Commodity markets

Nornickel metals' applications

Application area	Description
PGMS	
Automotive industry	Palladium, platinum, and rhodium are used as the active material in automotive exhaust gas catalysts to minimise the vehicles' environmental impact
Hydrogen solutions	Platinum, palladium, iridium, and ruthenium are widely used in rapidly developing hydrogen technologies. Platinum group metals find application as catalysts in low-carbon hydrogen production as well as for hydrogen purification, transportation, and use as an energy source in fuel cells
Chemical and petrochemical industries	Palladium, platinum, and rhodium are used as catalysts in chemical and petrochemical processes to boost process performance
Jewellery	Palladium and platinum are used in all kinds of jewellery, which is renowned for its beauty but also for durability
Electronics	Palladium is used as material for capacitors, motherboards, and other components, while platinum is primarily used in hard drives, and rhodium in coatings for connectors and contacts
Healthcare	PGMs are extensively used as catalysts in drug synthesis. Palladium has also found wide application in dentistry, while platinum is used in medical devices such as pacemakers and as an active ingredient in anti-cancer medicines
Glass fibre and optical glass	Platinum and rhodium are used to manufacture bushings for making glass fibre and optical glass
NICKEL	
Mechanical engineering, chemical and petrochemical industries, and construction	Nickel is used in stainless steel production. Adding nickel as an alloying element to stabilise the austenite structure enhances steel's corrosion resistance, high-temperature properties, weldability, formability, and resistance to aggressive environments
EV batteries	Nickel is a key element used in the production of precursor cathode active materials for EV batteries. The dominating technologies include nickel-intensive NCM and NCA batteries, owing to their higher volumetric and gravimetric energy density, which increases drive range. Nickel-based batteries are also more recyclable and reusable than other types of batteries
Aerospace industry	Nickel alloys are highly resistant to heat and aggressive environments and are used in the manufacturing of aircraft engines
Renewable energy	Nickel alloys are used in wind, solar, and geothermal power generation
COPPER	
Automotive industry	The automotive industry uses copper in batteries, electric motors, inverters, wiring, and charging infrastructure. Transport electrification is expected to become a key driver behind copper demand in this decade
Construction and air conditioning and cooling systems	The construction sector uses copper in pipes and tubing, heating and cooling systems as well as in wall cladding. Electrical and communication cables are also mostly made of copper
Renewable energy	Copper is intensively used in the construction of wind, solar, and other types of renewable power plants
Electronics and home appliances	Copper is used in electronics and home appliances due to its excellent electrical and thermal conductivity
Network infrastructure	Copper is used in power generation, transmission, and distribution as well as in all types of wiring. A strong push for transport electrification and transition to renewable energy will require significant expansion of distribution networks

Nickel market

Key market trends

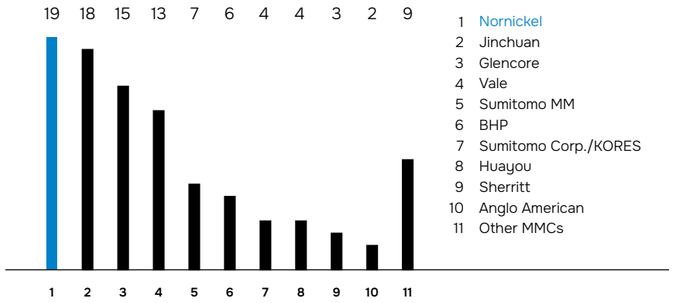
Nickel surplus persisted in 2023, exceeding 200 kt (compared to 113 kt of surplus in 2022), mostly in the low-grade nickel market. However, the high-grade exchange nickel market remained balanced as the inflow of metal to exchange warehouses was insignificant while alloys and specialty steels continued to generate steady demand.

In 2023, nickel was the worst performer among base metals on the London Metal Exchange (LME) due both to a significant surplus in the Class 2 market owing to oversupply of NPI in Indonesia following the commissioning of new capacities to produce nickel cathodes in China and Indonesia and the price correction following a massive short squeeze and growing speculative trading in the past year.

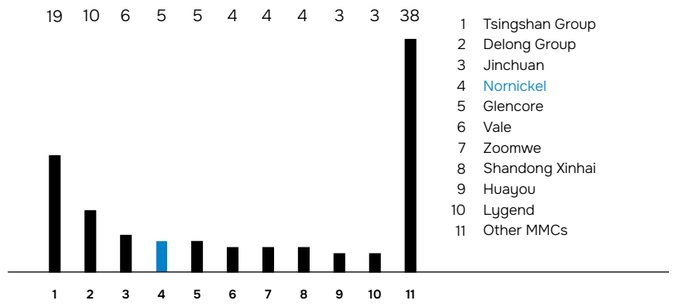
Early in the year, the price exceeded USD 31,000/t but dropped to USD 22,000/t in mid-March triggered by news that some Chinese nickel producers were considering launching production of nickel cathodes in China and Indonesia as early as in 2023. Another headwind was weak domestic demand in China amid prospects of further monetary policy tightening in the US and Europe.

In April, nickel prices rebounded to above USD 25,000/t, spurred by the short covering by speculative players, lower exchange inventories, and a weaker US dollar. The growth, however, was curbed by weak market fundamentals, and as a result the price slipped to USD 20,000–21,000/t in late May.

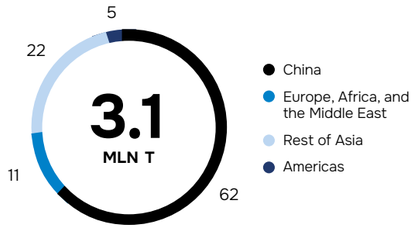
Nornickel – No. 1 in Class I nickel production, %[1]



Nornickel – No. 4 in primary nickel production, %[1]



Primary nickel consumption by region, %



Source: Company data

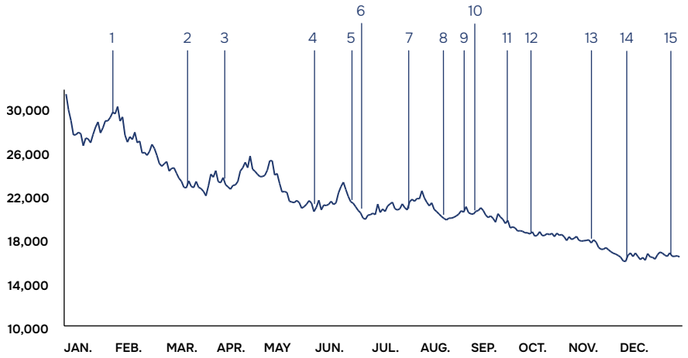
[1] Sources: producer reports, Company analysis as of early March 2024

In June–July, the LME nickel fluctuated within the range of USD 20,000–23,000/t as the expected recovery of the Chinese economy slowed down. In August, the price was supported by the news of a clampdown on illegal mining in Indonesia, followed by delays in the distribution of Indonesia's new quotas for nickel ore mining.

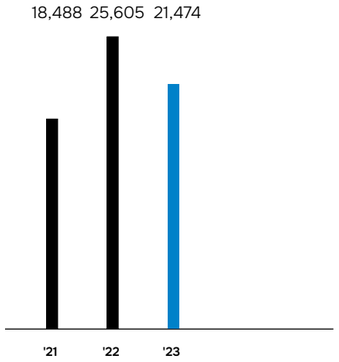
In the fourth quarter, nickel price fell below USD 20,000/t due to a surge in supply, weak demand from the European and US stainless steel sectors, and a record-high number of LME short positions of investment funds amid inflationary pressure and high interest rates around the world. Despite news that Indonesia wouldn't approve any new nickel mining quotas for 2023 and the country's high-grade nickel resources could face depletion in six years, the LME nickel plunged to USD 16,000/t late in the year.

As a result, the average nickel price in 2023 amounted to USD 21,474/t, or 16% below the average 2022 price (USD 25,605/t).

LME nickel price in 2023, USD/T



Average annual nickel prices, USD/T



Source: London Metal Exchange (cash settlement)

1. EV producers start to cut prices due to slowdown of demand growth
2. US banking crisis
3. LME announces action plan to strengthen its markets
4. Indonesia puts nickel export levy on hold
5. Huayou Cobalt launches Huafei HPAL project in Indonesia
6. China extends EV tax benefit scheme to 2027
7. LME approves Huayou's nickel cathodes as new brand
8. Indonesia arrests former top official accused of illegal mining
9. Tsingshan starts production of nickel cathodes in Indonesia
10. Distribution of Indonesia's mining quotas is delayed
11. The announcement, that Indonesia will not approve any new nickel ore mining quotas for 2023
12. Glencore to stop funding its Koniambo FeNi project
13. LME approves listing of GEM's nickel cathodes
14. Talks about a new Indonesian nickel price index
15. Germany cancels tax benefits for EVs

Source: London Metal Exchange, Company analysis

Market balance

In 2023, primary nickel use grew 4% y-o-y to 3.1 mln t amid steady growth in the stainless steel sector (up 4% y-o-y). Demand in the battery sector was down (–1% y-o-y) due to the continued 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. In 2023, nickel use in other industries (alloys, special steels, plating, etc.) increased by 6% y-o-y amid a stable environment in the aerospace, oil and gas, and military industries.

On the other hand, global primary nickel production grew 9% y-o-y to 3.4 mln t in 2023, driven by the continued growth in the Indonesian NPI (up 16% y-o-y) and nickel compounds output for the battery sector (up 31% y-o-y). The increase was due to the launch of new NPI-to-matte conversion and high-pressure acid leaching (HPAL) projects. Metal nickel production grew 7% y-o-y due to new nickel cathode production capacities launched in China and Indonesia.

As a result, in 2023, the nickel market moved into a surplus of more than 200 kt, mostly in low-grade nickel as last year, while the high-grade nickel market remained relatively balanced. However, given the substantial increase in current working stocks over the last years, which, according to our calculations, rose by as much as 100–200 kt Ni, the actual market surplus, i.e. excessive material available for immediate delivery, could be much smaller.

Consumption

Stainless steel remained the key sector of primary nickel use in 2023 (about 65% of total demand).

Stainless steel production uses almost all types of nickel feed (except for some special products, such as nickel powder and compounds). However, since the quality of nickel used has almost no effect on stainless steel quality, steelmakers primarily use cheaper low-grade nickel such as NPI, ferronickel, and nickel oxide. As a result, the share of high-grade nickel used in stainless steel has decreased in recent years.

In 2023, global output of stainless steel grew 3% y-o-y to 58 mln t amid the launch of new capacities in China, where production rose 10% y-o-y. In other Asian countries, stainless steel output declined 5% y-o-y, primarily due to lower production in Indonesia, which faced operational issues at a steelmaker caused by a conflict between shareholders, as well as due to weak operational performance in Japan and Taiwan. Meanwhile, stainless steel output dropped 7% y-o-y in Europe and the US due to destocking, higher imports from Asia, and weak consumer demand. As a result, primary nickel consumption in the stainless steel sector increased by 4% in 2023 and exceeded 2Mt.

The **battery industry** uses nickel as a key element in the production of cathode precursors for batteries. Despite record-high EV sales, nickel demand in the battery sector slipped 1% to 0.5 mln t in 2023 due to destocking across the battery value chain in China, higher non-nickel LFP share, and a partial shift from BEV to PHEV sales

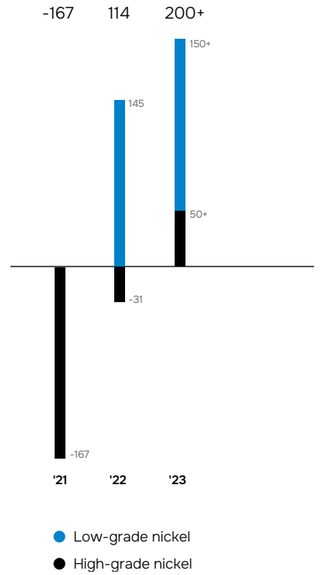
3.1 MLN T

Primary nickel consumption in 2023

3.4 MLN T

Primary nickel production in 2023

Nickel production and consumption balance, KT
(excluding changes in current reserves)



Source: Company's assessment as of March 2024

in China, which have lower battery capacity and, in turn, lesser nickel content.

In 2023, global EV sales[1] grew 29% y-o-y. 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 decelerated to 23% y-o-y following the country's partial withdrawal of the EV subsidies at the end of 2022. However, EV sales have been consistently rising in absolute terms. For instance, 5.7 million battery electric vehicles (BEVs) were sold in China in 2023, up 19% y-o-y from 4.8 million in 2022, while plug-in hybrid electric vehicle (PHEV) sales surged almost twofold to 2.7 million (up 88% y-o-y). Additionally, China has surpassed Japan as the world's largest automotive exporter, 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 internal combustion engine (ICE) vehicles with EVs in public domain vehicle fleets. This incorporates not only public buses but also taxis and government vehicles. When coupled with ongoing support for a rural EV buildout, this should ensure that the domestic China market continues to grow faster than the rest of the world.

Sales in Europe rose by 28% y-o-y, while constrained by the removal of subsidies in several countries. Additionally, there has been an influx of cheap Chinese EVs into the European market. In 2023, the share of Chinese BEV deliveries increased twofold to about 10% 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.

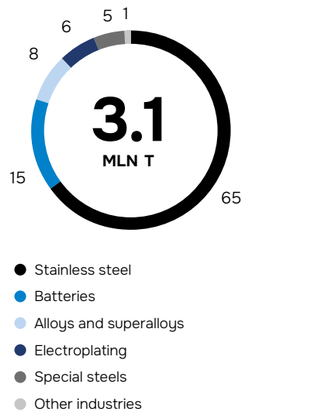
EV sales in the US increased by 50% in 2023, which could be attributed to the adoption of the US Inflation Reduction Act (IRA).

The growing popularity of electric and hybrid cars, along with the evolution of cathode technology towards nickel-intensive types, add to the tailwinds for significant growth in primary nickel demand in batteries in the long run. Despite the mounting competition across technologies, high-nickel formulations will remain the preferred option for automakers owing to their higher energy density, longer range, and better recyclability. In its base case scenario, the Company estimates that the nickel use in batteries will reach approximately 1.5 mln t of nickel by 2030, or 30% of total primary nickel demand (compared to 15% in 2023). Meanwhile, this figure may require further revisions given the continuous introduction of more ambitious carbon neutrality goals, subsidies-driven transport electrification, and cost optimisation of battery cell production.

In 2023, nickel use in **other industries** (alloys, special steels, plating, etc.) increased by 6%, or 0.6 mln t, amid the gradual post-COVID recovery of industrial demand and robust economic performance in the aerospace, oil and gas, and military industries.

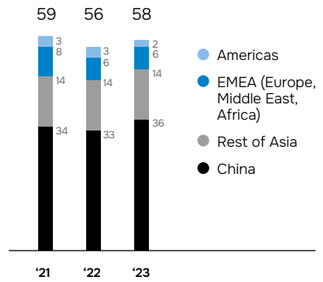
[1] Under this methodology, HEV and PHEV are recalculated according to their relative battery capacity ratio: HEV 2 kWh vs PHEV 12 kWh vs BEV 55 kWh.

Primary nickel consumption by industry, %



Source: Company data

Stainless steel production, MLN T



Sources: Eurofer, ISSF, USGS, SMR, METI, TSIIA, Company data

Supply

Primary nickel production can be divided into the high-grade and low-grade nickel segments.

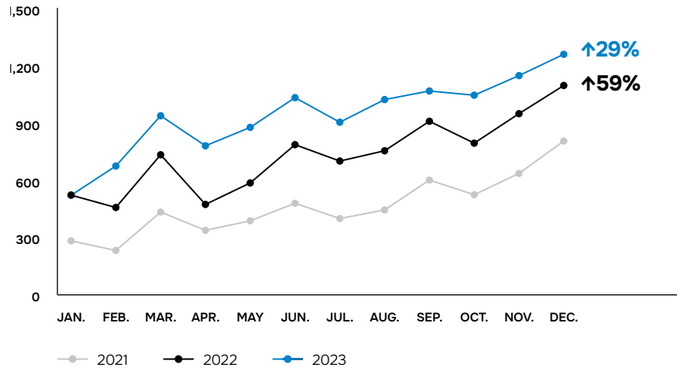
High-grade nickel is produced in the form of nickel cathodes, briquettes, pellets and powder, rounds, and other small special forms as well as chemical compounds, both from sulphide and from more common and available laterite raw materials. 2023's leading producers of high-grade nickel were Jinchuan, Nornickel, Glencore, Vale, Zoomwe, Huayou, and Sumitomo Metal Mining (SMM).

Low-grade nickel includes nickel pig iron, ferronickel, nickel oxide and utility nickel, which are produced from laterite raw materials only. In 2023, the key producers of low-grade nickel were Indonesian and Chinese NPI smelters, owned by Tsingshan and Delong, as well as the largest ferronickel producers: Anglo American, Eramet, South32, POSCO, etc.

The nickel market had been fundamentally divided into the low-grade and high-grade segments. However, these markets became interconnected once the practical implementation of the NPI-to-matte conversion started in early 2021 along with the massive launches of HPAL capacities and the launch of nickel cathode production from low-grade Indonesian s of HPAL capacities and the launch of nickel cathode production from low-grade Indonesian feedsources in 2023.

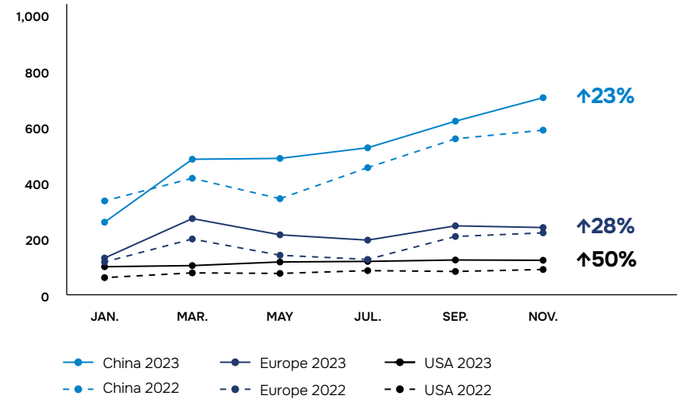
In 2023, nickel producers around the world were affected both by high interest rates, inflationary pressure,

Global sales of electric vehicles, THOUSAND UNITS

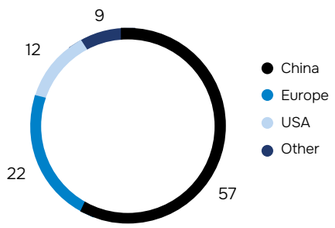


Source: Company analysis

Sales of electric vehicles by region in 2023, THOUSAND UNITS.



Sales of electric vehicles by region in 2023, %



logistical issues, and operational disruptions, and by negative price trends amid oversupply and continued surplus on the market. Nonetheless, primary nickel production grew by 0.3 mln t, or 9% y-o-y, to 3.4 mln t in 2023, driven by the growth in the Indonesian NPI production capacities and the continued underlying growth of nickel compounds for the EV battery sector, mainly fuelled by the launches of new HPAL capacities and NPI-to-matte conversion lines. Another contributor was the rise in metal nickel (Class 1) supply from new refining capacities in China and Indonesia.

Production of high-grade nickel grew 15% to 1.4 mln t in 2023.

Production of metal nickel rose 7% y-o-y to 0.9 mln t. In 2023, metal nickel production was steadily growing, mainly due to the launch of new nickel cathode capacities in China and Indonesia.

On top of this, Class 1 nickel output grew in Norway (due to the local enterprise's ramp-up to designed capacity after last year's strikes) and Japan (as a result of an increase in nickel converter matte exports from Indonesia) but declined in Canada and Australia on the back of operational issues and maintenance shutdowns.

Nornickel decreased its nickel output somewhat in 2023 owing to the decrease in mined ore volumes due to testing of the mining machinery from new suppliers and the gradual replacement of the existing equipment fleet. Nornickel mines recovered to the scheduled mining volumes in the fourth quarter. In 2023, the Company's nickel output came in line with the annual production guidance.

During the year, **production of nickel compounds**, including nickel sulphate from primary sources (excluding sulphate produced by high-grade nickel dissolution), increased by 31% y-o-y to 0.5 mln t.

Nickel sulphate can be produced from a variety of raw materials by different processes: directly from nickel intermediates such as mixed hydroxide precipitate (MHP), mixed sulphide precipitate (MSP), nickel matte, and crude nickel sulphate (product of copper processing), by dissolving Class 1 nickel (such as nickel briquettes or powder), or from recycled materials.

Despite the fact that nickel sulphate was traded at discounts to LME prices almost throughout the year, its output grew in 2023. The increase was fuelled by scheduled launches of new and ramp-ups of existing intermediates production capacities in Indonesia both at HPAL projects and at NPI-to-matte conversion lines. Chinese producers were the largest nickel sulphate producers in 2023, including Zoomwe, GEM, Huayou, and Jinchuan.

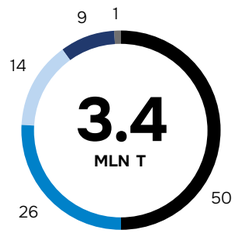
At the same time, nickel sulphate production by high-grade nickel dissolution, considered to be one of the most expensive production method, decreased several times over y-o-y amid the abundance of cheaper intermediates on the market.

Low-grade nickel output grew by 6% y-o-y to 2.0 mln t.

Indonesia continued ramping up its **nickel pig iron capacities,** which was the main driver behind the growing supply of low-grade nickel in 2023. The growing stainless steel output in China provided significant support to NPI production in Indonesia, but its growth rates slowed down somewhat year-on-year due to some furnaces switching to converter matte production and temporary suspension of new quotas issue for nickel ore mining later in the year, resulting in higher ore cost in the country.

3.4 MLN T
Primary nickel output in 2023

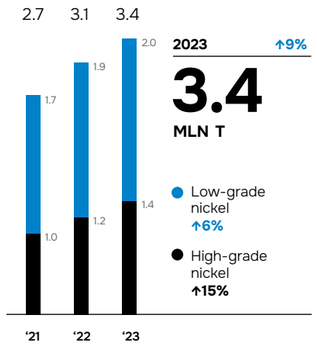
Primary nickel production by product, %



- Nickel pig iron
- Metal nickel
- Nickel compounds
- Ferronickel
- Nickel oxide and utility nickel

Source: Company data

Primary nickel production, MLN T



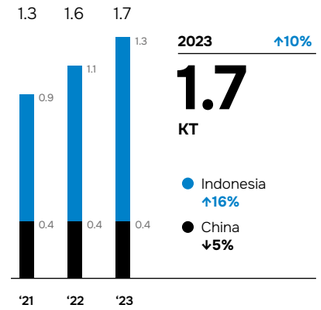
Source: Company data

Overall, we estimate the total 2023 NPI production in Indonesia at 1.3 mln t (up 16% y-o-y).

In 2023, **China's NPI output** continued to decline, falling 5% y-o-y to 0.4 mln t amid stronger imports of Indonesian NPI. Nevertheless, despite the growing competition from Indonesian NPI, the Chinese NPI output was supported by robust stainless steel production and showed a much more moderate decrease than expected.

In 2023, **ferronickel output** continued to decline, slipping to 0.3 mln t of nickel (down 13% y-o-y), a record low for more than 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 and electricity issues; some major producers' capacity utilisation rates being low. For instance, there were production shutdowns across several sites, including facilities in Guatemala, Serbia, North Macedonia, Greece, and Ukraine. Technical, operational, and financial disruptions were also observed at projects in the Dominican Republic, Myanmar, Japan, and New Caledonia.

NPI production, KT[1]



Source: Company data

[1] Note: Figures may not sum up due to rounding.