4 December 2023

Quintessentially Nickel

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KEY TAKEAWAYS

LME nickel price has continued its downward trend throughout the second half of 2023. As we said in our last issue, the main reason for the falling price was worsening market fundamentals, which included a substantial increase in low-grade nickel production, further rises in capacities to convert Class 2 into LME-deliverable Class 1, and, as a result, a significant market surplus. These factors continue to dictate the current state of the market, with the nickel price plummeting to around $16,000/t at the time of writing, down by almost 50% YTD from more than $30,000/t at the beginning of the year. However, from the fundamental perspective, we do not foresee the current price level being sustainable as more than a half of nickel producers are now making losses, considering the current level of discounts on Class 2 nickel.

Nevertheless, despite excessive nickel supplies, it was recently announced that high-grade saprolite nickel ore reserves in Indonesia could be depleted in only six years, potentially creating supply risks for the nickel market as Indonesia's supply share is due to reach 55% of the global mine production in 2023.

This is set against the backdrop of a suspension order issued by the Indonesian government: the authorities halted the allocation of new nickel mining quotas in 2023, citing an ongoing investigation into illegal mining activities and ore exports. Indonesia may also consider putting an end to new NPI projects and imposing additional nickel export duties to incentivise local downstream processing.

Nickel price has not yet reacted to the potential Indonesian supply risks; however, further restrictions or adjustments to the country's mining policy, including establishing an Indonesian nickel price index, could increase the fundamental nickel price. Moreover, the ever-increasing concentration of the global nickel supply in Indonesia is a legitimate concern for countries reliant on Indonesian nickel, given the depletion of high-grade resources, decline in NPI grades, potential trade restrictions, and ESG challenges.

MARKET BALANCE

Since our last report, we have revised the 2023 market surplus from over 200 kt Ni to more than 250 kt Ni, mostly in low-grade nickel. This is primarily attributed to a lower-than-expected nickel use in the battery sector (+4% YoY) due to the continuing destocking cycle in the EV supply chain, a greater share of non-nickel LFP batteries, and a partial shift from BEV to PHEV sales in China, even though EV deliveries are still hitting new record highs. Meanwhile, the launch of new Indonesian nickel capacities continued at a high pace.

Nickel	2022	2023E	2024E
Use	3.02 Mt +5%	3.13 Mt +4%	3.42 Mt +9%
Supply	3.13 Mt +16%	3.42 Mt +9%	3.62 Mt +6%
Market Balance	113 kt	250+ kt	190+ kt
Low-grade Ni Balance	*145 kt*	*200+ kt*	*140+ kt*
High-grade Ni Balance	*–32 kt*	*50+ kt*	*50+ kt*

We have revised our primary nickel use estimate downwards to 3.13 Mt Ni (+4% YoY) from 3.22 Mt Ni (or a 7% YoY increase) envisaged previously. The most significant contributor to this decline was the battery sector, growth of which was materially lower than we previously forecasted. On the other hand, robust stainless steel output in China (+10% YoY) was offset by falling stainless production in Indonesia (–10% YoY) and chronic weakness of the European and US stainless sectors (–5% and –6% YoY, respectively).

Our assessment of primary nickel supply was virtually unchanged (3.42 Mt or +9% YoY, slightly down from 3.44 Mt or +10% YoY in our May issue). The downgrade of Indonesian NPI (ex. conversion to nickel matte) to 1.32 Mt was offset by a higher-than-expected output of Chinese NPI (390kt or –5% YoY). Our estimate of production of nickel chemicals was reduced to slightly above 500 kt due to a lower supply of NPI-made matte. In turn, this decline was partly compensated by a strong production of MHP amidst the ongoing ramp-up of new HPAL projects in Indonesia.

In 2024, we expect the nickel market to sustain a surplus of more than 190 kt Ni owing to the glut amassed in the low-grade market. The commissioning of the Indonesian nickel capacities is expected to maintain its growth rate, however, the most significant contribution would come from NPI-to-matte and HPAL facilities, while the increase of NPI output is forecast to slow down to 5% YoY only. The ramp-up of new Class 1 projects in China and Indonesia is also projected to continue at a high pace, while production in other regions remained slightly unchanged YoY.

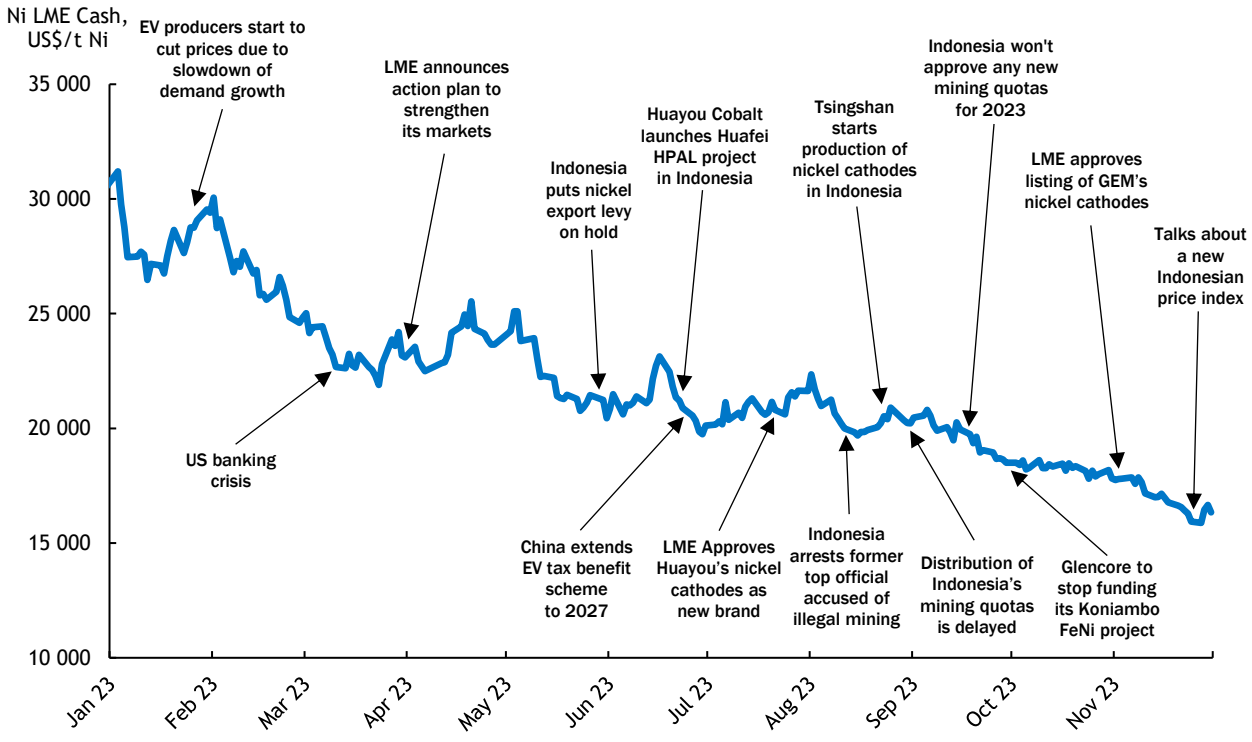
The growing supply will be accompanied by a robust increase of nickel use in stainless (+7% YoY), moderate growth in alloys and superalloys (+6% and +10% YoY, respectively), and the expansion of nickel use in the battery

sector for EVs (+26% YoY), driven by an anticipated restocking cycle in the battery supply chain to emerge during 2024. We believe that the restocking has already started as China's battery-grade nickel sulphate was traded with an average discount of $80/t in November, compared to the discount of over $6,000/t Ni in January.

However, given the ***substantial increase in working stocks*** over the last years, which, according to our calculations, rose by as much as 100-200kt Ni, ***the actual market surplus, i.e. excessive material available for immediate delivery, could be much smaller.***

In 2024, we have also factored in a disruption allowance of approximately 100 kt Ni, affecting both low-grade and high-grade nickel markets, as slower-than-expected commissioning of the Indonesian nickel capacities could happen. At the same time, potential technical difficulties and marketing issues may await newly established Class 1 operations in China and Indonesia. Additionally, there is a risk of significant underperformance of some projects producing other forms of low-grade nickel, specifically FeNi and NPI in China, given the oversupply of low-grade nickel and rising losses of several FeNi producers. Operational issues and logistical constraints across other Class 1 nickel producers also pose a potential supply risk to the high-grade nickel production.

MARKET SENTIMENT



Sources: LME, NN Analysis

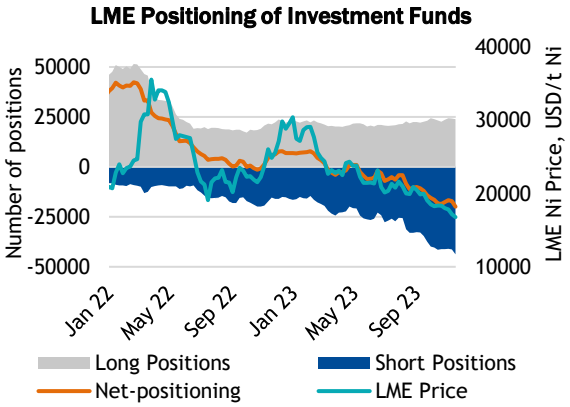
In June-July, the LME nickel fluctuated within the range of $20,000-23,000/t, although the price briefly declined to below $20,000/t following Huayou's nickel cathodes registration at the SHFE at the end of June. In August, the price managed to find some support from the news of a clampdown on illegal mining in Indonesia, followed by delays in the distribution of Indonesia's mining quotas.

Nevertheless, the LME price later fell to below $20,000/t as it was negatively affected by rising supply, particularly Class 1, and weak downstream demand in the stainless steel industry in Europe in the US, coupled with inflationary pressure and high interest rates all over the globe. Despite news that Indonesia wouldn't approve any new mining quotas for 2023 and the country's high-grade nickel resources could face depletion in six years, which would typically support the price, the LME nickel plunged to below $15,900/t on November 27. This was the lowest price level since 2020 as lingering concerns about oversupply weighed on the price. On November 28, however, the LME quotes briefly recovered to $16,500/t after an industry report raised the prospect of a new pricing index of Indonesian nickel, which supported the price.

Despite critically low levels of nickel exchange inventories, which is the lowest since 2007 and amounts to 6 days of global use only, new nickel cathodes produced by Huayou and GEM can now be delivered to the LME-registered warehouses, while China's CNGR also awaits the listing. This poses an additional risk to the LME price because an excessive Class 1 material produced by these companies could be stored in the LME system.

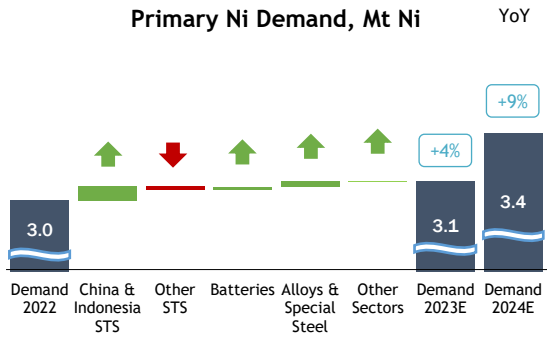
However, the $17,000-18,000/t range would seem to be a breakeven point for the industry based on the cost of conversion from Indonesian NPI-made matte into Class 1 nickel. We believe that the fundamental support stands at that level, otherwise, more than a half of all nickel producers would be making losses with the current price.

The LME COTR data shows a sizeable build-up of short positions of investment funds, especially in the second half of the year, when the price declined below the $20,000/t mark. By mid-November, the number of short positions was almost twice as high as that of long positions, while the volume of net shorts hit a record high. However, in case of any disruptions of nickel supply, both Class 1 and Class 2, we could see a short-covering rally take the LME prices higher. An annual re-balancing of commodity indexes in January could also incentivise some buying of nickel contracts and lead to the cutting of short bids.



Source: LME

DEMAND

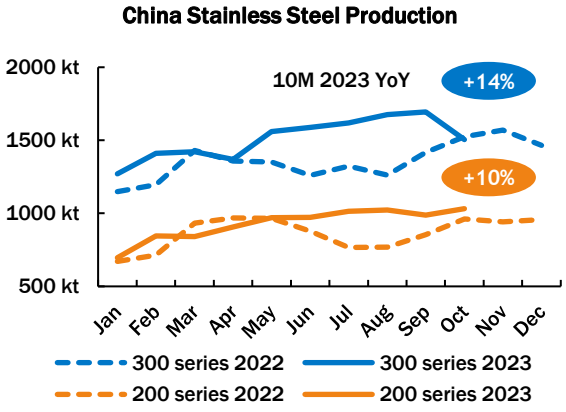


Source: NN Analysis

STAINLESS STEEL

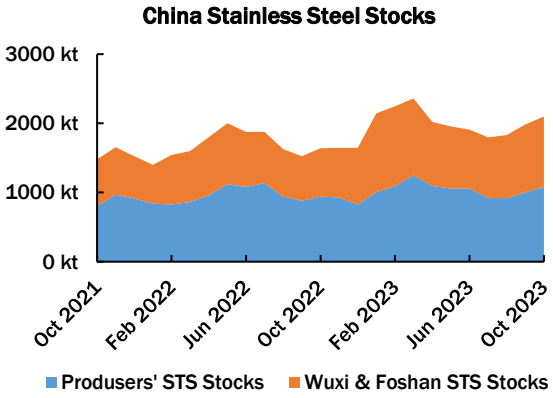
China

In 2023, China's stainless steel production was exceptionally strong, and 300 series production grew by 14% YoY in 10M.



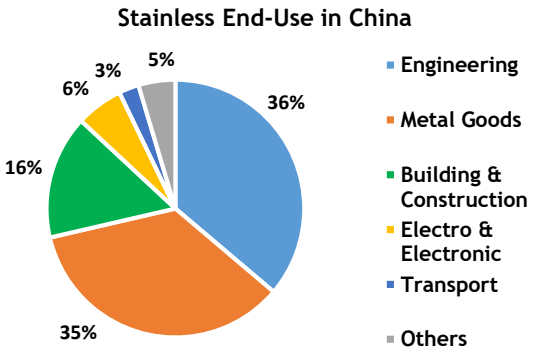
Source: Zljsteel

Despite the significant growth in stainless production, stocks in Wuxi and Foshan warehouses have shown only a moderate increase.



Source: Zljsteel

In order to understand where growth comes from, we need to look at the end-use. Below is the split of nickel use in stainless steel end-use sectors in China.



Source: Roskill, NN Analysis

Our nickel end-use tracker covers around 50% of stainless steel applications, with the other half, mainly cutlery and tableware, not covered due to a lack of reliable indicators. Notably, the engineering sector emerges as the leading consumer of nickel-bearing stainless steel. Notably, investments in fixed assets (FAI) continued to surge within some sectors, including chemical and petrochemical, food processing, and pulp & paper. Simultaneously, the catering industry, belonging to the second-largest end-use segment, exhibits robust performance. Conversely, the real estate construction sector shows a substantial decline, albeit contributing a mere 10% to the overall nickel end-use in stainless steel.

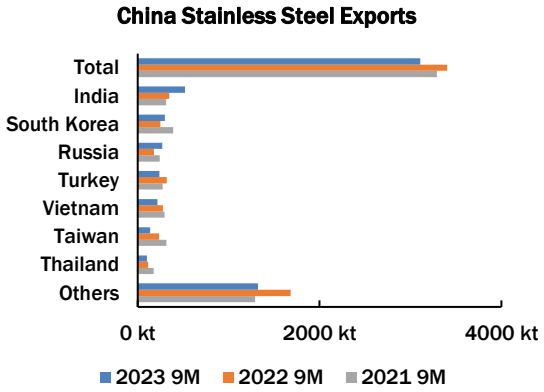
Industries	*Sectors*	*Ni end-use in STS*	*9M 23*
Chemical, petrochemical FAI	Engineering	14%	**+14%**
Floor space of real estate started this year	Construction	10%	**-19%**
Industrial boiler production	Engineering	5%	**-0%**
Food processing FAI	Engineering	5%	**+7%**
Wire production	Metal Goods	4%	**+0%**
Air conditioning	Construction	4%	**+13%**
Pulp & paper FAI	Engineering	3%	**+10%**
Catering FAI	Metal Goods	3%	**+6%**
Data processing & consumer electronics	Electro & Electronic	2%	**+1%**
Automotive & accessories	Transport	2%	**+4%**
Textile	Engineering	1%	**-2%**
Washing machines	Electro & Electronic	1%	**+22%**
Lifts	Construction	1%	**+3%**

Sources: National Bureau of Statistics of China, NN Analysis

The increase in stainless steel production in China was also driven by a significant decline in imports from Indonesia, the details of which are discussed below.

Most significantly, molybdenum has been in shortage this year. This may have been caused by a significant increase in 316 series production, which may also create additional demand for nickel as the 316 series has higher nickel content compared to the 304 series.

Chinese stainless steel trade. In 9M 2023, stainless steel exports from China amounted to 3.1 Mt, decreasing by 294 kt (–9% YoY), with exports to Taiwan dropping by 97 kt (–41% YoY) and to Turkey by 81 kt (–25% YoY). At the same time, there were much higher sales to India, growing by 174 kt (+50%) and to Russia by 91 kt (+51%).



Source: Trade Data

Stainless steel imports into China were at 1.4 Mt, plummeting by 1,1Mt (–43% YoY) mainly due to a decline of imports from Indonesia by 969 kt (–47% YoY). ***Overall, we expect the full-year Chinese primary nickel use in stainless to grow by 10% YoY, which translates into 1,358 kt Ni. In 2024, we expect it to rise by 5%, resulting in 1,430 kt of primary nickel demand.***

In the context of long-term drivers influencing stainless steel use in China, it is imperative to remember the vulnerability of the nation's medium and large cities to flooding. Recent floods in China's capital have also been further exacerbated by its inadequate drainage systems, as corroborated by specialists.

In the context of long-term drivers influencing stainless steel use in China, it is imperative to mention the development of something called "sponge cities" – a long-term framework incorporating innovative integrated urban water management strategies. These ambitious initiatives are designed to reduce water waste and leakages, and alleviate water scarcity in urban spaces. Critically, stainless steel pipes are the most sustainable solution for these pioneering undertakings, which translates into dozens of thousands of additional nickel use in years to come.

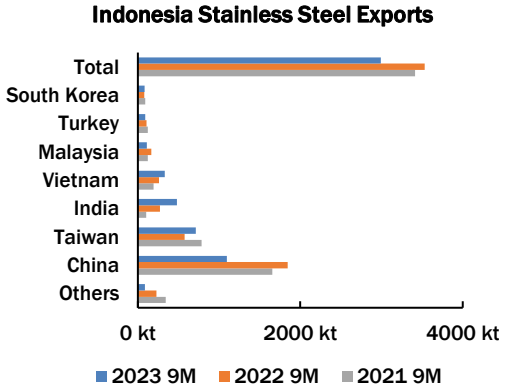
Indonesia

In 10M 2023, the 300 series production in Indonesia decreased by 14% YoY, with Tsingshan production increasing by 8% YoY and Delong plummeting by 72% YoY. Delong experienced a very steep decline in output in the first half of the year on the back of stakeholder disputes. The production was halted entirely in May-June. Thanks to the robust Chinese demand, the company was able to restart production in the second half of the year, with volumes showing steady growth.

Source: Zljsteel

We anticipate the production in Indonesia to be 4.4Mt in 2023 (–8% YoY), which translates into 328 kt of primary nickel demand. In 2024, we expect their production to amount to 5 Mt, with the nickel use rising to 379 kt.

In 9M 2023, stainless steel exports from Indonesia amounted to 3 Mt, declining by 542 kt (–15% YoY).



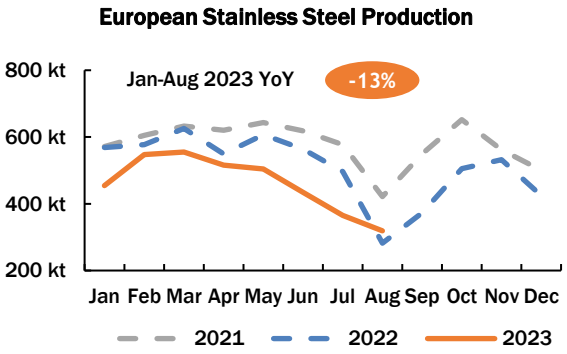
Source: Trade Data

Europe

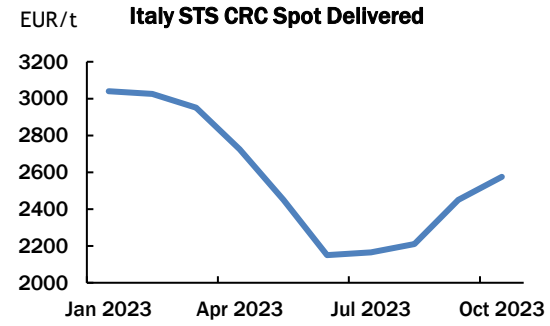
As the end of the year is near, the probability of any significant recovery in the European sector becomes almost negligible. Moreover, while the European energy sector has mainly been stable, the approaching winter poses another risk for the already vulnerable stainless steel sector.

While the current prospects remain mostly negative, top European manufacturers report that the issues with the extended destocking cycle have been largely resolved. However, it is highly doubtful that there will be any immediate pick-up in demand as the economy of the Eurozone has been worsening in recent months, with HCOB's PMI index, which is compiled by S&P Global, falling to the lowest level since November 2020.

Since our last issue, European stainless steel output has continued to contract further and further. Even if the upcoming winter proves to be warmer than the previous one, it is still likely to negatively impact manufacturing, even though the current gas storage levels in Germany are considered adequate. Furthermore, interest rates in the Eurozone remain high, albeit they stopped growing for the first time in ten months, which is yet another obstacle significantly impeding key end-use sectors.



Low order books have been the key issue throughout the year, affecting the European producers' bottom line. The stainless steel cold rolled coil spot prices have remained at the lower end, plunging dramatically from ~€5,150/t in April 2022 to ~€2,575/t in October 2023, although the prices have been increasing for the past three months. When it comes to prices, the key factor is the tightening of the European trade policies rather than any substantial pick-up in demand. In August, the EU announced an anti-circumvention investigation, which will likely to result in new anti-dumping duties for Vietnam, Turkey and Taiwan. Similar measures have already been introduced for the Indonesian stainless steel. Additionally, Europe is also going to introduce Carbon Border Adjustment Mechanism (CBAM) in 2026, aiming to level the playing field by subjecting steel imports to an increasing carbon surcharge. Due to the tightening of the trade policies, it is expected that the price gap of stainless steel between the US and the EU is most likely going to gradually shrink over time.



Source: Kallanish

As the European markets continue to go through a time of great uncertainty, with some stainless producers reporting lower demand than during the energy crisis of the last year, there is little to no indication that the users' appetite will improve any time soon. In our baseline scenario, we anticipate a decrease of 8% YoY in European stainless steel production for 2023.

Our proprietary end-use model shows that in Jan-Nov 2023, the demand for nickel by the downstream sectors in

Germany, which accounts for 24% of the total EU nickel use, has continued to shrink rapidly. According to the latest data, nickel end-use has fallen by a significant –11% YoY. The negative trend started as far back as in June 2022, and since January, it has consistently declined by double digits. Currently, there is no indication that the market is recovering.

Considering the bleak state of the European markets, ***we expect the stainless steel output in Europe to decline from 6.1 Mt in 2022 to 5.7 Mt this year, and we revise downward our forecast for the 2023 nickel demand to 142 kt Ni.*** While a positive momentum in Q4 2023 is expected, we do not yet believe it is a sign of a much-needed recovery, considering current Q3 levels are still considerably lower than compared to the previous year.

For 2024, we forecast that European markets will finally stabilise compared to the turbulent 2023 and will experience a growth of 4%, with the nickel demand growing to 148 kt in 2024.

USA

The US stainless steel sector has so far endured a similar downward trajectory to that of Europe. However, the overall outlook for the US market is quite positive, while the vulnerable and highly sensitive European market is going through a time of great uncertainty. Moverover, in the near future, some new capacities are expected in the US, such as Acerinox's $244 million investment in the North American Stainless mill, which is expected to increase its output by 20%.

Not only did the US end-use outperforms that of Europe, but the US end-use also experienced only a positive trajectory throught the year and has been up every month. In 2023, the overall nickel use is expected to increase by 5%. The current positive trend of nickel end use is mainly driven by the Automotive (+3% YTD), Oil and Gas (+13% YTD) and Construction (+12% YTD) sectors. No end-use sectors are expected to decline, although, since our last issue, the machinery is now expected to break even instead of experiencing growth.

In 2023, the USA's stainless steel nickel use is forecast to reduce by 6% to 31 kt, with the total melt output amounting to 1.9 Mt.

We believe that in 2024 the US melt output will outperform Europe's, although the scale of it largely depends on the broader risks of global recession as well as high interest rates, which already have been putting significant pressure on the global industrial and construction sectors. ***Thus, we expect that the US total melt output in 2024 will grow by 4%, which amounts to 2.0 Mt in 2024, with the nickel use increasing to 32 kt Ni.***

ALLOYS & SUPERALLOYS

In 2023, the demand for nickel alloys exceeded our expectations and continued the rally after the post-pandemic resurgence. We expect a similar positive trend to continue in 2024, driven primarily by the aviation and liquefied natural gas (LNG) sectors.

Project development in the oil & gas industry has experienced stagnation throughout 2023, with the total number of active oil rigs constantly decreasing and also seeing its sharpest fall in active drilling rigs since 2020, reversing the post-pandemic recovery trend.

At the same time, LNG trade continues to expand this year and is expected to increase by 4% as per BNEF. It is projected to increase by further 4% in 2024. Nickel alloys are essential for this application because of the strict safety regulation of LNG storage at temperatures of –162°C, further boosting the demand for alloys.

The 5 largest international oil companies plan to increase their 2023 CAPEX significantly (by +14% YoY vs 2022). However, the planned investment growth is only projected to be 3% YoY in 2024. Considering the ever-growing number of project bids won by the European and US mills and the solid financial performance of the oil & gas industry, we expect the use of nickel, especially in Inconel 625, to keep the momentum well into 2024-2025.

The aerospace sector had a strong rebound in 2022 and continued its momentum well into 2023. The positive trend has continued, with Asia recording its first YoY growth in August 2023 since the start of the pandemic. Overall, global air traffic rose by about 14% YoY.

In 2022, new orders for jet engines rose significantly, with commercial engine sales increasing by 14% and military jet engines by 10%. So far, 2023 has maintained a similar trend, with commercial engine sales rising by 23%, further boosting the demand for nickel in superalloys. However, military jet engine shipments so far have experienced a reduction of 3% YoY. At the same time, deliveries of new airplanes from Boeing and Airbus have kept up the positive momentum and increased by around 18% YoY. In the long term, Boeing also expects to boost its production to approximately 50 jets per month in 2025/2026 – a figure comparable with the pre-pandemic rate of 52 jets per month.

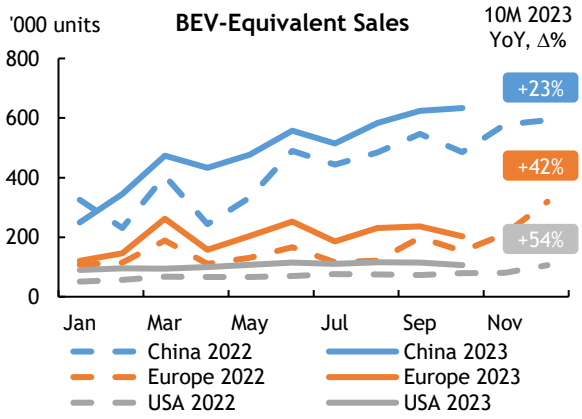
When it comes to China, the alloys and superalloys sectors have also been performing exceptionally well. Due to the rising risk of trade disruptions coming from the US and EU, the Chinese government has ordered to increase the production of superalloys and to raise self-sufficiency to 62% by 2030. Additionally, after 2025, Chinese-made aero engines will come into service, which will drive superalloy demand even further.

Overall, we expect the alloys sector demand to increase in 2023 to 185 kt (+8% YoY), while that of the superalloys sector to grow in 2023 to 68 kt (+15% YoY). In 2024, the nickel use in alloys and superalloys is expected to maintain its strong growth and reach 196 kt and 75 kt, respectively.

BATTERIES

The nickel use in the battery sector, although continuing to be one of the fastest-growing industries in terms of the primary nickel demand, has largely disappointed due to significant destocking across the whole battery value chain in China, higher-than-expected LFP share, and partial shift from BEV to PHEV sales in China, which have lower battery capacity and, in turn, lesser nickel content. As a result, despite the sales data continuing to show new highs for global EV deliveries, ***we have revised the nickel use in batteries downwards from the initially expected 567 kt Ni to 486 kt Ni (+4% YoY) in 2023.***

In 2024, however, we forecast a 26% increase to 614 kt Ni due to the beginning of a restocking cycle, wider EV penetration, better affordability amid lower prices and increasing availability of EVs in a highly competitive environment, optimisation of battery costs, and development of charging infrastructure.



Source: SNE Research

In Jan-Oct 2023, global BEV-equivalent sales[1] increased by 33% YoY. Following several years of rapid growth, the EV market seems to be entering a maturity phase, and grappling with the associated challenges of further expansion.

Sales in China reduced their growth rate to 23% YoY following the country's withdrawal of the EV subsidies at the end of last year. However, EV sales have been consistently rising in absolute values. For instance, 4.4 million BEVs were sold in China in Jan-Oct 2023, up from 3.7 million from a year ago (or +19% YoY), while PHEV sales surged almost twofold to 2.0 million (+87% YoY). Additionally, China has surpassed Japan as the world's largest automotive exporter, of a core part of which has been EVs.

Furthermore, support for the EV sector in China continues to flow. Recently, a national pilot involving eight separate ministries was launched to replace ICEs with NEVs in "public domain vehicle" fleets. This incorporates not only public buses but also taxis and government vehicles. This initiative targets 15 cities for charging infrastructure upgrades, with 700,000 new charging piles and 7,800 battery swapping stations and puts 600,000 more EVs on the road. When coupled with ongoing support for a rural EV buildout, this should ensure that the domestic China market continues to grow quicker than the rest of the world.

Sales in Europe rose by 42% YoY while constrained by the removal of subsidies in several countries and lower penetration rates. Additionally, there has been an influx of cheap Chinese EVs into the European market. In Jan-Oct 2023, the share of Chinese BEV deliveries increased twofold to 8% of total European BEV sales, with SAIC-owned MG being the fourth best-selling brand after Tesla, Volkswagen, and BMW. In September, the European Commission launched an anti-subsidy investigation to impose additional tariffs on Chinese EVs to protect local producers, potentially slowing down EV penetration rates in Europe, especially in the low-cost segment.

BEV-equivalent sales in the US have increased by 54% YTD in 2023, which could be attributed to the re-introduction of subsidies by the US Inflation Reduction Act (IRA).

Since our last issue, no significant gigafactories have been announced in Europe. However, there have been a few cancellations, such as Volkswagen scrapping their second battery factory. As we have said in our previous issue, the European battery sector runs a high risk of the planned battery production being delayed, scaled down or outright cancelled, unless Europe is going to catch up with the US by introducing incentives similar to IRA. As it stands, our forecast for the 55 announced factories is 1.5 TWh by 2030 in Europe, with over 45% of their output being provided by Asian companies. At the same time, the announced PCAM capacities in Europe make up 35% of the theoretical demand by the gigafactories, and CAM takes up about 50% of the demand.

Considering low available PCAM capacities in Europe, which is by itself heavily influenced by a limited material supply originating from within the region, we believe that nickel is going to be mainly exported from China, where it

[1] Under this methodology, HEV and PHEV are re-calculated in BEV equivalents according to their relative battery capacity ratio: HEV 2 KWh vs PHEV 12 KWh vs BEV 55 KWh

will be used in further expanding local PCAM capacities, further increasing China's influence over the market.

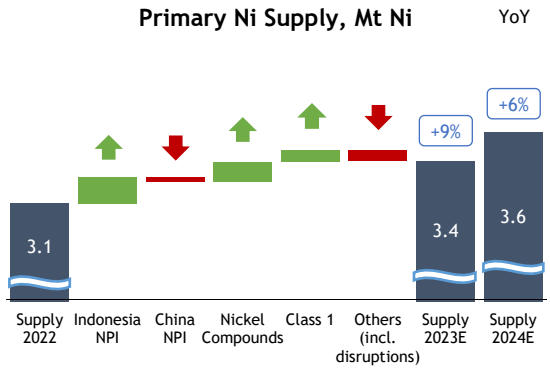
Looking at a policy level, as expected, the IRA has resulted into a great success for the US battery scene, with lots of new battery plant announcements happening in 2023, such as Samsung SDI and Stellantis JV in Kokomo, IN, or plant by Gotion in Manteno, IL.

At the same time, the Critical Raw Material Act introduced by the EU, which aims to process domestically 40% of the total annual use of strategic raw materials, has brought no positive changes to the struggling European battery sector. As discussed in our earlier issues, it already is and will still be quite challenging for the EU to attract new market participants and investors unless attractive incentives are introduced. This sentiment is shared by the BloombergNEF report, which we discussed in our last issue. It has concluded that setting up a new metal processing plant could be $400 million cheaper in the US than in Europe.

Looking at recent technological developments, Northvolt's partner Altris has recently announced a breakthrough in a sodium-ion technology based on hard carbon anode and Prussian White-based cathode. The cell holds 160 Wh/kg and has best-in-class energy density. It has a theoretical capacity of 170 mAh/g and an average output voltage of 3.2 V. For the time being, this technology is only envisioned for energy storage systems, with EVs having to wait for another few generations of technological development. However, this technology highlights the potential of sodium-ion batteries, which are seen as a low-cost competitor to the LFP batteries.

All in all, we still maintain our view that the EV sector will underpin a huge increase in long-term nickel demand. High-nickel bearing chemistries will gain the majority share as OEMs are likely to stay hesitant to use LFP or Na-Ion batteries in more than entry models. Considering the West's growing geopolitical tensions with China, which also includes a recent probe into cheap Chinese EVs flooding the European market, currently, it is unlikely that the West will be cooperating with the Chinese technology providers and EV makers to make a substantial shift towards introducing the LFP infrastructure as China is holding all the cards.

SUPPLY



Source: NN Analysis

A significant surplus that emerged in 2022 on the back of the strong Indonesian supply and weaker demand was maintained in 2023 and even further increased. This growth is primarily fuelled by the Indonesian NPI as well as nickel matte and intermediates from HPAL processing, which was partly offset by the decrease in Chinese NPI and FeNi production.

The high-grade market has also moved to a slight surplus in 2023 due to the continued rises in the Class 1 supply from new refining capacities in China and Indonesia.

Overall, the incremental growth of the NPI-to-matte conversion and HPAL capacities appears to be a significant oversupply factor leading to an increase in the production of both nickel sulphate and Class 1 nickel.

We have slightly revised upwards our forecast for the refined nickel production to 9% YoY in 2023, reaching 3.42 Mt Ni.

We reconfirm our previous forecast that the ramp-up of the Indonesian NPI, NPI-to-matte conversion capacities, HPAL and nickel sulphate projects is expected to continue, coupled with the commissioning of new Class 1 projects in China and Indonesia. As a result, ***we forecast the 2024 primary nickel production to grow further to 3.62 Mt Ni (+6% YoY).***

LOW-GRADE NICKEL

NPI

Indonesia continues to grow its NPI production capacities, raising them to 1.8 Mt Ni in 2023.

As a result of the growing NPI production, ore processing is projected to exceed 200 Mt in 2023. This substantial increase in volume underscores the critical significance of ore availability for the industry.

Most notably, the Indonesian nickel ore mining quotas suffered delays in the second half of 2023 as the regulators reverted to an earlier approval process. The government has stated that no new mining output quotas will be granted this year. Due to its limited supply, ore is now sold at a premium to the benchmark mineral price (HPM), which also affects the cost of nickel production. It is now expected that new quotas will only be issued in early 2024.

Ramp Up of New NPI Capacities in Indonesia

Project	2023E	2024E
IMIP	8*60MVA RKEF	
IWIP	10*48MVA RKEF 4*60MVA RKEF	
Delong Gunbuster	5*42MVA RKEF	8*42MVA RKEF
Lygend Obi Island	6*48MVA RKEF	
Qingdao Zhongcheng	1*33MVA RKEF	
Wanxiang	2*36MVA RKEF	1*36MVA RKEF
Huadi IP	1*39MVA RKEF	3*39MVA RKEF
Shangtai Kalimantan	1*42MVA RKEF	3*42MVA RKEF
Huabao IP		4*48MVA RKEF

Sources: Mysteel, NN Analysis

The Indonesian Nickel Miners Association (APNI) and Shanghai Metals Market (SMM) have signed a memorandum of understanding on the Indonesian Nickel Price Index. The goal is to form an index that better reflects domestic nickel prices. Starting from December 1, SMM has officially released Indonesia's domestic nickel ore price and NPI FOB Price Index.

Yet, it is not just the quantity but also the quality of the ore that requires attention. In their quest for higher profitability, NPI producers have focused on processing high-grade nickel ore. ***This has prompted a warning from the Indonesian Nickel Miners Association, cautioning that reserves of high-grade nickel ore may be depleted in approximately six years.***

Indonesia High-Grade Nickel Ore Reserves, Mt Ni

Nickel content	Probable	Proven	Total
1.7-1.8% Ni	5.8	6.1	11.9
1.8% < Ni	9.6	4.8	14.4
Total (1.7% < Ni)	15.4	10.9	26.3

Source: Indonesian Nickel Miners Association

Even a modest 0.1% decline in the ore's nickel content could result in a significant 100 kt drop in nickel output, considering existing production capacity. Our analysis of the Indonesian trade data shows that there has been a significant decline in the nickel content of NPI produced in Indonesia Morowali Industrial Park (IMIP) this year. In 2022, the average nickel content was 13%, but it has decreased to 11.5% in 2023.

However, despite the challenges, we still expect the NPI production in Indonesia to reach 1.32 Mt Ni (+16% YoY) in 2023 and 1.4 Mt Ni (+5%) in 2024, although the pace of the NPI growth is slowing down due to the depletion of the high-grade ore reserves and potential limitations of building new NPI plants in the country.

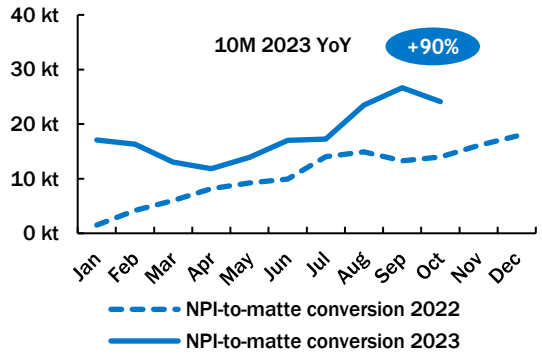
In our May issue, we estimated the Chinese NPI production to decline to 340 kt Ni in 2023. Nevertheless, the Chinese output was supported by robust stainless steel production and showed a much more moderate decrease. ***In 2023, we expect the production to fall to 390 kt Ni (–5% YoY). In 2024, the Chinese NPI output will likely fall to 320 kt Ni due to the ever rising competition with the Indonesian NPI.***

NPI-to-matte

As discussed previously, the demand for NPI in the current year has been receiving robust support from the growing Chinese stainless steel sector. In contrast, the demand for nickel sulphate within the battery industry remained notably weak. Consequently, Tsingshan made a decision to curtail its NPI-to-matte conversion activities.

In the second half of 2023, matte production has started in four new projects located in Indonesia Weda Bay Industrial Park (IWIP). We expect these projects to achieve full operational capacity by the year's end, resulting in a monthly nickel output of ~15 kt Ni. The new projects were designed for the battery value chain, and they do not posess Tsingshan's flexibility, which is an integrated stainless steel producer, so in the current tight market it is quite challenging for them to switch to NPI production.

NPI-to-matte conversion in Indonesia



Sources: Mysteel, NN Analysis

We estimate the NPI-to-matte conversion to reach 229 kt Ni and 346 kt Ni in 2023 and 2024, respectively.

Ferronickel

Revising our May estimates, we now expect the 2023 FeNi output to decrease even more to 302 kt Ni (–11% YoY), which is the lowest level in over a decade. The primary factors behind the decrease are: the continuing negative price dynamics (FeNi is traded at a discount to the LME, at a level close to the NPI prices); high production costs; fuel & electricity issues; some major producers' capacity utilisation rates being low.

Solway's subsidiary Pronico, with its Fenix plant in Guatemala, has remained suspended so far as it has faced unforeseen difficulties caused by the sanctions imposed on its companies by the US Department of Treasury (OFAC)

since the end of last year. Another Solway's facility – the Pobuzhsky plant in Ukraine – is on permanent care and maintenance (C&M) after it halted production in November 2022 due to the ongoing military conflict in Ukraine.

The major Japanese FeNi producer, PAMCO, has maintained a limited output level throughout 2023 following its volume-control policy to maintain profitability. Another Japanese facility, Hyuga, which is owned by Sumitomo Metal Mining, has also reduced its FeNi output in 2023. Northern Macedonian producer Euronickel Kavadarci, which was reportedly placed on C&M in 2022 due to high electricity prices, was relaunched in 2023 but is still producing well below its nameplate capacity. Another European producer, Larco from Greece, is still searching for an investor to relaunch its facility, which was placed on C&M late last year.

On the other side, the Burmese Tagaung Taung's nickel plant, which was facing operational challenges after the military coup in Myanmar (Burma) and the sabotage of the electricity pylons last year, has strongly ramped up, reverting back to its nameplate capacity in 2023. Operations at Eramet's Doniambo, a FeNi producer from New Caledonia, which were heavily disrupted by the blackouts and bad weather conditions in 2022, is gradually reverting to its normal production levels. Eramet reports that, assuming normal operations, the plant's output is expected at above 45 kt Ni in 2023, which could be a 3-year high. Another New Caledonian producer, Koniambo, which belongs to Glencore, has reported a growing YoY output in 2023.

We have revised downwards our May estimates to the extent that, depending on the market situation, the 2024 FeNi production could modestly rebound to 324 kt Ni (+7% YoY) driven by the new Indonesian-based facility Antam Halmahera launched in the second half of 2023 as well as the continuous ramp-up of the North Macedonian producer Euronickel Kavadarci. In early October 2023, Solway reported that after a review, the US OFAC had given the green light to relaunch the plant that was closed earlier because of the US sanctions.

Considering the rising costs of production as well as the continuing price pressure on the back of persisting oversupply (especially in Class 2 Ni products), some probable major reduction in the FeNi output could still take place as Glencore and Eramet have recently announced their intentions to withdraw from financing both New Caledonia's operations Koniambo and Doniambo, which puts around 75 ktpa of production capacities at risk. Furthermore, South Korean POSCO is advancing its plans to switch to nickel sulphate production with a corresponding decrease in FeNi production, while Japanese Pamco and Sumitomo Metal Mining will presumably keep their FeNi output at low production levels in 2024.

To sum it all up, rising costs, a depressed price environment as well as the continuous surplus on the nickel market add some additional uncertainty to our forecast.

Nickel Oxide & Utility Nickel

We have revised downwards our May YoY 2023 estimates of the nickel oxide and utility nickel output and now forecast a decrease to 28 kt Ni (–23% YoY).

A single feed source supplier of the Japanese Matsusaka refinery, Indonesian-based nickel matte producer PTVI, has reported plans to increase its output YoY in 2023, benefiting from improved mine grades and better furnace performance after the C&M activities completed in 2022. However, despite the higher feed source availability from PTVI, Vale has reported a lower YoY refined nickel production guidance for 2023. Our understanding is that under the pressure of the unfavourable price environment and lower STS production in Japan, Matsusaka will produce even less Tonimet this year than we expected in May, which could be partly offset by a higher crude nickel oxide output, which is used as a feed source for Vale's Clydach refinery in the UK.

Contrary to our May projections, we now expect Cuban Punta Gorda's output to decrease YoY in 2023. It seems that the previously announced investment programme aiming to upgrade the production equipment to debottleneck output has not yet yielded its expected results.

We have revised our May assumptions, and presently, we expect the 2024 nickel oxide and utility nickel production at lower levels, which might remain relatively flat YoY at around 30 kt Ni. We believe that Matsusaka's Tonimet production will remain flat YoY, while Cuban Punta Gorda plant will modestly increase its output depending on the progress of their production equipment modernisation programme and the state of the Cuban economy, which is still struggling from the consequences of a severe economic crisis on the island state.

HIGH-GRADE NICKEL

Class 1 Nickel

Our latest Class 1 production estimate for 2023 is at 897 kt Ni (+9% YoY). Nickel metal and powder production is growing steadily in 2023, primarily due to the launch of new Class 1 nickel capacities in China and Indonesia.

Vale's Copper Cliff pellets and powder production is expected to grow YoY on the back of the planned increased 3rd party feed processing in line with the strategy to maximise the utilisation and performance of its downstream operations challenged by the decreased own sourced ore supply from Creighton mine due to extended

maintenance. Long Harbour rounds' output is forecast to fall YoY as a result of the maintenance activities at the refinery and the ongoing planned transition period between the depletion of the open pit Ovoid mine and the ramp-up of the underground VBME project.

Despite the ramp-up period after the maintenance in Q2 and regional water supply outage in July, the UK-based Clydach refinery is anticipated to increase its carbonyl nickel output YoY in 2023, given the expected growth in the availability of PTVI matte as well as higher YoY supply of crude nickel oxide from Matsusaka.

Glencore's Nikkelverk refinery in Norway is expected to substantially increase its YoY output in 2023, aiming to produce 95 kt Ni. The Norwegian refinery is ramping up after the strikes at the refinery and the Raglan mine last year, which have impacted not only the 2022 output but the 2023 nickel production as well, given the long lead time from ore mining in Northern Quebec to finished nickel production in Norway and maintenance outages that impacted the Sudbury smelter.

Trade data shows that Glencore is increasing the imports of carbon-intensive Indonesian matte in 2023 (~14 kt Ni in 10M 2023, +237% YoY), which could adversely affect the carbon footprint of its production.

In Australia, Glencore is expected to maintain its production at the Murrin-Murrin plant flat YoY, partly because of the longer-than-expected C&M in H1 2023. BHP's Nickel West is forecast to grow its 2023 total refined nickel output YoY in a minor way, provided that $NiSO_4$ output will slightly rise while Class 1 nickel production will stay almost unchanged.

Japan-based nickel producer Sumitomo Metal Mining is steadily boosting its 2023 Class 1 nickel output YoY after experiencing the weakest results over several years in 2022, caused by feed shortage from the Filipinos JV's HPAL operations and Indonesian PTVI.

Ambatovy – a nickel producer from Madagascar – is gradually ramping up its nickel briquette production, moving closer to 40 kt Ni in 2023.

Anglo American's Rustenburg 2023 nickel cathodes production is expected to remain flat YoY due to an unplanned municipal water stoppage at the processing complex in Rustenburg and lower metal content in the concentrate as well as Eskom load curtailment. The second biggest South African nickel producer – Implats – is projected to stay relatively flat YoY in 2023 due to maintenance activities in the first half of the year as well as the continuous intermittent regional power interruptions impacting operations.

Sibanye-Stillwater's Sandouville in France plant is showing a modest YoY growth of nickel cathodes' production in 2023. Operational issues at the cathode unit, which impacted output in H1 2023, have been resolved, resulting in production stabilization during Q3 2023. However, it was still adversely affected by heavy rainfalls in this period.

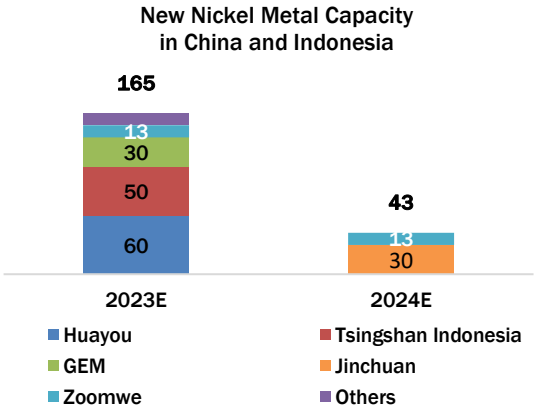
Despite the somewhat improved operational performance, the Sandouville refinery remains in the red due to the inflationary cost pressure, elevated maintenance costs and a negative YoY trend in the average nickel price. The operations are not commercially viable at current nickel prices, and Sibanye's management is progressing with optimisation studies aimed at securing a sustainable future for the Sandouville refinery.

We forecast the 2024 global nickel metal production to keep growing to 985 kt Ni (+10% YoY), mainly on the back of the ramp-up of the new Class 1 nickel capacities in China and Indonesia.

New Class 1 Capacities in China and Indonesia

Since our May issue, Huayou and GEM have registered their brands on the LME, while CNGR applied for the registration at the end of October. In total, more than 100 kt of new nickel cathode production capacity could be commissioned in China this year. In addition, an Indonesian JV of Tsingshan and CNGR with a planned capacity of 50 kt launched production in August.

The new volumes of nickel metal will create additional pressure on prices. The peculiarity of the situation is that the new cathode production facilities mainly use Indonesian raw materials, the cost of which is so far linked to the LME price. As a result, Class 1 overproduction will undermine the value of Indonesian nickel resources.



Source: NN Analysis

Russia

Since the beginning of 2023, Nornickel has continued to test the machinery from new suppliers and replace the retired mining equipment with new technology. The successful implementation of equipment replacement is essential to delivering on the production plans.

In Q3 2023, Norilsk's consolidated nickel output increased by 21% QoQ to 54 kt. This growth is attributed to processing the high-grade matte from the Polar Division that was earlier accumulated during the inter-navigational season. In the named period, Nornickel produced and

supplied a trial batch of premium quality nickel for the electroplating sector. The Company plans to increase these types of products, which should help diversify its sales to new markets.

In 9M 2023, Nornickel's total nickel output decreased by 9% YoY to 145 kt. The decrease is due to the current scheduled annual repairs of furnaces at Nadezhda Smelter and a scheduled maintenance of the grinding mill at Talnakh Concentrator in Q1 2023.

Considering all these ongoing activities, the Company reconfirms its earlier 2023 production guidance from its own Russian feed at a range of 204-214 kt Ni. The production programme targets for 2024 will be announced as usual at the beginning of 2024.

Following our May issue, we reconfirm that Nornickel continues its assets' modernisation and repairs programme aimed at improving industrial safety. As part of this program, the major repairs of furnace #2 at Nadezhda Plant have been postponed and are expected to affect the output of finished products in 2024. During the demolition of the old smelter and the launch of the new one, the main processing load will be redistributed to furnace #1.

In a statement made on November 3, 2023, Sergey Malyshev, Senior Vice President – Chief Financial Officer of the Company, said that next year, the Company will be facing several challenges related both to costs (inflation and new export tax) and to revenue (major reconstruction of a furnace at Nadezhda Plant and uncertain situation on metal markets).

Nornickel has successfully inaugurated its Sulphur Programme at the Nadezhda Smelter. It aims to drastically reduce sulphur dioxide (SO_2) emissions in Norilsk, significantly improving the city's air quality. The construction stage of the Sulphur Programme took more than three years. It is a unique, brand-new, state-of-the-art innovative facility equivalent in size to seven football pitches that has created approximately 500 new jobs to ensure its seamless round-the-clock operation.

The Nadezhda Smelter sulphur complex will reach its full-scale capacity in phases. ***With its completion, Norilsk anticipates a minimum 20% reduction in overall pollutant emissions in 2024 only. By 2025, the city will see a 45% reduction in sulfur dioxide emissions compared to the 2015 levels.***

The project at the Nadezhda Smelter leverages a technological process that converts sulphur dioxide into sulphuric acid. The acid is then neutralised using limestone to make gypsum, which is safely managed within a designated storage facility.

Nickel Compounds

The battery sector – a major nickel sulphate user – continues to be one of the fastest-growing industries in terms of the primary nickel demand. The volumes of nickel sulphate production are largely determined by the amount of available feed sources. Nickel sulphate can be produced from various feed sources using different production routes either directly from such intermediates as MHP, MSP, nickel matte, crude nickel sulphate, or by Class 1 nickel dissolution, and by processing recycled materials (e.g. battery scrap).

We have revised downwards our previous estimates for the 2023 production of nickel compounds from the primary sources, excluding Class 1 nickel dissolution, to 506 kt Ni (+34% YoY) due to lower supply of NPI-made matte and weaker demand from the battery industry.

Despite complex price dynamics, the nickel sulphate production growth continues, boosted by the planned launches and ramp-ups of the new & existing HPAL capacities in Indonesia. On top of that, the New Caledonian Goro plant is steadily growing its 2023 MHP output YoY, while the PNG-based Ramu plant is showing excellent operating efficiency, producing at a rate over 100% of its nameplate capacity in 2023.

Notwithstanding some operational issues related to enhanced production rates, integrated nickel sulphate producers also aim to increase their output. Australian BHP is slowly growing its $NiSO_4$ production at Kwinana. The same relates to a somewhat complicated ramp-up at Terrafame's Talvivaara battery chemicals plant. It decided to stop production in June-July following a scheduled maintenance shutdown in May, as it was heavily pressured by the declining prices for nickel sulphate, but then it restarted production in August.

POSCO's Gwangyang in South Korea sticks to its plans to convert a 20 ktpa FeNi line to making nickel matte for nickel sulphate production, which is to be launched in late Q4 2023. The single major contributor should be Lygend Harita, the first nickel sulphate producer in Indonesia, which, according to our latest estimates, is aiming to produce over 10 kt of nickel in 2023.

Considering price-related risks, we have also reviewed our May estimates and now expect the production of nickel chemicals to soar to 663 kt Ni (+31% YoY) in 2024. The major drivers of the 2024 growth should remain the same – namely, the development of the NPI-to-matte conversion facilities and the expected launches and ramp-ups of the new & existing HPAL capacities in Indonesia, Australia, New Caledonia, and South Korea.

In 2023-2024, Class 1 nickel dissolution is expected to decline from the previous year's level due to the abundance of the semis from Indonesia and other regions, NPI-to-matte conversion and a growing share of battery scrap.

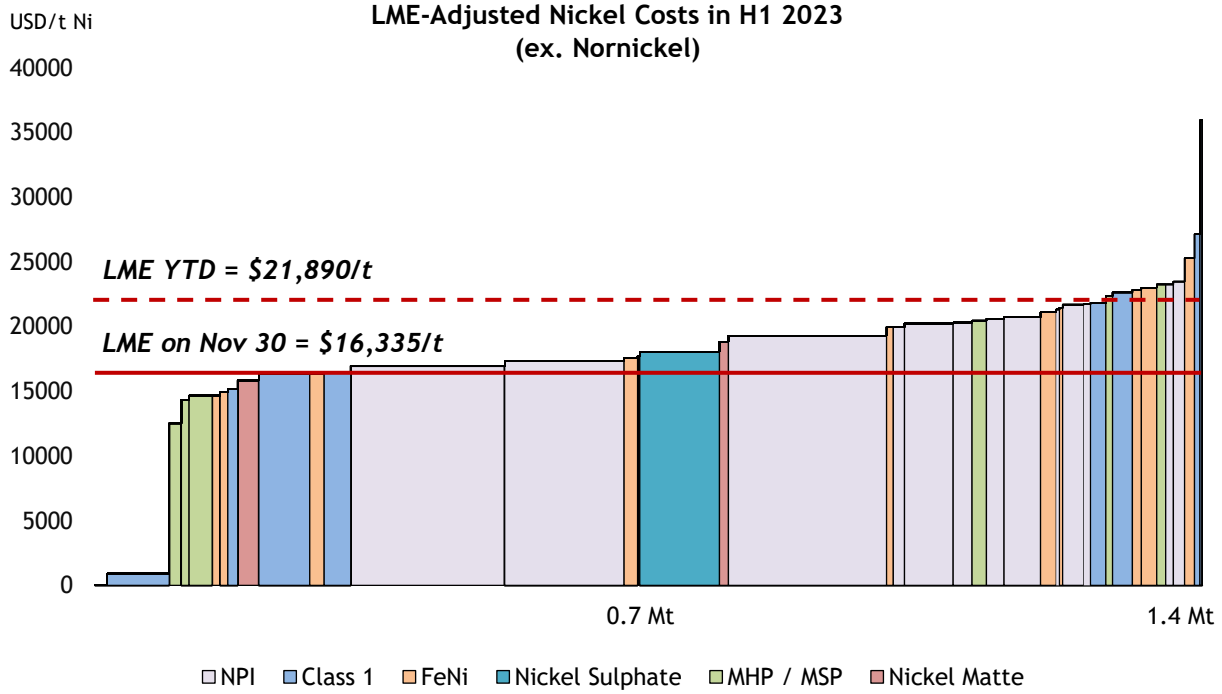
HPAL

Following the commissioning of the initial three HPAL projects in Indonesia, the industry eagerly expected a quicker capacity expansion. However, this year's developments have revealed that the ramp-up process may require more time than initially expected. The inaugural HPAL project in Indonesia, established as a JV between Lygend and Harita, was designed with a planned production capacity of 120 ktpa Ni. In 2021, the project achieved a significant milestone by commissioning the first phase, providing a capacity of 37 ktpa Ni. Subsequently, it took approximately a year to add the second phase, contributing an additional 18 ktpa Ni. The remaining 65 ktpa Ni capacity was initially expected to be commissioned by the end of 2023. However, the latest information suggests that the company postponed the ramp-up until 2024.

Huayou, the company with the most significant pipeline of HPAL projects in Indonesia, launched its second HPAL project, named Huafei, in IWIP in 2023. Initial reports indicated that all six production lines, with a collective capacity of 120 ktpa Ni, would be commissioned by the end of 2023. However, recent updates suggest that only 60 ktpa will be operational this year. Furthermore, it has also been reported that Huayou is postponing their Huashan project in Weda Bay. Notably, no technical challenges during the execution of the IWIP projects have been reported so far. The most plausible reason for these delays and postponements appears to be the insufficient demand by the battery sector. In light of the global battery market's erratic dynamics, it has become imperative to make prudent adjustments to the capacity ramp-ups.

We see the nickel production by the Indonesian HPAL projects increasing to 153 kt Ni (+71% YoY) and 294 kt Ni (+92% YoY) in 2023 and 2024, respectively.

PRODUCTION COSTS



Sources: Company reports, SMM, LME, NN Analysis

It has been a turbulent year for the nickel industry as many nickel producers were facing decreased profitability against the backdrop of a depressed price environment and increases in production costs caused by various factors such as lower by-product credits, growing mining inflation rates, rising labour and contractor services costs, higher electricity & fuel costs, logistical and operational constraints.

Based on the details presented in the producer's quarterly reports, it appears that numerous Class 1 nickel producers experienced a substantial increase in cash costs during 2023. For example, Vale's Sudbury division has reported elevated costs at $21,645/t in Q3 (+13% YoY), while its VB & LH operations have shown a substantial increase to $30,316/t (+81% YoY). This surge can be attributed to the ongoing transition of VB to underground operations and additional maintenance at the Sudbury refinery in Q3 which lead to decreased sales YoY.

Glencore has reported a noteworthy 101% YoY increase in cost in H1 2023 at $16,358/t for its Class 1 operations (Integrated Nickel Operations & Murrin Murrin). This

increase primarily stems from the supply chain impacts of 2022's prolonged Raglan strike on its refined own source nickel production at Nikkelverk. Similarly, another Class 1 Ni producer, Sherritt, has reported a considerable growth in its operating costs for Ni by 59% YoY to $15,366/t in 9M 2023, primarily as a result of higher mining, processing and refining costs and lower fertilizer and cobalt by-product credits.

Conversely, Ambatovy demonstrated a 16% reduction in its nickel breakeven costs in Q3 2023, benefiting from lower coal and sulphur prices, coupled with increased production, but the costs were still above the current nickel price and amounted to $22,707/t Ni.

Ferronickel producers are traditionally particularly sensitive to nickel price fluctuations. Both owners of the New Caledonian ferronickel giants – Eramet and Glencore – have recently announced their plans to cease funding these facilities. In Q3 2023, Eramet reported a slight 2% reduction in the cash cost of its FeNi production to $18,078/t Ni. This decrease was attributed to lower fixed costs and a positive volume effect, but was partially offset by a negative price effect on nickel ore and an unfavorable FX impact.

In turn, South 32 has increased its operating unit costs at Cerro Matoso by 13% YoY to $11,332/t Ni in H1 2023, as lower price-linked royalties, was more than offset by a stronger Colombian peso and higher labour costs. Additionally, in H1 2023, Anglo American facilities (Barro Alto & Codemin) have reported an increased C1 cost by 13% YoY at $12,125/t Ni, reflecting the impact of higher production costs due to a lower-grade ore as well as higher consumable input prices.

In H1 2023, another low-grade Ni product, NPI, exhibited a reduction in YoY costs. According to the data from analytical agencies, the weighted average cost for Chinese NPI producers has decreased by 20% YoY in H1 2023 to around $14,500/t Ni, presumably due to lower YoY ore prices. Simultaneously, the Indonesian NPI producers experienced a slight decrease of 2% YoY in their weighted average cost in H1 2023, amounting to around $11,600/t, as lower costs related to nickel ore and labour were partly offset by higher energy costs.

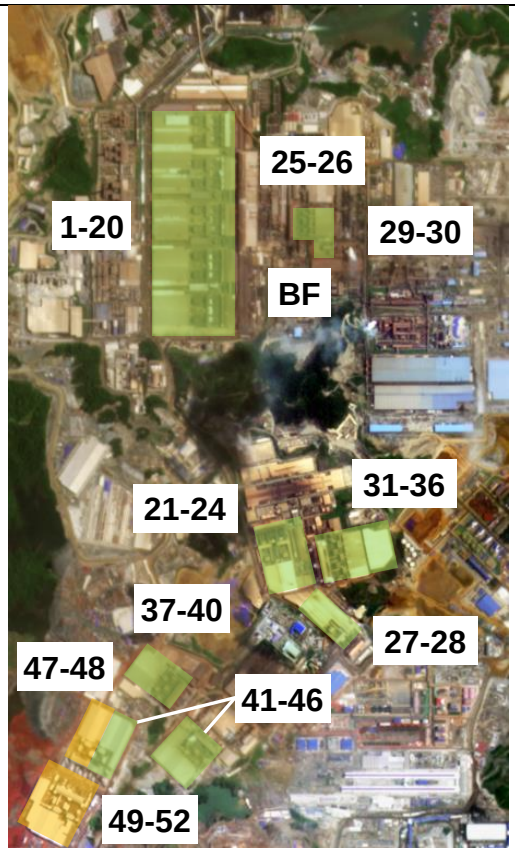
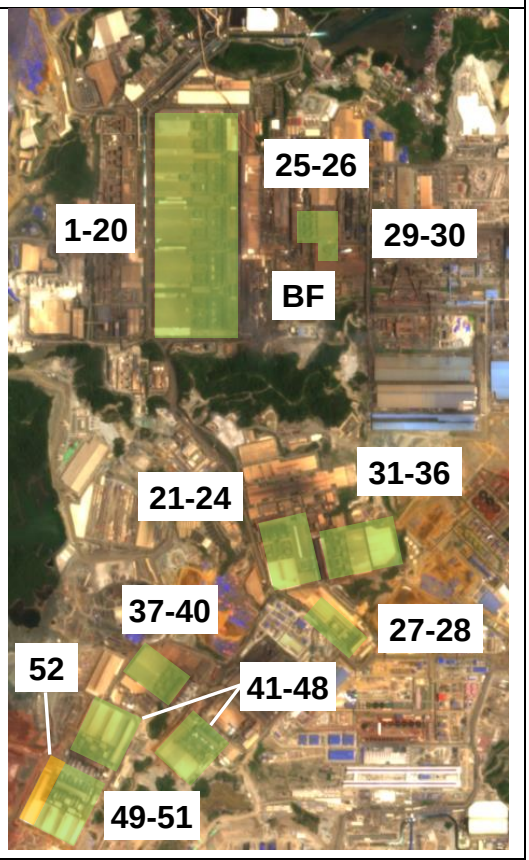
Intermediate nickel producers have observed an increase in production costs. In Q3 2023, FQM reported a modest increase in costs by 4% YoY to $20,900/t Ni, reflecting a reduced production of MHP as well as higher costs related to labour, contractors and maintenance costs. Nickel 28 has reported an increase of 9% YoY in actual cash cost in 9M 2023 to $7,143/t Ni at its Ramu plant. Meanwhile, Indonesian MHP producer PT HPL reported a substantial growth in YoY cash cost in H1 2023 by 177% to $7,304/t Ni due to a sharp drop in Co by-product credits. In Q3 2023, however, its costs declined to $6,824/t.

Indonesian nickel matte producer PTVI reported a decrease in its cash costs in Q3 2023 by 15% YoY to $9,915/t Ni, mainly due to reduced fuel costs. Nickel Industries' Hengjaya Nickel said its Q3 operating cash cost declined by 13% QoQ to $11,379/t Ni due to falls in nickel ore, smelting coal and electricity prices.

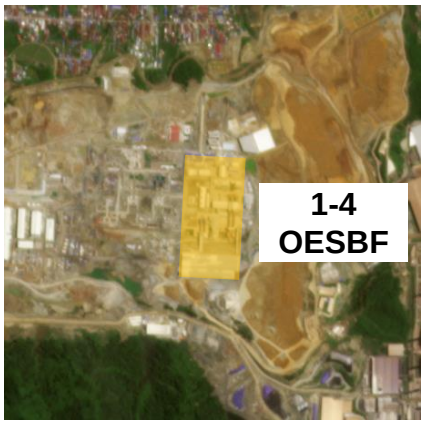
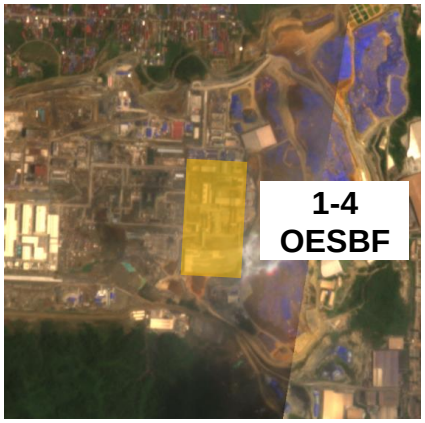
On the cash cost curve graph provided above, we have shown our estimates of the LME-adjusted costs of various nickel products' producers in H1 2023 based on the publicly reported data from themselves as well as according to our internal calculations & assumptions. ***LME-adjusted costs refer to production costs adjusted to the LME deliverable Class 1 by adding an assessed product premium or discount for each form of nickel for the corresponding period.***

With the average nickel price in 2023 YTD being 21,890/t (as of November 30), around 10% of global nickel producers are making losses. However, if we look at the current LME nickel price, the number of loss-making producers is accounting for more than a half of global nickel supply, considering the current level of discounts on Class 2 nickel products. Given the possibility of the price downturn persisting, there is a concern that the annual results could deteriorate even further. All those risks and factors intensify the challenges for the high-cost, loss-making producers who are already grappling with significant pressure.

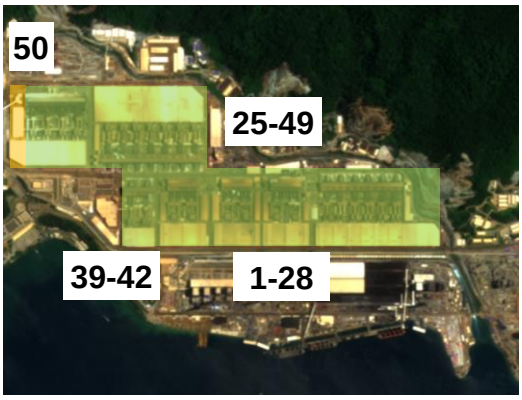
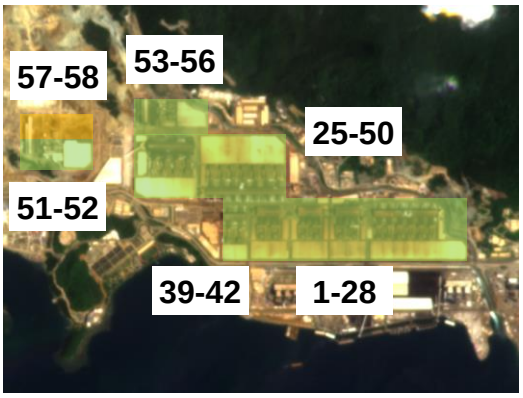
SUPPLEMENTARY MATERIALS

Figure 1: Indonesia Morowali Industrial Park		
Date	Apr 2023	Oct 2023
Satellite Image		
Lines under Construction	6 = 65 kt Ni (annual capacity)	1 = 11 kt Ni (annual capacity)
Completed Lines	46 + 1BF = 450 kt Ni (annual capacity)	51 + 1BF = 504 kt Ni (annual capacity)

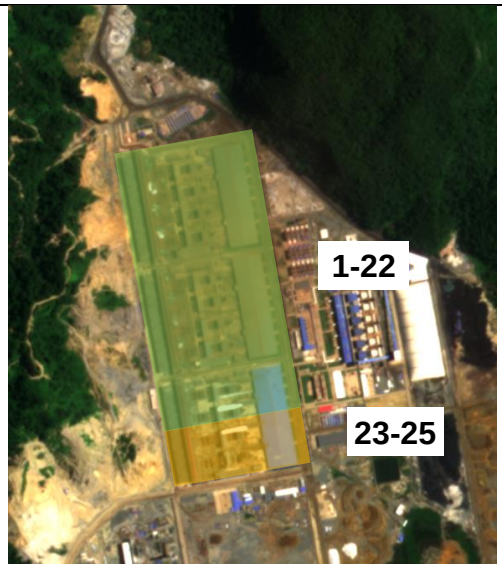
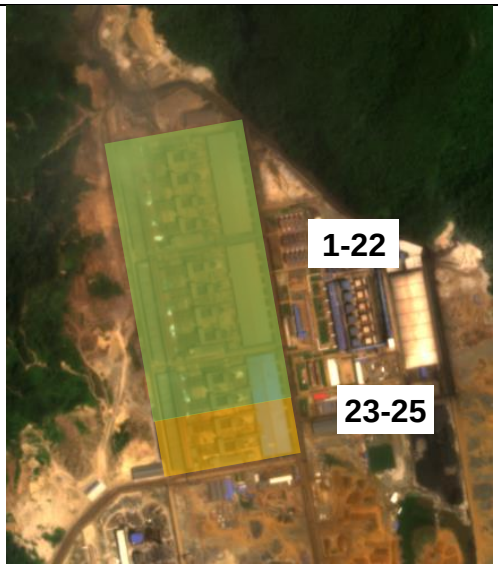
Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 2: ZhongTsing New Energy		
Date	Apr 2023	Oct 2023
Satellite Image		
Lines under Construction	4 OESBF = 40 kt Ni (annual capacity)	4 OESBF = 40 kt Ni (annual capacity)
Completed Lines	0	0

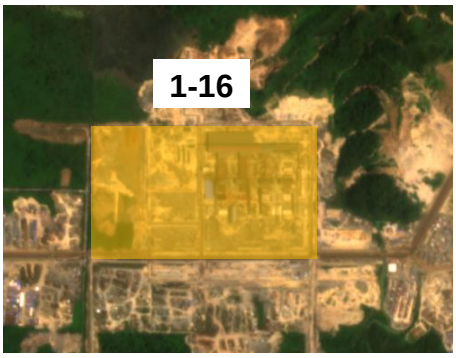
Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 3: Indonesia Weda Bay Industrial Park		
Date	Apr 2023	Oct 2023
Satellite Image		
Lines under Construction	1 = 11 kt Ni (annual capacity)	2 = 21 kt Ni (annual capacity)
Completed Lines	49 = 500 kt Ni (annual capacity)	56 = 574 kt Ni (annual capacity)

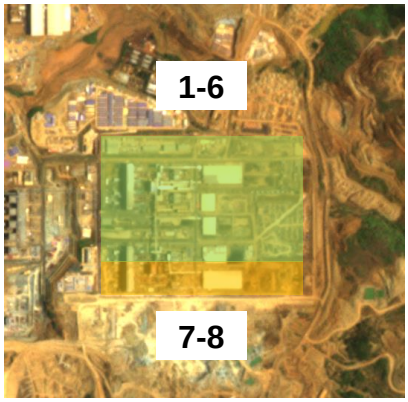
Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 4: PT Gunbuster		
Date	Apr 2023	Oct 2023
Satellite Image		
Lines under Construction	3 = 22 kt Ni (annual capacity)	3 = 22 kt Ni (annual capacity)
Completed Lines	22 = 164 kt Ni (annual capacity)	22 = 164 kt Ni (annual capacity)

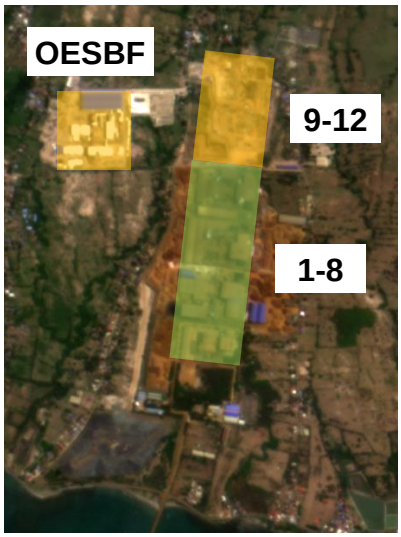
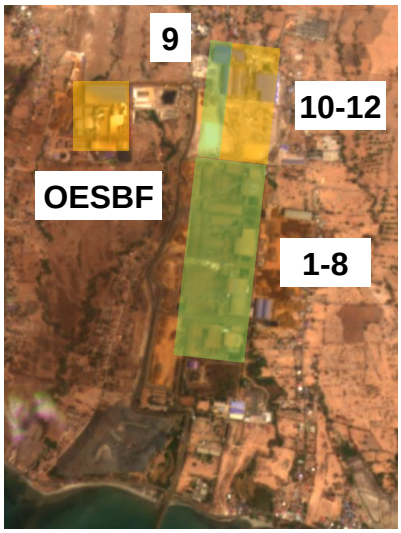
Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 5: PT Nica Nickel Indonesia		
Date		Oct 2023
Satellite Image		
Lines under Construction		16 = 120 kt Ni (annual capacity)
Completed Lines		0

Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 6: Lygend		
Date	Mar 2023	Oct 2023
Satellite Image		
Lines under Construction	2 = 22 kt Ni (annual capacity)	0
Completed Lines	6 = 65 kt Ni (annual capacity)	8 = 87 kt Ni (annual capacity)

Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 7: Huadi		
Date	Mar 2023	Oct 2023
Satellite Image		
Lines under Construction	4 + 1 OESBF = 30 kt Ni (annual capacity)	3 = 15 kt Ni (annual capacity)
Completed Lines	8 = 37 kt Ni (annual capacity)	9 + 1 OESBF = 52 kt Ni (annual capacity)

Sources: Planet Labs Inc, Mysteel, NN Analysis

Figure 8: Indonesia Huabao Industry Park		
Date		Oct 2023
Satellite Image		
Lines under Construction		12 = 132 kt Ni (annual capacity)
Completed Lines		0

Sources: Planet Labs Inc, Mysteel, NN Analysis

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GLOSSARY OF TERMS

Abbreviation	Term
APNI	Indonesian Nickel Miners Association
BEV	Battery electric vehicle
BF	Blast furnace
CAGR	Compound annual growth rate
CAM	Cathode active material
CBAM	Carbon border adjustment mechanism
COTR	Commitments of traders report
C&M	Care and maintenance
EF	Electric furnace
ESG	Environmental, social, governance
EV	Electric vehicle
FAI	Fixed asset investment
FeNi	Ferronickel
FX	Foreign exchange
GWh	Gigawatt-hours
HCOB	Hamburg Commercial Bank
HEV	Hybrid electric vehicle
HPAL	High-pressure acid leaching
IMIP	Indonesia Morowali Industrial Park
IWIP	Indonesia Weda Bay Industrial Park
JV	Joint venture
kt	Thousand tonnes
ktpa	Thousand tonnes per annum
KWh	Kilowatt-hours
LFP	Lithium iron phosphate battery
LME	London Metal Exchange
MHP	Mixed hydroxide precipitate
MSP	Mixed sulphide precipitate
Mt	Million tonnes
Mtpa	Million tonnes per annum
MVA	Megavolt-ampere
NCM	Nickel cobalt manganese battery
NEV	New energy vehicle (battery electric and plug-in)
Ni	Nickel
$NiSO_4$	Nickel sulphate
NPI	Nickel pig iron
OESBF	Oxygen-enriched side-blown furnace
OFAC	The Office of Foreign Assets Control
PCAM	Precursor cathode active material
PHEV	Plug-in hybrid
PMI	Purchasing managers index
QoQ	Quarter-on-quarter
RKEF	Rotary kiln-electric furnace
SHFE	Shanghai Futures Exchange
TWh	Terawatt-hours
YoY	Year-on-year
YTD	Year-to-date