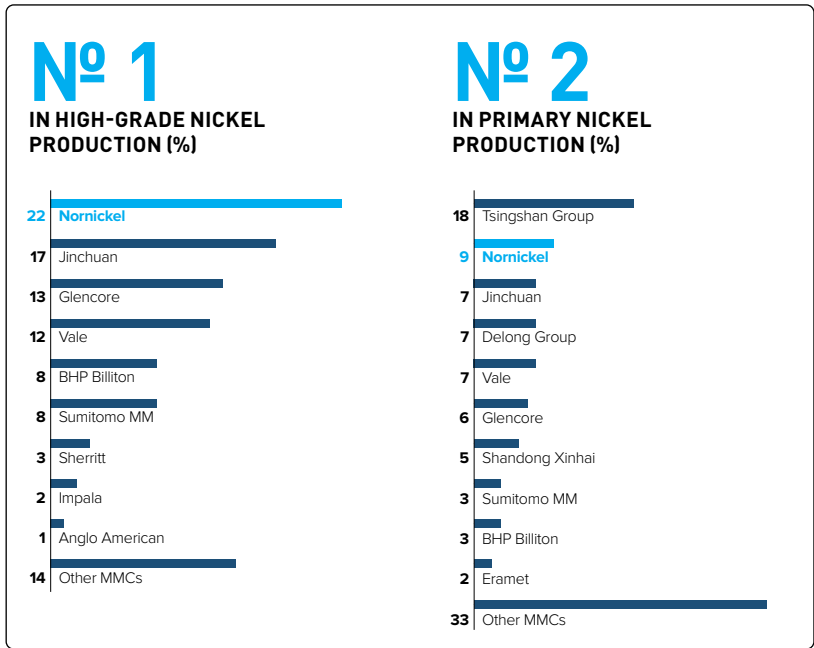


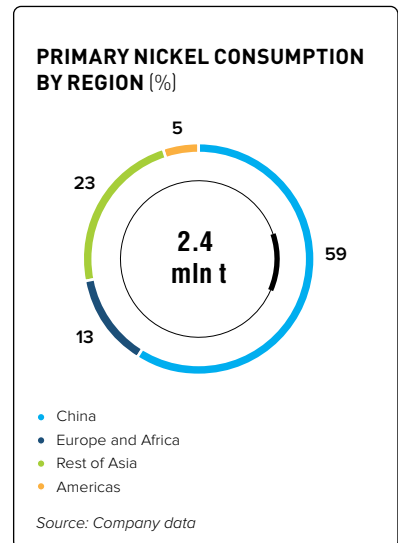
NICKEL (Ni)

THE COMPANY'S INDUSTRY POSITION



KEY TRENDS IN THE NICKEL MARKET

In 2020, the nickel market moved into a surplus of 87 kt, or 4% of annual consumption (compared to a deficit of 28 kt in 2019). This was due to a record increase in nickel pig iron (NPI) production driven by the commissioning of new facilities in Indonesia amid a COVID-19 related marginal decrease in high grade nickel consumption.



Amid the first wave of COVID-19 (with rapidly growing number of cases, national lockdowns imposed in a number of countries, movement restrictions and increased global uncertainty), nickel price fell to USD 11,000/t at the end of the first quarter of 2020; however, starting from the second half of April, the price showed stable growth, reaching USD 17,000/t by year end. As a result, the average nickel price in 2020 decreased by only 1% y-o-y. The price recovery was driven by the following factors:

- Stimulus package introduced by the Chinese government for post-coronavirus recovery of the economy, which led to increased production of 300-series stainless steel in China and Indonesia
- Growth in nickel ore prices due to higher domestic demand in China, Indonesian nickel ore export ban, disruptions to ore supply from the Philippines due to nationwide COVID-19 lockdown
- Lower interest rates, higher global liquidity, and a weaker US dollar, all which had an overall favourable impact on raw material prices
- Long-term expectations of higher demand for nickel in the battery sector on the back of a significant increase in electric vehicle sales in Europe and recovering sales in China, bolstered by the Tesla CEO's call for mining more nickel while maintaining a relentless focus on sustainability.

AVERAGE ANNUAL NICKEL PRICES (USD/T)

2015	2016	2017	2018	2019	2020
11,807	9,609	10,411	13,122	13,936	13,789

Source: London Metal Exchange (cash settlement)



MARKET BALANCE

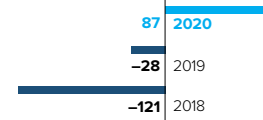
In 2020, the nickel market moved into a surplus of 87 kt (compared to a deficit of 28 kt in 2019), primarily driven by higher NPI production in Indonesia (up 63%, or 228 kt) on the back of new production start-ups. The commissioning schedules were not affected by the COVID-19 pandemic. NPI production in China dropped by 12%, or 72 kt, due to Indonesian nickel ore export ban introduced from 2020 and disruptions to ore supply from the Philippines, with its high-grade nickel ore reserves running down. Production of refined nickel decreased by 3%, or 29 kt, while production of its chemical compounds increased by 9%, or 12 kt, mostly due to higher nickel sulphate production for use in lithium-ion batteries. Conversely, production of other forms of low-grade nickel decreased by 6%, or 26 kt.

Nickel consumption remained virtually unchanged in 2020 with a marginal decrease of 2 kt. Growth in stainless steel production in China (+8%) and Indonesia (+16%) coupled with higher nickel consumption in the battery sector (+13%) was offset by weaker demand from other industries due to COVID-19 restrictions. Thus, nickel consumption in the stainless steel sector in other countries fell by 15%; global consumption in alloys and special steels by 13%; in electroplating by 12%; and in other industries by 17%.

The combined nickel inventories of the London Metal Exchange (LME) and Shanghai Futures Exchange (SFE) grew by 77 kt to 265 kt by year end. The biggest metal inflow for the year was recorded in January and February when LME-approved warehouses received over 80 kt of nickel, primarily

from sources where inventories were built up during a major draw-down of nickel inventories from LME-approved warehouses in 2019. Since March, the exchange nickel inventories remained practically unchanged.

NICKEL PRODUCTION AND CONSUMPTION BALANCE (KT)



Source: Company data

CONSUMPTION

NICKEL CONSUMPTION BY INDUSTRY IN 2020 (KT)

Industry	Consumption	Share, %
Stainless steel	1,779	73
Batteries	211	9
Special steels	131	5
Electroplating	127	5
Alloys	124	5
Other	69	3

MAIN CONSUMING INDUSTRIES

Stainless steel production is the main area of nickel consumption (over 70% in 2020). There are many grades of stainless steel, with austenitic stainless steel being the most common family (over three quarters of global production), which includes the 300 series and 200 series.

The 300 series steels have higher nickel content, ranging typically between 8% and 12% but reaching 20% in certain grades. Nickel in these concentrations improves corrosion resistance and strength in a broad range of operating temperatures, ensures good ductility, resistance to aggressive environments, and makes the metal non-magnetic. This series is the most versatile and is widely used in the construction, food, chemical, transport, energy, and other industries.

In comparison, nickel content in the 200 series is lowered by alloying with manganese, and these steels are not complete substitutes for grades with high nickel content. The 200 series steels are prone to surface (pitting) corrosion, are not heat resistant and are not resistant to aggressive environments. However, due their lower cost, they are widely used in consumer goods such as domestic appliances. China and India alone account for over 90% of the global 200 series steel production.

Although they account for only 1% to 2% of global crude steel output, austenitic-ferritic (duplex) stainless steels also use nickel and are distinguished from other grades by a higher content of chromium (18% to 25%) and molybdenum (1% to 4%).

Ferritic and martensitic stainless steels (400 series) typically do not contain nickel, and their properties are similar to those of low-carbon corrosion-resistant steels; however, their mechanical properties are inferior to those of austenitic stainless steels. These steels are mainly used to manufacture automotive exhaust systems, cargo container frames, water heaters, cutlery, kitchenware, home decor items, and razor blades.

Stainless steel production uses almost all types of nickel feed (except for some special products, such as nickel powder and compounds). As nickel feed quality has practically no impact on the quality of stainless steel, steel mills predominantly use cheaper feeds. It is for this reason that high-grade nickel has been losing its share of nickel units consumed in stainless steel production in recent years.

In 2020, total stainless steel output decreased by 3% to 52 mln t. An increase in crude steel output in China (up 4%

to 31 mln t) and Indonesia (up 20% to 2.7 mln t) was offset by steel output declines in other countries and regions due to the COVID-19 pandemic, led by Europe (– 10%), USA (– 18%), Japan (– 18%), India (– 30%) and Taiwan (– 14%).

Nonetheless, primary nickel consumption for stainless steel production grew by 3% to 1.78 mln t. This growth was completely offset by increased use of NPI (up 16% or 156 kt) in China and Indonesia, while the consumption of high grade nickel in stainless steel production dropped by 13%, or 85 kt, to 238 kt. NPI supply is expected to grow in the coming years, putting a significant pressure on high grade nickel consumption by the stainless steel sector.

The battery industry uses nickel as a key element in the production of cathode precursors for battery cells. However, nickel consumption trends vary depending on the type of battery.

↑ Lithium-ion batteries (Li-ion). Li-ion batteries were first commercially launched in 1991 and became widespread due to their ability to retain a high level of energy capacity, even after multiple recharge cycles. Lithium-cobalt cathodes were initially used in electronics. In the 2000s, nickel and aluminium and later manganese were also added to the composition.

↔ Nickel-metal hydride batteries (Ni-MH). Ni-MH batteries were developed in 1989 as a substitute for Ni-Cd batteries, to phase out cadmium. Currently, the nickel-metal hydride battery market is growing at a slow pace (with the hybrid vehicle projects of some manufacturers being its only growth driver) and is facing formidable competition from lithium-ion batteries.

↓ Nickel-cadmium batteries (Ni-Cd). These were the first batteries using nickel, developed back in 1899. These days their use is limited, as the EU prohibited cadmium on grounds of toxicity.

Growth in lithium battery production is primarily driven by road transport electrification. The 2016–2020 CAGR of electric vehicles (plug-in HEVs and battery electric vehicles) was over 40%. The impetus for transport electrification has come from government incentives, more stringent environmental regulations, improved battery performance, and lower production costs of battery cells.

In recent years, China has been one of the most important growth hubs for EV manufacturing, with plans to increase NEV (electric vehicles and plug-in hybrids) sales to 20% of total vehicle sales by 2025 and to 50% by 2035.



To this end, China implemented a number of initiatives to stimulate transport electrification, including subsidies for the purchase of electric cars and mandatory requirements for large automakers to produce electric vehicles and plug-in HEVs. However, government subsidies were slashed in the second half of 2019, leading to the first-ever decline in NEV sales for 12 consecutive months. As a result, NEV sales dropped by 44% in the first half of 2020. Sales increased as the nation's economy quickly recovered in the second half of the year, posting a 5% annual growth for the full year – nonetheless a multi-year low.

It was against this backdrop, that Europe became the new global driver of EV sales growth. In a number of countries, including Belgium, Germany, the UK and France, buyers receive handsome subsidies and tax incentives for buying EVs; in Norway, where EVs account for 54% of total vehicles sold in 2020, buyers are exempted from vehicle registration tax and value added tax (VAT).

Europe's share of global EV sales grew from 26% in 2019 to 44% in 2020. In March 2019, the European Commission approved new requirements for greenhouse gas emissions from road transport, which call for a more than 2X reduction of CO₂ emissions by 2030 from a 2018 baseline. The initiative pressures automakers to expedite electrification under the threat of fines reaching into the billions. Also, the European Green Deal, a plan to achieve carbon neutrality and net-zero emissions by transition from fossil to renewable energy, was adopted. A battery production chain is being developed

in the region in anticipation of increased demand. The total announced capacity of key producers (CATL, LG Chem, SK Innovation, Samsung, Northvolt and others) already exceeds 500 GW•h by 2025, which would be equivalent to 400 ktpa of nickel. By 2030, total capacity is expected to exceed 700 GW•h (about 600 kt of nickel per year).

Battery cell production is one of the final stages of battery manufacturing, preceded by the production of cathode precursors (hydroxides of transition metals) and then, the production of cathode material itself by thermal conversion into oxide when lithium is added. The main hubs of cathode precursor production in 2020 included China (63% of global production), Japan (28%) and South Korea (9%).

There are several types of lithium-ion batteries available depending on the cathode materials used: LCO (lithium, cobalt oxide), LFP (lithium, iron phosphate), LMO (lithium, manganese oxide), NCM (nickel, cobalt, manganese) and NCA (nickel, cobalt, aluminium).

LCO batteries are principally confined to mobile electronics, as the small size of the market, high cobalt prices and low power prevent their application in EVs. However, other types of cathodes are widely employed in the EV sector. The current trend is the growing global share of nickel-containing NCM and NCA batteries, owing to their higher energy density and specific energy, which increases drive range. LFP batteries for cars are made only in China, where these batteries accounted for about 30% of the total in 2020.

Growing nickel consumption in Li-ion batteries is driven not only by an increasing share of nickel-containing batteries but also by a higher average nickel content in the cathode material, which, in turn, is caused by the need to replace expensive cobalt units and increase energy density. In comparison to 2016, when NCM 1:1:1 (with a nickel mass fraction of 20% of the total cathode mass) accounted for the lion's share of compounds in cathode materials, 2020 saw nickel-intensive compounds – NCM 6:2:2, NCM 5:3:2, and NCM 8:1:1 – take the lead. Going forward, conversion to NCMA (nickel, cobalt, manganese, aluminium) with a higher content of nickel is expected, and some producers announced plans to launch commercial production of LNO (lithium, nickel oxide), a cathode material with nickel content exceeding 50%.

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 consumption by the industry in the longer run.

In 2020, total nickel consumption in other industries (alloys, special steels, electroplating) dropped by 14%, or 71 kt, amid weaker end consumer demand due to COVID-19 restrictions. These sectors are expected to recover in 2021 albeit at the rates below pre-pandemic levels.

PRODUCTION

Primary nickel can be sorted into two major groups:

- High-grade nickel (cathodes, briquettes, carbonyl nickel and nickel compounds), produced from both sulphide and laterite feed. 2020's main producers of high-grade nickel were Nornickel, Jinchuan, Glencore, Vale, BHP and Sumitomo Metal Mining
- Low-grade nickel (ferronickel, NPI and nickel oxide), produced from laterite feed only. In 2020, the key producers of low-grade nickel included Chinese and Indonesian NPI smelters, as well as ferronickel producers such as Eramet, POSCO, Anglo American, Solway, South32 and others

In the first half of 2020, the COVID-19 pandemic caused disruptions to many production sites. In most cases, operations were restarted later although some sites in Australia and Africa have not resumed production yet.

Despite production restrictions, primary nickel production in 2020 grew by 5%, or 112 kt, y-o-y driven primarily by a growing NPI output in Indonesia.

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Most of the growth in 2020 low grade nickel production came from Indonesian NPI at 590 kt (+ 63% y-o-y), driven by new production capacity start-ups. COVID-19 pandemic restrictions did not affect the capacity project launch times. NPI production in China decreased to 512 kt (- 12%), due to Indonesian nickel ore export ban imposed in January 2020 and disruptions to ore supply from the Philippines, which reduced availability of raw materials for NPI production in China.

Ferronickel production remained virtually unchanged in 2020 at 388 kt (- 3%). Increases in ferronickel output in the Dominican Republic, Guatemala and Brazil were offset by production curtailments in Japan, Greece, New Caledonia and Columbia.

Nickel oxide output declined by 21% to 52 kt primarily due to VNC's New Caledonia refinery decommissioning and switch to a 100% mixed hydroxide product, followed by a shutdown of operations at Vale's site in Dalian.

Notably, some ferronickel assets face a growing risk of shutdown due to the threat of potential replacement of ferronickel by NPI in the stainless steel sector. Also, social and political tensions in New Caledonia, where the conflict over the sale of Vale's asset and the island's independence recognition continued to escalate, resulted in a production halt at VNC's site and disrupted operations at SLN's Doniambo.

