climate change, there has often been little recognition of the toll that extraction and processing of these raw materials — including technologies now urgently needed to produce the quantity and quality of minerals required — will take on the lives and livelihoods of local communities and the surrounding environment.

Laterite nickel ore comes in two forms, and until recently there was no need to use the acid-leaching technology in part because Indonesia was mining the kind known as saprolite, which can be processed partly by using traditional smelters. But Indonesia — and the world — is running out of saprolite ore. What will be left is lower-grade limonite ore, which consists of less than 1.5 percent nickel, making processing by traditional means nearly impossible.

The decline in saprolite ore has occurred just as the demand for battery-grade nickel has spiked. Most nickel mined in Indonesia has previously gone into products like stainless steel, which can use a lower-grade mineral. But batteries require a higher standard, which has placed an unprecedented premium on the acid-leaching process.

One afternoon late last year, Liyus, a 52-year-old farmer on Obira, walked along the coast where his family has lived for four generations. It's been quiet on this island for most of his life. Without a private jet, getting to Obira from the Indonesian capital, Jakarta, is at least a two-day journey involving an overnight ferry and hours of driving on roads stippled with potholes.

Liyus, who goes by one name, said he used to drink from the rivers that run past his village, but since the nickel mine added its acid-leaching refinery two years ago, the waterways have turned dark red, so thick with pollution at some points that rows of coconut trees have been killed off. He doesn't know what's in the water, only that it bleeds into the sea and that his nephews have had to go farther and farther out to find fish. He pointed to a fishing net

drying on a nearby tree. It was stained a reddish brown.

In an hour-long interview, representatives from the two companies that jointly own the processing plant on Obira island — an Indonesian firm, Harita Group, and a Chinese firm, Lygend Resources — said that the operation has not had a negative impact on the environment and that the pollution along the coast was not related to waste produced by their plant. All of their operations, they emphasized, are in “full compliance” with government requirements. “We looked at what was the best and we confirmed it with the government,” said Tonny Gultom, Harita’s head of health, safety and environment. Like other inhabitants of the village of Kawasi, which sits at the foot of Obira’s nickel-mining operation, Liyus has never owned a car and has no idea why there’s been a sudden interest in the mineral that sat untouched on his island for so long.

“We had a comfortable life,” Liyus said, “before this.”

Daunting challenges

High-Pressure Acid Leaching (HPAL) is a method of refining low-grade nickel ore by combining it with sulfuric acid under high pressure and heat, producing a slurry that allows for the extraction of pure, high-grade nickel. The technique was pioneered in the 1960s in Cuba but has rarely been used elsewhere — until recently.

Managing the acidic material under extreme heat is more complicated than traditional methods of refining nickel ore. And the titanium vessels needed to mix the chemicals are expensive, part of why capital costs for HPAL projects are typically double those of conventional smelters, according to the International Energy Agency, an intergovernmental research organization.

The leaching process is also energy-intensive, and generating that energy produces about 20 tons of carbon dioxide per ton of nickel, or about double the amount of the prevailing processing method, according to the IEA. And then there’s the waste.

HPAL produces an enormous amount of corrosive chemical tailings — often in the millions of tons for each mine per year — that are extremely challenging to neutralize, store and contain. Even after the slurry is treated, studies show, this waste can contain harmful heavy metals, such as certain types of chromium, linked to respiratory illnesses and an increased risk of cancer.

Engineers have suggested three disposal options: putting the waste into a ditch behind a dam; drying out the waste and stacking it on vacant lots; and pumping it into the ocean. Each approach can go wrong.

Some of the world’s biggest mining companies have tried to master the HPAL process — and failed.

In 2021, Brazilian mining conglomerate Vale exited a multibillion-dollar HPAL nickel-mining project in the Pacific archipelago of New Caledonia after having five chemical spills in 10 years. Studies by scientists in New Caledonia had by that time found “high levels” of toxic hexavalent chromium in water samples collected in and around the HPAL refining facility. The facility, now owned by a consortium of New Caledonia companies, had yet another leak in November at its tailings dam, prompting local authorities to impose new regulations that could limit production.

Closer to Indonesia, in Papua New Guinea, a Chinese company operating an HPAL plant has for years been criticized by residents and officials for dumping its tailings into the sea. After a tank filled with mining waste overflowed onto the coast in 2019, thousands of residents filed a lawsuit against the company demanding \$5.2 billion in damages. The case is still pending in court, said lawyer Ben Lomai, who represents the plaintiffs.

HPAL’s troubled history, however, has done little to deter industry enthusiasm for the technology.

While research is being conducted on safer ways to process limonite nickel ore, they won’t be able to satiate existing demand, said Brian Menell, founder of TechMet, an investment firm that focuses on minerals required for the green-energy transition and does not operate in Indonesia. Indonesia’s HPAL facilities “might not be how you want your nickel,” he said, “but right now, you’ve got no choice.”

A change of plans

The nickel mine on Obira has been operated by Harita since 2016, but in 2018, Lygend joined to plan, design and construct the **HPAL refinery**, eventually acquiring a majority stake in the project. The processing facility, which was designated a priority for the national government, opened in 2021.

After the companies withdrew their initial plan to dump the HPAL waste into the sea, they told authorities that they would store the waste on land, drying out the acidic slurry before dumping it back into the mining pit, and then treating the residue water in a tailings “pond.” Only a year earlier, however, Harita executives had published a research article in a science journal stating that land disposal on Obira is actually “less suitable” because the region is in a notoriously active seismic zone — as recently as 2019, a 7.2-magnitude earthquake devastated a port town on Bacan island, less than 50 miles from Obira — and is frequently visited by heavy rainfall. That article also noted that about 7,000 villagers lived downstream from the site, concluding that the construction and water control required for land disposal was “not feasible.”

Asked about those findings, a Harita spokesman acknowledged that storing the waste on

land is dangerous but said the company is managing the risks by drying out the slurry and dumping it back into the mining pit, where it is prevented from seeping into local waterways.

But a foreign mining consultant who has been working on projects in Indonesia for more than two decades said: “It’s a massive heap of waste. And if it’s not stored properly, you can have landslides. That’s my biggest concern.” He spoke on the condition of anonymity because of business considerations.

Following the public outcry over the initial disposal plan, the Indonesian government barred all nickel-processing plants from dumping waste into the sea, said Luhut Binsar Pandjaitan, Indonesia’s coordinating minister for investment and maritime affairs and chief architect of the country’s nickel strategy.

“We tackled this very well, you know?” Luhut said, speaking at his office in Jakarta last year. “We listened to the advice of the European Union and we stopped. We don’t do that anymore.”

Villagers and environmental activists say they remain concerned that Harita and Lygend, which operate jointly in Indonesia under the name PT HPAL, are failing to honor their promise to keep the waste on Obira out of the ocean and have not adequately addressed the risks posed by storing the waste on land.

Four international mining experts independently reviewed photos of the mining site at Obira taken by The Washington Post. The experts said that it was impossible without a formal audit to ascertain whether Harita and Lygend were dumping HPAL tailings into the sea, but that there were multiple signs that the companies were generally failing to contain mining waste.

The photos show “devastating” levels of deforestation, which can increase the risks of tailings accidents, said Aimee Boulanger, executive director of the Initiative for Responsible Mining Assurance, an organization that audits mining operations and measures them against social and environmental standards. Even if tailings were not being actively pumped into the sea, there don’t appear to be “any significant controls” over what’s flowing out of the mine and entering waterways, she added.

Sam Riggall, an advocate of responsible mining and the chief executive of Sunrise Energy Metals, an Australian nickel and cobalt mining company, said the material entering the rivers around the mining facility resembled processed waste, rather than just runoff from open-pit mines.

“Frankly, I feel a bit ashamed to be part of an industry that’s allowing this to happen,” Riggall said. “If this is the legacy we leave behind ... who will be happy with that?”

Gultom, Harita's head of safety, acknowledged that the HPAL refinery was producing a "huge volume" of waste that could pose safety risks if not properly managed, but he stressed that it was being handled with adequate precautions.

The discolored water near Obira's coast, he said, was caused by sedimentation created by timber mining years ago. "It has nothing," Gultom said, "to do with us."

Harita, which debuted on the Jakarta stock exchange in April, plans to add a second processing plant on Obira next year, company executives said.

A booming industry

Across the nickel-rich islands of North Maluku province, old mining companies are expanding and new ones are taking root. They're taking over large tracts of land, residents say, sometimes with government authorization, sometimes without. Bulk carrier ships congregate along coastlines, recalling for some communities Indonesia's colonial history, when Dutch and Portuguese settlers exploited these islands for spices such as nutmeg and cloves.

Nickel production in Indonesia hit a record high of 1 million metric tons in 2021, though it pales in comparison with what is projected to come. By 2028, according to Macquarie, the country will be producing at least 2.5 million metric tons of nickel annually.

China's CATL and South Korea's LG, the world's largest battery manufacturers for EVs, recently announced they would open HPAL plants in Indonesia. Ford Motor Co. said it would join an HPAL project being developed by Vale and Chinese mining company Huayou on Sulawesi island in eastern Indonesia. And last year, Tesla signed a \$5 billion deal to buy nickel from Indonesia, government officials said.

One of Indonesia's biggest upcoming HPAL projects is not far from Obira in North Maluku. The Indonesia Weda Bay Industrial Park on Halmahera island, a joint venture between French and Chinese companies, has more than doubled its footprint in the past five years, satellite imagery shows. So far, the facility has primarily produced nickel for stainless steel, but a group of Chinese companies said in 2021 that they would add a \$2.1 billion HPAL facility.

Maryama Usama, 60, lives in Sagea, a village just outside the industrial park. She has heard that the nickel companies on Halmahera need more space. And she said she knows people in the neighboring village of Gemaf who weren't given any notice before heavy equipment showed up on the land that had belonged to their families for generations.

"The government may have given them permits," Usama said, brushing the corner of her eye with her hijab. "But the land does not belong to them. It's ours."

A matter of trust

At a mining conference in 2021, Gultom outlined Harita's mission: "Sustainable excellence through continuous improvement of people and process." On its website, Lygend says it is committed to making "green" nickel that will "accelerate carbon neutralization."

But Faizal Ratuela, executive director of the North Maluku chapter of WALHI, an Indonesian environmental advocacy group, questioned whether these companies can be trusted to responsibly operate nickel refineries, especially those that use technology as complex as HPAL. He pointed to their environmental records in Indonesia and China.

Since the Harita Group ventured into mining in the early 2000s, it has clashed with local communities several times, including on Obira, where journalists who tried to report on the effects of the mine have been detained and intimidated by security personnel employed by Harita, Ratuela said.

Sian Choo Lim, head of sustainability at Harita, said that there may be an "image" that the company has not done enough to protect the environment, but that it's unfounded. "We've never had any issues with the Kawasi community," she said.

Lygend and its subsidiaries have been cited in **China** for violating environmental regulations at least four times in as many years, according to a Post review of statements released by Chinese provincial governments. These citations, made as recently as last year, include exceeding standard emissions of smoke and mismanaging waste.

Zhang Baodong, a Lygend representative, declined to address these violations. "What we've done [at Obira] is already very up to mark," he said. "I have nothing more to add."

Indonesian companies are aware that HPAL is a "totally different" technology from what they're familiar with and that the waste management is particularly tricky, said Meidy Katrin Lengkey, head of the Indonesian Nickel Mining Association. "But as companies, we say, as long as there is a regulation, we'll make sure to follow."

Environmental regulations in Indonesia have long been difficult to enforce because they're often delegated to faraway provincial governments, which are not only strapped for funds but prone to corruption, activists say. Now, they say, even those regulations are being rolled back in some cases to attract foreign investment.

Villagers, as a result, fear they are defenseless.

"The government is supposed to protect us," said Arnikus Jinimaya, 66, a Halmahera resident who said he lost his land to the Weda Bay Industrial Park. "But now, we see they only protect those who have money."

Luhut, the senior minister, scoffed at the idea that officials were overlooking social or environmental safeguards. There are problems "here and there" with the nickel-refining industry, he said, but the government is more than able to take care of the country's

resources without “the lecturing” of environmental activists — especially those from carbon-emitting Western countries.

The tall, mustachioed former general has spent the past few years engineering the growth of the nickel industry, personally inaugurating new HPAL facilities and courting figures such as [Tesla](#) chief executive **Elon Musk**. At cabinet meetings and international summits, he has repeatedly made the case that the global energy transition presents the biggest economic opportunity for Indonesia since it gained independence in 1945.

“This,” Luhut said, leaning over his desk to point at a graph charting nickel growth, “is going to transform Indonesia.”

In June 2021, a few months after the refinery on Obira began operating, Luhut visited the island, donning a red hard hat as he examined the new **HPAL technology**. Liyus and other residents of Kawasi said they had expected him to stop at their village, where they hoped to show him the rivers that had started to run red and the trees that had died when their roots were covered by sludge from the mine.

He never came, locals said.

Source: Washington Post