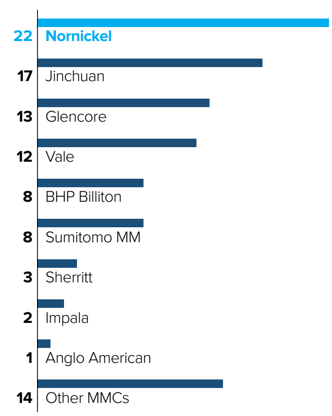
NICKEL (Ni)

THE COMPANY'S INDUSTRY POSITION

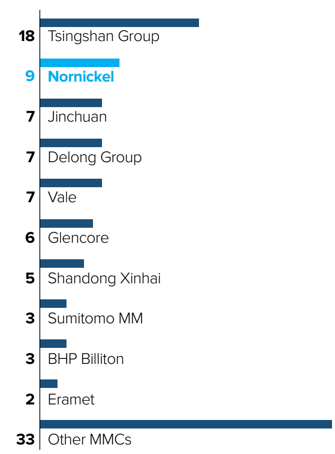
№ 1

IN HIGH-GRADE NICKEL PRODUCTION (%)



№ 2

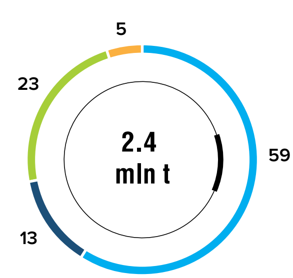
IN PRIMARY NICKEL PRODUCTION (%)



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.

PRIMARY NICKEL CONSUMPTION BY REGION (%)



- China
- Europe and Africa
- Rest of Asia
- Americas

Source: Company data

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)

LONDON METAL EXCHANGE NICKEL PRICE (USD/T)

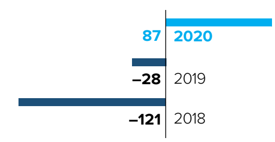
MARKET BALANCE

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.

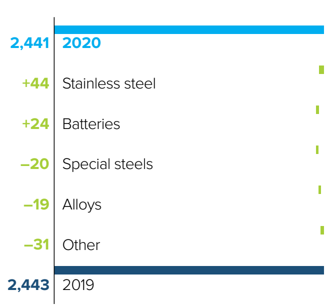
⇔ Nickel-metal hydride batteries (Ni-MH). Ni-MH batteries were developed in 1989 as a substitute for Ni-Cd batteries, to phase out cadmium. Currently, the nickel-metal hydride battery market is growing at a slow pace (with the hybrid vehicle projects of some manufacturers being its only growth driver)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

NICKEL CONSUMPTION IN 2020
(KT)



Source: Company data

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.

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.

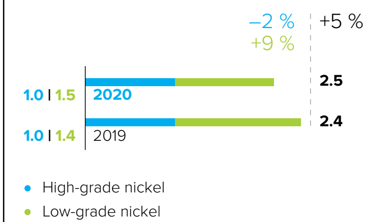
Most of the growth in 2020 low grade nickel production came from Indonesian NPI at 590 kt (+ 63% y-o-y), driven by new production capacity start-ups. COVID-19 pandemic restrictions did not affect the capacity project launch times. NPI production in China decreased to 512 kt (– 12%), due to Indonesian 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.

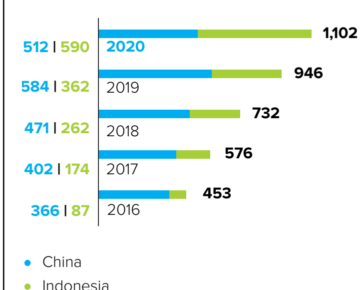
Notably, some ferronickel assets face a growing risk of shutdown due to the threat of potential replacement of ferronickel by NPI in the stainless steel sector. Also, social and political tensions in New Caledonia, where the conflict over the sale of Vale's asset and the island's independence recognition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

PRIMARY NICKEL PRODUCTION IN 2019–2020 (MLN T)



Source: Company data

NPI PRODUCTION IN 2016–2020 (KT)

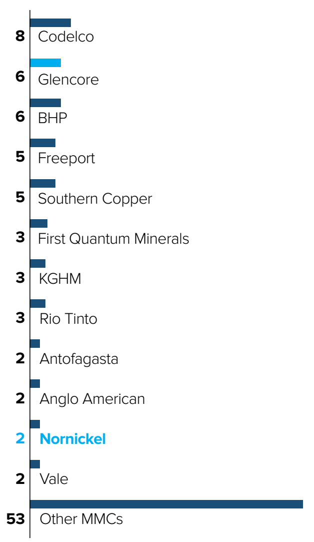


COPPER (Cu)

THE COMPANY'S INDUSTRY POSITION

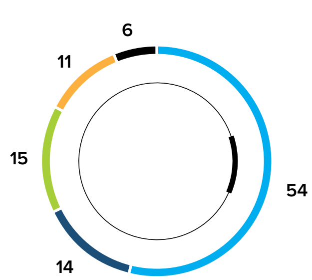
№ 11

IN THE COPPER MINING INDUSTRY (%)



Sources: Wood Mackenzie, corporate reports, Company data

REFINED COPPER CONSUMPTION BY REGION IN 2020 (%)



- China
- Rest of Asia
- Europe
- Americas
- Other

KEY TRENDS IN THE COPPER MARKET

Copper was priced at USD 6,200/t early in 2020 but slumped to USD 4,600/t in March amid an escalating COVID-19 pandemic. However, already in April, when lockdowns were lifted and the economy started recovering, copper price trend reversed its trajectory to become positive. In the second half of the year, this price rally intensified bolstered by government support, further production recovery in China, growing investor optimism after positive results of coronavirus vaccine trials were announced, and expectations of accelerated road transport electrification.

Towards the year end, the positive price trend was driven by disruptions to mine operations in Latin American, a new policy of copper scrap recategorization in China, and expectations of additional green economy investments in the United States announced by the new administration. These developments contributed to the copper price peaking at USD 7,964/t in December 2020, a fresh high since 2013.

Despite the global economy taking a hit from the COVID-19 pandemic, global consumption of copper cathodes decreased by only 1% in 2020. This was primarily due to a 4% growth in China's consumption, as the Chinese economy posted a V-shape recovery following a two-month lockdown in early 2020, which boosted demand for copper in the second half of the year. Consumption ex-China slipped 7% in the reporting period.

Copper mine production decreased by 1.5% in 2020; however, the draw-down of copper concentrate inventories boosted refined copper output by 2%. As a result, the market flipped to a marginal surplus of less than 2% of annual consumption.

Stocks held in Shanghai Futures Exchange and London Metal Exchange warehouses kept growing in Q1 2020, peaking early in Q2, then staring to fall as the global economy recovered, and hitting record lows towards the year end amid lower global copper output and increased buying.

The LME copper price averaged in 2020

6,181 USD/t

up 3% from USD 6,000/t a year prior.

AVERAGE ANNUAL COPPER PRICES (USD/T)

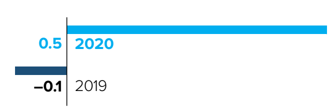
2015	2016	2017	2018	2019	2020
5,494	4,863	6,166	6,523	6,000	6,181

Source: London Metal Exchange

MARKET BALANCE

In 2020, the refined copper market was close to balance, with a surplus of less than 2% of the total market volume, or 544 kt. In 2020, total exchange inventories dropped by 13% to 265 kt (304 kt at year-end 2019), or at little more than four days of global consumption. The fall in exchange inventories was driven by stock relocation to non-exchange warehouses, mostly in China.

REFINED COPPER MARKET BALANCE (MLN T)



Sources: Company data, Wood Mackenzie

CONSUMPTION

Given its high electrical and thermal conductivity, ductility and corrosion resistance, copper is widely used in various industries. Up to 75% of refined copper produced globally is used for manufacturing electrical conductors, including various types of cable and wire. Key copper-consuming industries include construction, electrical and electronic equipment manufacturing, power industry, transport, mechanical engineering, various equipment and consumer goods production.

China remains the largest copper consumer globally, accounting for 54% of the total in 2020. Despite the pandemic, the Chinese economy posted a V-shape recovery as early as Q1 2020. China imported 4.5 mln t of refined copper in 2020, up 30% y-o-y. Copper scrap imports fell 35% to 0.8 mln t due to China's tighter requirements for imported scrap quality. Copper concentrate imports decreased marginally by 1% to 5.4 mln t. Refined copper consumption in China rose by 4% to 12.5 mln t.

Copper demand in developed markets was shrinking in 2020, with consumption in Europe (the Group's key market for copper cathodes) declining by 5.7% in 2020, in North America by 7.2%, in Middle East by 8.9%, and in Asia excluding China by 10%. Russia increased its copper consumption by 2%.

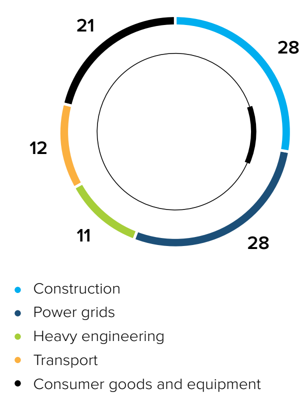
In 2020, global refined copper consumption totalled

23.4 mln t

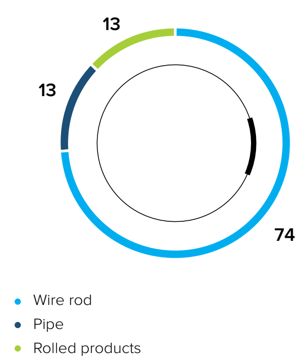
down 1%, or 0.3 mln t, y-o-y.

REFINED COPPER CONSUMPTION BY INDUSTRY

END USE BY INDUSTRY (%)



FIRST USE (%)



Sources: Company data, Wood Mackenzie

PRODUCTION

In 2020, global refined copper output rose by 2%, or 0.4 mln t, y-o-y to 23.9 mln t. The biggest growth came from China, which is firmly on track to deliver smelting and refining capacity expansions. In 2020, refined copper production in China grew by 1% to 9.16 mln t, while its share in total global output reached 38%. Copper ore mined locally supports just 20% of total Chinese production, with the remaining 80% covered by imported copper concentrates and scrap copper.

Refined copper output increased by 1% in Asia on the back of growth in Japan and the Philippines; dropped 8% in North America, driven primarily by declines in the US market; rose by 2% in South America (Chile and Peru); and went up by 3% in Europe (led by Germany, Finland and Bulgaria).

In 2020, global copper mine production fell 1.5% to 20.6 mln t due mostly to the coronavirus pandemic and disruptions to Chilean and Peruvian mine operations caused by strikes

In 2020, mined production in Chile, the world's leading producer of copper, declined by 1% y-o-y to 5.8 mln t due to the coronavirus pandemic and short-lived strikes. Production in Peru dropped 13.5% to 2 mln t, also due to the pandemic.

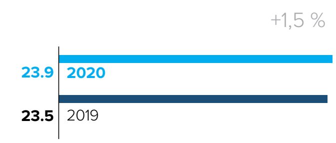
A 6% growth in Africa's mined production to 2.59 mln t was mainly due to higher output from mines in the Democratic Republic of the Congo and Zambia.

China ramped up copper mine production by 4% to 1.8 mln t in 2020, while mined production in Indonesia grew 26% to 0.5 mln t driven by the continued ramp-up of underground operations at Grasberg. Mongolia and Myanmar posted marginal output increases.

Production in North America decreased by 2% to 2.58 mln t – down 3% and 4.5% in the USA and Canada, respectively, and up 1% in Mexico.

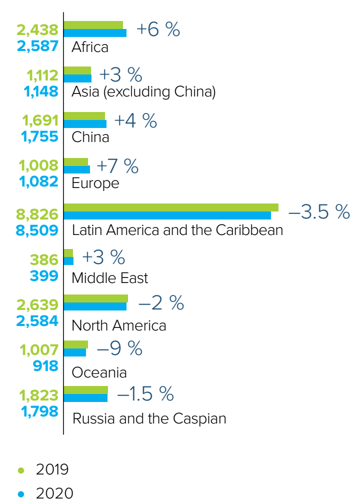
Russia's copper mine production increased by 2% in 2020.

REFINED COPPER PRODUCTION IN 2020 (MLN T)



Sources: Company data, Wood Mackenzie

COPPER MINE OUTPUT IN 2020 (KT)



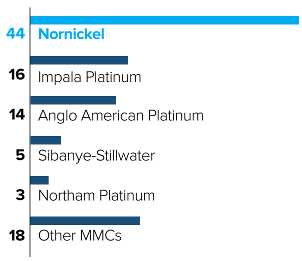
Sources: Company data, Wood Mackenzie

PALLADIUM (Pd)

THE COMPANY'S INDUSTRY POSITION

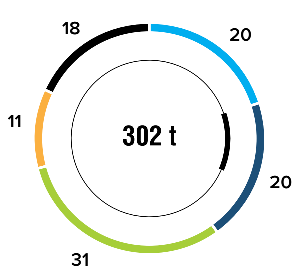
№ 1

NO. 1 IN PALLADIUM PRODUCTION[1] (%)



Source: Company data

INDUSTRIAL CONSUMPTION OF PALLADIUM BY REGION (%)



- North America
- Europe
- China
- Japan
- Rest of world

Source: Company data

2020 palladium prices averaged at

2,197

USD/oz,

up 43% from the 2019 average of USD 1,538/oz.

KEY TRENDS IN THE PALLADIUM MARKET

Despite price volatility in the first half of 2020, palladium chalked up further gains over the year. Early in 2020, palladium maintained its price momentum from the second half of 2019 amid high demand and metal shortages on the spot market, hitting an all-time high of USD 2,795/oz on 28 February. After reaching this level, palladium plummeted by almost 45% in March amid a global pandemic and the automotive industry virtually grinding to a halt. However, the plunge was followed by an equally fast recovery, supported by a faster-than-expected pick-up in the automotive industry and suspended processing operations at South Africa's mines. Palladium price was further bolstered by a weaker US dollar and negative real yields of treasury bills in key countries stemming from extraordinary monetary and fiscal measures taken by central banks and governments across the world. By year end, palladium price consolidated between USD 2,315/oz and USD 2,350/oz. Average annual net speculative positions dropped 71% to 10 tonnes on the New York Mercantile Exchange (NYMEX).

AVERAGE ANNUAL PALLADIUM PRICES (USD/OZ)

2015	2016	2017	2018	2019	2020
691	613	869	1,029	1,538	2,197

Source: LPPM

MARKET BALANCE

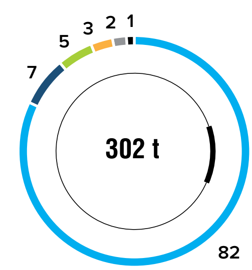
Since 2010, there has been a sustained undersupply in the physical palladium market covered by the inventories accumulated in previous years. In 2020, palladium supply deficit was fully offset by drawdown of consumers' strategic stocks on lower demand and uncertainty caused by the pandemic and lower ETF inventories.

[1] Refined metal including production from own feedstock by third parties under tolling agreements

PALLADIUM MARKET BALANCE IN 2020 (T)[2]

Palladium production and consumption balance	–6
Outflows from ETFs	4
Destocking by consumers	2
Supply and demand balance	0

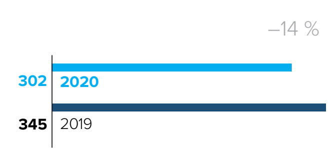
PALLADIUM CONSUMPTION IN 2020 BY INDUSTRY (%)



- Exhaust aftertreatment systems
- lectronics
- Chemical catalysts
- Dental alloys
- Jewellery
- Other

Source: Company data

INDUSTRIAL CONSUMPTION OF PALLADIUM IN 2019–2020 (t)



Source: Company data

CONSUMPTION

In 2020, industrial consumption of palladium decreased by 43 t (– 14%) y-o-y to 302 t.

AUTOMOTIVE INDUSTRY

Exhaust treatment systems account for the bulk of total palladium consumption. In this sector, palladium is used in catalytic converters to detoxify exhaust fumes. In most countries, such converters are legally required to be installed on all motor vehicles.

Due to its unique catalytic properties ensuring effective chemical reactions throughout the entire vehicle life cycle, there are almost no alternatives to palladium in this sector except for platinum, which is used mostly in diesel vehicles, and rhodium. Given the already significant share of the automotive industry in rhodium consumption and small market size (annual global production stands at 23 t), rhodium is subject to high price volatility and risk of physical metal shortage.

[2] Excluding reallocated other reserves

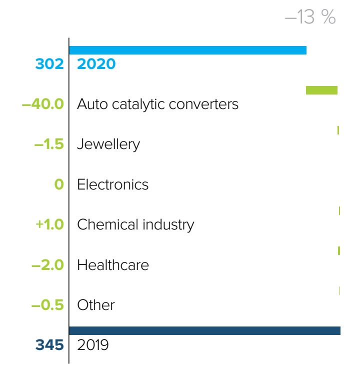
In 2020, palladium consumption in the automotive industry decreased by 40 t. The plunge was driven primarily by the spread of the coronavirus infection and the subsequent halts in business activity across the globe. In early spring, most automakers had to suspend operations, while dealers stopped selling. However, new safety rules were implemented at production sites and sales outlets in a relatively short time, and automakers and their dealerships in various countries were able to resume operations by early summer. China, which was the first market to be hit by the pandemic and subsequent restrictions, led the global automotive market recovery in the second half of the year: while sales fell 79% y-o-y in February, they were up y-o-y as early as April. In the reporting period, car sales in China slipped 4%. European and North American automotive markets were slower to recover as they were affected by the pandemic later than China and were under restrictions for a longer period of time. In September, European and North American market recovery slowed down on fears of a second wave of COVID-19 and tougher restrictions. 2020 automobile sales in Europe and North America were down 20% and 15%, respectively. Notably, fiscal incentives and low interest rates have mitigated the negative impact of the pandemic on the global automobile industry. Fiscal incentives helped towards restoring consumers' purchasing power, while lower interest rates made car loans more affordable.

Despite declining car production and sales, higher usage of platinum group metals (PGMs) per autocatalyst partially offset the negative trend. The higher PGM loadings per vehicle were mostly driven by tougher regulations on pollutant emissions, including the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) – a new procedure for testing cars' emissions that took effect in the EU and Japan in September and October 2019, respectively. WLTP is designed to make tests more rigorous by extending their distance and duration, increasing the car weight, requiring faster acceleration, and stipulating that testing should be performed at different altitudes and temperatures. The Real Driving Emissions (RDE) test in the EU is another recently introduced regulation, in effect as of September 2019. These developments forced automakers to implement more sophisticated exhaust treatment systems and use more PGMs per catalytic converter. In China, the marked increase of palladium usage in autocatalysts came in the wake of tougher environmental requirements as part of the China 6b rollout across the country starting from 2019. The China 6b standard is based on best practices in emission control as developed in the USA and the EU, and sets out certain additional requirements.

Changes in the fleet mix also boosted palladium consumption among automakers as light diesel vehicles were further replaced with petrol cars and hybrids, which make greater use of palladium-based catalytic converters for exhaust fumes. The market share of diesel cars in Europe (the 27 EU countries + the UK + EFTA countries) dropped over the year from 30% to 26%.

Vehicle hybridisation is another trend driving palladium consumption. In 2020, production of hybrid-electric vehicles, so called mild, full and plug-in hybrids (PHEVs), increased by 69%, 8% and 51%, respectively. Since hybrids include petrol engines, they mostly use palladium-based catalytic converters. With the same engine displacement as the regular petrol vehicle, the hybrid uses more of the metal due to more frequent cold starts. The growing use of PGMs in the automotive industry is also driven by consumers migrating from sedans to larger-engine crossovers. In the USA, the SUV/pickup share grew by 5% to 69% in 2020.

CHANGE IN PALLADIUM CONSUMPTION IN 2019–2020 BY APPLICATION AREA (t)



Source: Company data

ELECTRONICS

In 2020, palladium consumption in the electronics industry remained unchanged at 23 t. In recent years, the use of palladium in multi-layer ceramic capacitors has been in decline, becoming limited to the most sophisticated products with a focus on reliability and performance in harsh environments, such as those in the defence and aerospace industries. Given the metal price inelasticity of demand, consumption in these sectors is expected to remain flat. Transition to 5G telecoms networks should also somewhat offset lower demand elsewhere. Moreover, despite disruptions at electronics assembly lines during the first half of the year, the work-from-home trend driven by the pandemic bolstered demand for laptops and TV sets.

CHEMICAL INDUSTRY

In 2020, the use of palladium in chemical catalysts increased by 1 t y-o-y. In the medium term, growing consumption of palladium in the chemical industry will be driven by newly launched terephthalic acid projects in China.

CHEMICAL INDUSTRY

The consumption of palladium in the healthcare sector continued a downward trend and declined by 23%, or 2 t, y-o-y due to the substitution of palladium with composite material alternatives and gold, which is currently priced lower. In Japan, the largest consumer of dental palladium, demand for palladium has been declining in recent years by an average of 5% to 10% per year.

JEWELLERY

Palladium is used in white gold alloys or in its pure form to make wedding rings among other items. In 2020, jewellery-related consumption of palladium decreased by another 1.5 t. A drop in Chinese demand for jewellery amidst a general slowdown in consumer spending and a consumer shift to other luxury goods were the primary cause of the continued sales decline. Sales of men's palladium wedding jewellery were also affected by growing prices for the metal.

INVESTMENTS

Investor demand for palladium kept shrinking in 2020 mostly due to outflows from exchange-traded funds (ETFs), which had their inventories reduced by 4 t to 18 t – an all-time low since 2008. The outflows amid growing palladium prices were driven by a wave of profit taking and by investors reallocating their capital to other palladium investment options.

PRODUCTION

In 2020, primary refined palladium production decreased by 10% y-o-y to 200 t.

In Russia, the leading palladium producing country, palladium output decreased by 3 t due to a high base effect from 2019, when the Krasnoyarsk Precious Metals Refinery (Krastsvetmet) processed Nornickel's work-in-progress inventories that had been built up previously.

South Africa, the world's second largest producer, also demonstrated a decrease (– 19 t) in refined palladium output due to the COVID-19 nationwide lockdown and operational issues at Anglo American Platinum's pyrometallurgical facilities.
In Zimbabwe, palladium output increased by 1 t.

Primary palladium production in Canada and the USA remained largely flat.

The main sources of recycled palladium supply are scrapped auto catalytic converters, as well as jewellery and electronic scrap. In 2020, recycled output declined by 15 t to 96 t due to COVID-19 restrictions and a drop in new car sales which, in turn, impacted the supply of vehicles for recycling.

The sources of previously accumulated palladium stockpiles include trading companies, financial institutions, government reserves, and consumers' surplus inventories.

ANNUAL PRIMARY PALLADIUM OUTPUT IN 2019–2020 (t)

2019:— 221 t

Countries	2020
South Africa	– 19
Zimbabwe	+1
Russia	– 3
Canada	0
USA	0
Rest of world	0
Total	200

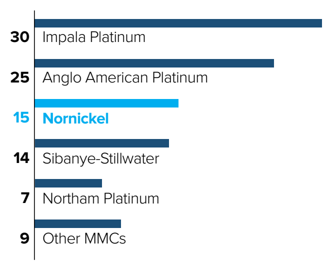
Source: Company data

PLATINUM (Pt)

THE COMPANY'S INDUSTRY POSITION

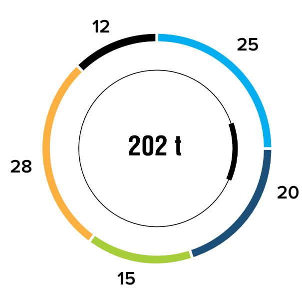
№ 3

IN PLATINUM PRODUCTION[1] (%)



Source: Company data

PLATINUM CONSUMPTION BY REGION (%)



- Europe
- North America
- Japan
- China
- Rest of world

Source: Company data

2020 platinum prices averaged at

884

USD/oz,

a 2% increase over the 2019 average of USD 863/oz.

KEY TRENDS IN THE PLATINUM MARKET

Platinum price remained relatively stable in January and February, staying within a narrow range between USD 900/oz and USD 1,000/oz before falling to a 10-year low of USD 600/oz in March. However, the price quickly recovered to between USD 800/oz and USD 850/oz. In the second half of 2020, the platinum price continued an upward trend, reaching the August 2016 level of USD 1,050/oz driven by equipment failures at Anglo American Platinum's pyrometallurgical facilities and stronger investor demand, which was manifested through inflows into ETFs (+ 16 t) and higher retail investment volume (+ 11 t). Average annual net speculative positions dropped 4% to 49 t on the New York Mercantile Exchange (NYMEX).

AVERAGE ANNUAL PLATINUM PRICES (USD/OZ)

2015	2016	2017	2018	2019	2020
1,053	989	949	880	863	884

Source: LPPM

[1] Refined metal including production from own feedstock by third parties under tolling agreements

MARKET BALANCE

In 2020, the platinum market came into balance, with the metal production sufficient to meet consumption. However, strong investment demand pushed the market into deficit, which was offset by previously accumulated metal stocks. The sources of previously accumulated platinum stockpiles include trading companies, financial institutions, and surplus inventories of consumers, while the movement of these inventories is non-transparent.

PLATINUM MARKET BALANCE IN 2020 (t)

Palladium production and consumption balance	0
Investor demand	11
ETF inflow	16
Supply and demand balance	–27

CONSUMPTION

Industrial consumption of platinum in 2020 declined to

202 t,

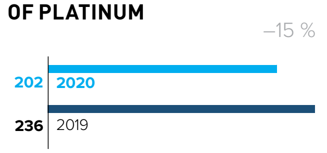
down 34 t (or 15%) y-o-y.

AUTOMOTIVE INDUSTRY

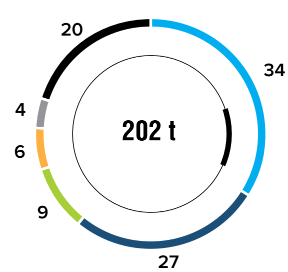
The automotive industry is the predominant consumer of platinum. Over 30% of platinum in this industry is used to manufacture exhaust gas catalysts for diesel vehicles.

Platinum consumption in the automotive sector slumped in 2020 (down 19 t from 2019) due to the COVID-19 pandemic and a falling share of diesel vehicles in the European market (the 27 EU countries + the UK + EFTA countries), a key market for vehicles running on this fuel, – the market share slipped from 30% to 26% in 2020.

INDUSTRIAL CONSUMPTION OF PLATINUM

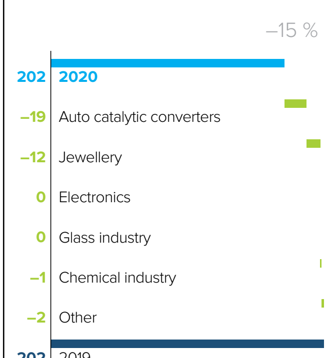


PLATINUM CONSUMPTION IN 2020 BY INDUSTRY



Source: Company data

PLATINUM CONSUMPTION BY APPLICATION AREA (t)



Source: Company data

JEWELLERY INDUSTRY

The second-largest platinum consumer is the jewellery industry, accounting for a third of demand. The reporting period saw a sustained downward trend in platinum consumption in the industry (down 12 t), persisting over the last few years. Apart from the coronavirus, the decrease was driven primarily by lower jewellery demand in China due to consumers switching to other investment options, and the falling demand for luxury goods amid concerns over the country's sustained economic growth. Platinum in this market is under increasing pressure from gold jewellery.

CHEMICAL INDUSTRY

In 2020, platinum consumption in industrial catalyst manufacturing decreased by 1 t due to falling refining volumes.

GLASS INDUSTRY

Platinum is needed to produce glass fibre and optical glass. Demand for the metal in this industry remained unchanged in 2020.

Platinum consumption in electronics also remained flat.

INVESTMENTS

Platinum is widely used as an investment instrument. Physical investments may vary from coins and smaller bars to investments in physical platinum ETFs, which accumulate large amounts of platinum in standard bars. In 2020, demand for platinum bars from retail investors rose slightly (up 11 t) due to low prices coupled with expectations of growth. During the year, investments in platinum ETFs rose by 16 t to 121 t.

PRODUCTION

Global production of primary refined platinum in 2020 decreased y-o-y by 40 t to 150 t.

In the reporting period, supply from South Africa, the world's largest platinum producer, declined by 40 t due to the nationwide lockdown and operational issues at Anglo American Platinum's pyrometallurgical facilities, while Zimbabwe increased its output by 1 t. The Russian Federation's output remained flat. Production in North America slipped 1 t.

The main sources of recycled platinum include used exhaust gas catalysts and jewellery scrap. In 2020, recycled output declined by 10 t to 52 t due to COVID-19 restrictions and a drop in new car sales which, in turn, impacted the supply of vehicles for recycling.

PRIMARY PLATINUM PRODUCTION IN 2019–2020 (t)

2019: 190 t

Countries	2020
South Africa	–40
Zimbabwe	+1
Russia	0
Canada	–1
USA	0
Rest of world	0
Total	150

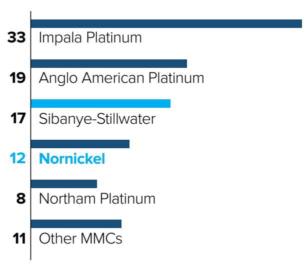
Source: Company data

RHODIUM (Rh)

THE COMPANY'S INDUSTRY POSITION

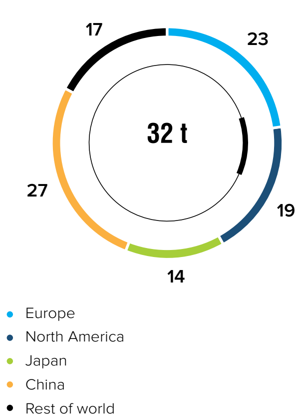
№ 4

IN RHODIUM PRODUCTION[1] (%)



Source: Company data

RHODIUM CONSUMPTION BY REGION (%)



Source: Company data

Rhodium prices in 2020 averaged at

11,231

USD/oz,

up 188% from the 2019 average of USD 3,904/oz.

KEY TRENDS IN THE RHODIUM MARKET

2020 saw a major increase in rhodium prices although with high volatility: rhodium prices reached an all-time high of USD 13,800/oz amid high demand and shortages in the spot market in early March, but due to the spread of COVID-19, the price plunged 60% to USD 5,500/oz on 24 March. However, prices quickly recovered to between USD 8,000/oz and USD 9,000/oz as early as in the beginning of April. In the second half of 2020, the automotive industry recovery and relaxation of coronavirus restrictions as well as the breakdown in Anglo American Platinum's pyrometallurgical processes led to resumed growth in rhodium prices reaching a new high of USD 17,000/oz at the end of December. Stronger rhodium price fluctuations in 2020 compared to other PGMs are attributed to a relatively small size of the market, expectations of further growth in consumption by the automotive industry driven by the new vehicle emission standards, nontransparent reserves, and concentration of production in the southern Africa where production suffered from instability during the year.

AVERAGE ANNUAL RHODIUM PRICES (USD/OZ)

2015	2016	2017	2018	2019	2020
952	694	1,105	2,220	3,904	11,231

Source: JMI

[1] Refined metal including production from own feedstock by third parties under tolling agreements.

MARKET BALANCE

In 2020, the rhodium market remained undersupplied, as the metal's production decline outpaced growth in demand from the automotive and other industries.

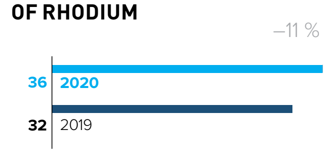
RHODIUM CONSUMPTION IN 2020 BY INDUSTRY (t)

production and consumption balance	–2
Investor demand	0
ETF inflow	0
Supply and demand balance	–2

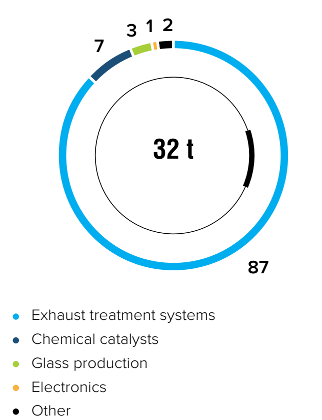
CONSUMPTION

Industrial consumption of rhodium in 2020 declined to 32 t, down 4 t (or 11%) y-o-y.

INDUSTRIAL CONSUMPTION OF RHODIUM

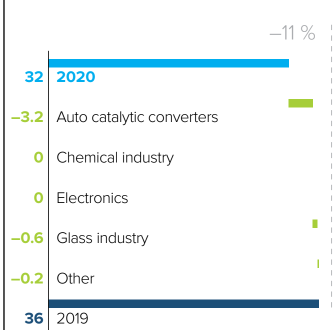


RHODIUM CONSUMPTION IN 2020 BY INDUSTRY



Source: Company data

RHODIUM CONSUMPTION BY APPLICATION AREA (t)



Source: Company data

AUTOMOTIVE INDUSTRY

The automotive industry is the key consumer of rhodium which is used in catalytic converters to detoxify exhaust fumes, thanks to the unique properties of this metal. Installation of such converters on motor vehicles is a legal requirement. Rhodium is considered the best catalyst for nitrogen oxide removal in petrol motors. In 2020, rhodium consumption by the automotive industry decreased by 3.2 t (down 10%) to 27.4 t, mainly due to falling vehicle output amid lockdown restrictions. However, the relaxation of coronavirus restrictions in the second half of the year, fiscal stimuli from most governments and monetary easing led to a recovery in demand. Another growth driver included tougher regulations on pollutant emissions, including the Real Driving Emissions (RDE) test, in effect in the EU as of September 2019. In China, the marked increase of rhodium usage in autocatalysts came in the wake of tougher environmental requirements as part of the China 6 rollout across the country starting from 2019. Tighter Tier 3 and LEV III standards in the USA and declining global share of diesel vehicles (due to their replacement with petrol vehicles) also partly offset the consequences of the decline in vehicle production in 2020 thanks to higher rhodium use per vehicle.

In 2020, rhodium consumption in the glass industry also plunged. Rhodium is used to make crucibles for glass batch melting. In 2020, the industry's demand for this metal decreased by 0.6 t due to its replacement with cheaper platinum.

Rhodium consumption in the chemical and electronics industries remained flat.

PRODUCTION

Global production of primary refined rhodium in 2020 decreased by 5 t y-o-y to 20 t. In the reporting period, supply from South Africa, the world's largest rhodium producer, declined by 5 t due to the nationwide lockdown and operational issues at Anglo American Platinum's pyrometallurgical facilities. The output of the Russian Federation, North American and other countries remained flat.

Used exhaust gas catalysts are the main source of recycled rhodium. In 2020, recycled output declined by 0.6 t to 10.4 t due to the pandemic restrictions and a drop in new car sales which, in turn, impacted the supply of vehicles for recycling.

PRIMARY RHODIUM PRODUCTION IN 2019–2020 (t)

2019–25 t

Countries	2020
South Africa	–5.1
Zimbabwe	+0.1
Russia	0
Canada	0
USA	0
Rest of world	0
Total	20

Source: Company data