# COMMODITY MARKETS

**No. 1** globally in palladium production

**No. 1** globally in high-grade nickel production

**No. 4** globally in platinum production

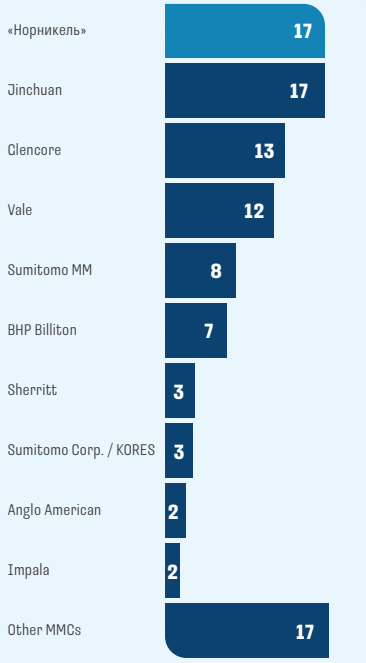
**No. 5** globally in rhodium production

**No. 12** globally in copper mine production

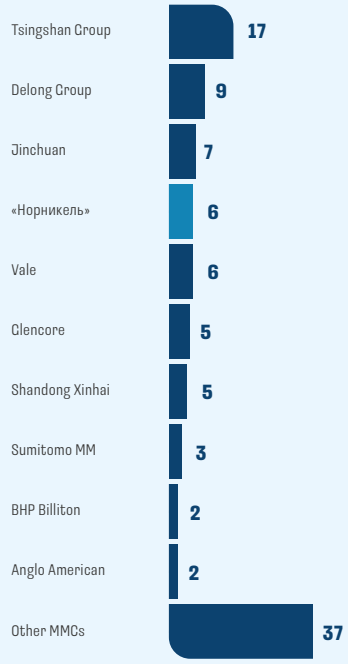
Nornickel retains leadership in the global industry.

# NICKEL (Ni)

**No. 1 in high-grade nickel production** (%)




**No. 4 in primary nickel production** (%)

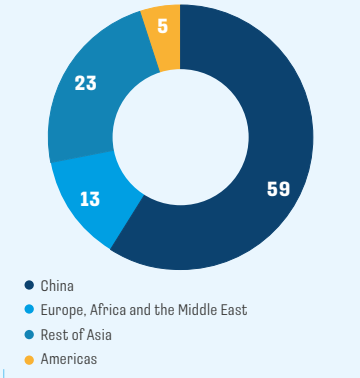



Sources: producer reports, Company analysis as of 5 March 2022.

## Key trends in the nickel market

In 2021, the nickel market moved into a deficit of 159 kt, or 6% of annual consumption (compared to a surplus of 89 kt in 2020). This was due to a strong recovery in stainless steel smelting and a high demand from the battery sector amid slow ramp-up in Indonesia's nickel pig iron (NPI) production and lower output of nickel metal due to production constraints.

**Primary nickel consumption by region** (%)




Source: Company data

Early in 2021, the nickel price was growing steadily, hitting a seven-year high of USD 20,000/t at the end of February. The growth came on the back of market optimism about the pace of global economic recovery, the dollar weakening as the new Biden administration announced a USD 1.9 trillion stimulus package, as well as industrial incidents in Norilsk, affecting the metal supply on the market.

In early March, China's Tsingshan announced plans to convert low grade nickel (NPI) into nickel matte for subsequent battery production, resulting in a price drop of more than 20% to USD 16,000/t. In April, the nickel price was consolidating between USD 16,000/t and USD 16,500/t, but grew to USD 18,000/t in May on the back of non-ferrous metal rally.

In early June, the nickel price stood at USD 18,000/t, but news that Russia was going to impose temporary duties on base metals exports and Indonesia was considering restrictions on the construction of new NPI and ferronickel plants caused the London Metal Exchange (LME) nickel price to reach a five-month high of USD 20,000/t at the end of July.

In August, increased price volatility was caused by concerns over the spread of the COVID Delta variant potentially hitting global economic recovery. A month later, despite pessimistic comments from the US Federal Reserve, the nickel price surged to a new seven-year high of USD 20,400/t on 10 September, as strong market fundamentals and falling LME stocks increased speculative demand. However, the Evergrande's debt crisis and widespread power outages in

China eventually sent the price to below USD 18,000/t in early October – the lowest level since June.

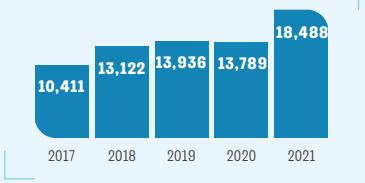
The LME Week demonstrated market optimism and triggered a price rally amid bullish sentiments among traders and concerns over nickel supply due to a number of reasons from Vale's reduced production guidance to suspension of Onça Puma's ferronickel production in Brazil to unfavourable weather in the Philippines affecting nickel ore mining volumes in Q4. The price increase was also due to fundamental factors: the nickel market deficit, dwindling LME stocks, high market premiums on all forms and in various markets, opening of the arbitrage between the Shanghai Futures Exchange (SHFE) and LME, and significant backwardation. As a result, the LME nickel price topped USD 21,000/t at the end of November, hovering around this level for the remainder of the year despite significant volatility.

The LME nickel price averaged USD 18,488/t in 2021, up 34% from the 2020 average of USD 13,789/t.

The LME nickel price averaged in 2021

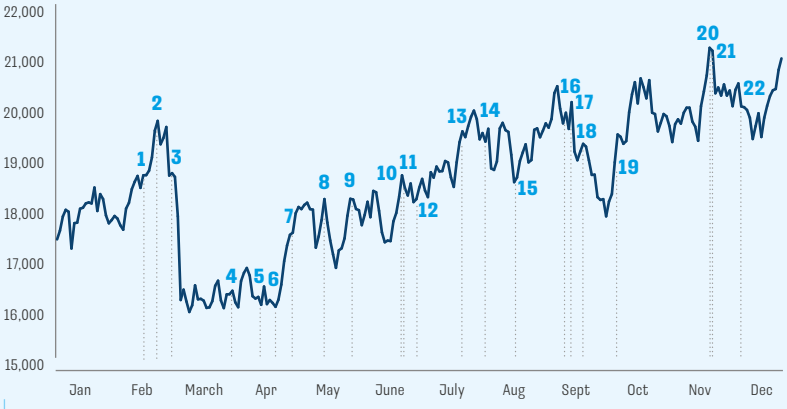
**18,488 USD/t**

**Average annual nickel prices** (USD/t)




Source: London Metal Exchange (cash settlement)

**LME nickel price in 2021** (USD/t)




Source: London Metal Exchange

1. Industrial incidents in Norilsk
2. Nickel price hits a seven-year high
3. Tsinghan announces plans to supply nickel matte to Chinese battery material makers
4. Ambatovy resumes production following a 12-month closure
5. The Philippines lifts moratorium on new mines
6. LME non-ferrous metals prices surge amid record-high copper and iron ore prices
7. Start of LME inventories' drawdown
8. Startup of the first high-pressure acid leaching (HPAL) project in Indonesia
9. Strike starts at Vale's Sudbury operation
10. Indonesian government announces plans to limit construction of NPI and ferronickel plants
11. Temporary taxes on base metals exports in Russia from 1 August
12. Opening of SHFE/LME arbitrage, available for most of the second half of the year
13. Indonesia bans entry of foreign workers, slowing down the construction of NPI plants
14. End of the strike at Vale's Sudbury operation
15. LME slips into persistent backwardation for the remainder of the year
16. Indonesia considers export tax on products with <70% Ni content
17. Debt crisis of the Chinese developer Evergrande
18. Start of the power crunch in China
19. Bullish market sentiment after the LME Week
20. New seven-year high on market tightness
21. Massive spread of the Omicron strain begins
22. Launch of the first project to convert NPI to nickel matte in Indonesia

# Market Balance

Primary nickel consumption surged in 2021 by a record 17% y-o-y to 2.85 mln t. Falling stainless steel production in China (–1% y-o-y) caused by the energy crisis is offset by smelter production growth in Indonesia (+90%) and strong demand for battery-grade nickel (+73%) on the back of healthy sales of electric vehicles (EV). Other consumption segments (apart from stainless steel and batteries) grew by 9% on the back of economic recovery from the acute phase of the coronavirus pandemic and inventory restocking across the entire value added chain.

Primary nickel production totalled 2.69 mln t in 2021 (+7% y-o-y). Our production guidance was sharply revised down vs the start of 2021, as new Indonesian NPI capacity was slower to come on stream than initially expected amid the COVID-related constraints at Tsingshan's facilities and Delong's projects. This was accompanied by falling nickel metal production caused by a strike at Vale's Sudbury operation and incidents in Norilsk, as well as lower ferronickel production due to production curtailments at the Koniambo in New Caledonia and Doniambo projects and high energy prices impacting Kosovo's Ferronikeli.

As a result, the market plunged into a major deficit of 159 kt in 2021 amid a strong demand recovery and slow production growth. This led to a shortage of metal available for spot buying, which was reflected in dwindling exchange inventories, high market premiums for all forms of metal, opening of the arbitrage between SHFE and LME, and a significant backwardation of the forward curve..

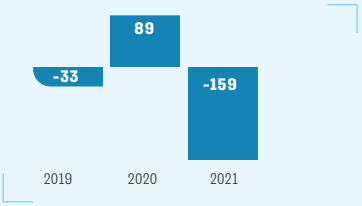
In 2021, total nickel inventories of LME and SHFE dropped by 60%, or 158 kt, to 107 kt at the year end. This major outflow of inventories was caused by a metal shortage as market participants rushed to buy metal from exchange warehouses amid a nickel market deficit. LME-approved warehouses in Malaysia, Singapore, and Taiwan saw the largest outflows in the second half of the year. Nickel briquette inventories decreased more than others, largely due to the fact the nickel briquettes can be dissolved to produce nickel sulphate used as a raw material to produce batteries for the EV sector.

Market premiums (markup on the metal price for buying a particular form in a particular location) for all forms of nickel soared by more than 50% in all regions amid high consumer demand and limited supply, and for some products by about 700%. Logistical issues (high freight costs, container shortages, difficulties in securing vessel space, major sea-routes disruptions) also put upward pressure on premiums. Major shortages of nickel briquettes as well as other small shapes (rondelles, shot, etc.) persist amid strong demand from the battery sector and restocking across the value chain.

Also in the second half of the year, the arbitrage between SHFE and LME (difference in contract value between the stock exchanges which allows buying an asset at one exchange for resale at the other) remained open for most of the period, indicating a consistently high demand for nickel in China and contributing to the reallocation of metal to the Chinese market.

In 2021, backwardation (a situation on the futures market where spot contract prices, i.e. contracts with immediate delivery, are higher than forward contract prices, i.e. contracts with delivery at a future date) put an extra pressure on the nickel market since mid-August, hitting USD 200/t and compounding the effects of steadily declining stocks and rising premiums. This trend reflects the persistent supply tightness and robust demand for spot metal.

**Nickel production and consumption balance** (kt)




Source: Company data

Primary nickel production totalled in 2021

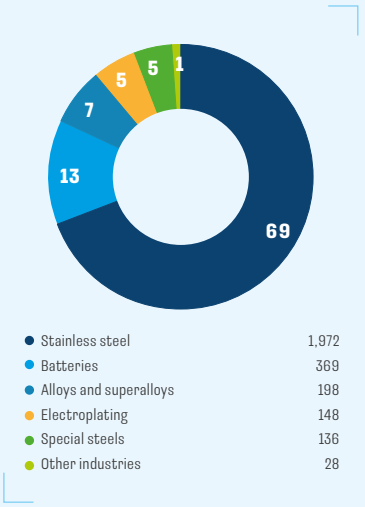
**2.69 mln t**

**+7%** y-o-y

**IN 2021, BACKWARDATION PUT AN EXTRA PRESSURE ON THE NICKEL MARKET SINCE MID-AUGUST, HITTING USD 200/T AND COMPOUNDING THE EFFECTS OF STEADILY DECLINING STOCKS AND RISING PREMIUMS.**

# Consumption

**Nickel consumption by industry in 2021** (kt)




Source: Company data

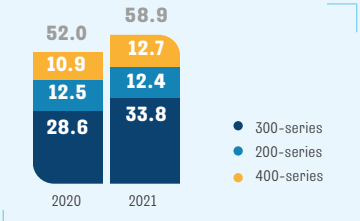
Stainless steel production continues to be the key driver of nickel consumption (about 70% of total consumption) in 2021. Adding nickel as an alloying element to stabilise the austenite structure enhances steel's corrosion resistance, high-temperature creep resistance, weldability, ductility, and resistance to aggressive environments.

The 300-series stainless steel is the most widespread grade (about 60% of global steel output) and offers a higher nickel content, mainly from 8% to 12%. Therefore, nickel consumption is primarily driven by the output of this particular grade. This non-magnetic steel series has high corrosion resistance, strength and flexibility, can be easily processed using different methods, which makes it the most versatile type of steel, driving its wide use in the construction, food, chemical, transport, energy, and other industries.

The 200-series steel features low nickel content (about 1%–2%, although it can be as low as 4% in some cases) due to manganese alloying. Compared to the 300-series steel, it is more susceptible to surface corrosion and does not have comparable high-temperature creep resistance and resilience, but its lower cost makes it widely used in the production of consumer goods, such as household appliances.

Ferritic and martensitic stainless steels (400-series) typically do not contain nickel. Their key properties include an increased content of chromium and low content of carbon, making it highly flexible and ductile. Its main applications include the automotive industry, in particular car exhaust systems, as well as the manufacture of cutlery, kitchenware, shipping container frames, interior architectural design elements, and razor blades.

**Stainless steel production by eries** (mln t)




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

Stainless steel production uses almost all types of nickel feed (except for some special products, such as nickel powder and compounds). 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 production has decreased in recent years.

In 2021, global stainless steel output grew 13% to 59 mln t amid a strong post-pandemic recovery in demand, while the output of 300-series nickel-intensive steel increased by 18% to 34 mln t. The highest steel production growth rates were seen in Indonesia (up 86% y-o-y), Japan (18%), North America (16%), and Europe (14%), while Indonesia and China were the leaders for production growth in absolute terms (2 mln t each).

About 60% of the total stainless steel output is concentrated in China. In 1H 2021, China's stainless steel production increased significantly by 25% y-o-y, driven by the economic stimulus programme launched by the Chinese government in 2020 in an attempt to help the country's business activity recover after the acute phase of the COVID-19 pandemic. However, in 2H 2021, China's stainless steel production slowed down due to power shortages caused by both coal deficit and power outages organised to meet the CO2 emissions target, as well as by lower supplies of ferrochromium from South Africa due to logistical constraints. As a result, in the second half of the year, stainless steel output fell by 9% y-o-y, while total steel production in 2021 only rose by 7%. Despite the higher steel output, primary nickel consumption in China's stainless steel sector dropped 1% to 1.2 mln t amid the increased use of recyclables.

In 2021, stainless steel output in Indonesia almost doubled to 5 mln t driven by the commissioning of new facilities by China's Tsingshan and Delong, which are already integrated with their NPI operations, resulting in significantly lower production costs. China is the largest importer of Indonesian stainless steel.

In 2021, stainless steel production in Europe grew by 14% to 7 mln t. The recovery that started in 2H 2020, following the pandemic-related disruptions in stainless steel supply and demand, accelerated in 2021 as market participants continued restocking amid the recovery in business activity. Lead times at European mills were increased, and order books are extending now up into Q3 2022 in some cases. This recovery in demand, coupled with low inventories, import restrictions under protectionist trade policies, and the rising cost of raw materials, logistics and energy, has led to a twofold surge in stainless steel prices in Europe. In this market context, major European manufacturers showed record financial performance in 2021.

Just like in Europe, the stainless steel industry in the United States has seen a strong rebound starting in Q4 2020, supported by increased end use demand from the industrial machinery, appliances, construction, and automotive industries, driving stainless steel output up by 15% to 2.5 mln t.

Supported by the global growth of stainless steel output, primary nickel consumption in this sector increased by 12%, or 218 kt, in 2021. This growth was partially offset by a stronger NPI output (up 17% or 186 kt), while the production of other low-grade nickel (ferronickel, nickel oxide, and utility nickel) decreased by 17 kt in total. As a result, consumption of high-grade nickel in stainless steel production, sluggish in recent years, grew by 23% to 263 kt driven by the shortage of low-grade nickel units due to slower than expected commissioning of new NPI production capacities in Indonesia. Nevertheless, NPI supply is expected to grow in the coming years, putting further 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 batteries. In 2021, nickel consumption in this sector increased by 73% to 369 kt. Lithium-ion batteries (Li-ion) are the key type of batteries because of their high energy storage capacity and long life cycle.

Growth in lithium-ion battery production is primarily driven by road transport electrification. In 2021, sales of electric vehicles (plug-in HEVs and battery electric vehicles) more than doubled to 6.5 million units, growing at a CAGR of over 50% between 2015 and 2021. The impetus for transport electrification comes from government incentives, more stringent environmental regulations, improved battery performance, and lower production costs of battery cells.

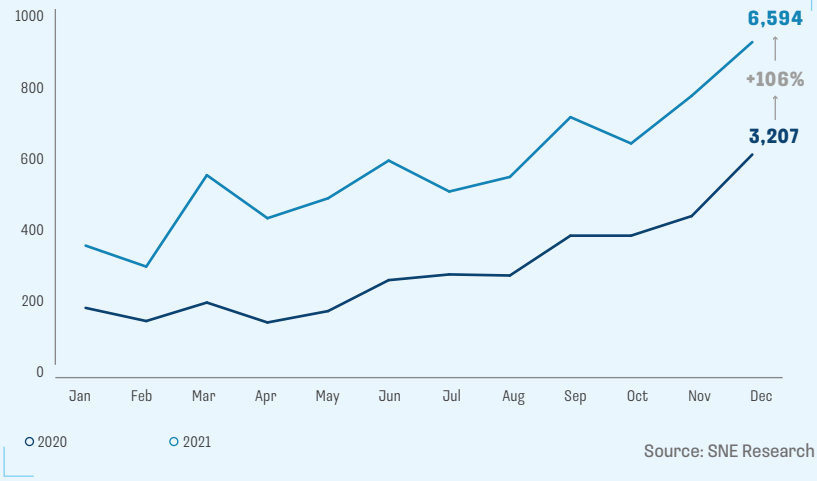
The global electrification race continues to gather pace as an increasing number of battery-related investments have been announced in the last year in China, Europe and North America. Global car manufacturers have also set targets for EV sales by 2030 and have earmarked a total of over USD 500 billion so far to invest in EV production.

In recent years, China has been one of the most important growth hubs for EV manufacturing. Electric vehicle sales grew 2.5 times in 2021 to 3.5 million units even despite the planned reduction in subsidies. China aims to increase EV sales to 20% of total vehicle sales by 2025 and to 50% by 2035. Initiatives to stimulate transport electrification, including mandatory requirements for large carmakers to manufacture electric vehicles, will also work towards these targets.

In Europe, the drive for building a local supply chain continues to be propelled by public policy and legislation. In July 2021, the EC unveiled its Fit for 55 climate package containing legislative initiatives for achieving the goals of the Green Deal, among which there is a provision that all new cars registered as of 2035 should be zero-emission. In addition, member states will be required to install charging and hydrogen refuelling points at regular intervals on major highways (every 60 km for electric charging and every 150 km for hydrogen refuelling).

In anticipation of stronger demand, the EU is building a battery production chain, with the announced total capacity of key manufacturers (Tesla, Volkswagen, Northvolt, LG Energy Solution, FREYR, Samsung SDI, etc.) estimated at about 1 TWh by 2030, which is equivalent to the annual consumption of over 800 kt of nickel.

**Global sales of electric vehicles in 2021**




Source: SNE Research

The pace of electrification initiatives has recently accelerated in North America, too. On the policy side, in August 2021, President Biden signed an executive order, which sets a target for half of all cars sold in the country to be zero-emission vehicles by 2030. This paradigm shift to an electric future is also underlined by the Bipartisan Infrastructure Deal, which will provide funding of USD 7.5 billion for building a nationwide EV charging network and USD 3 billion as a grant programme to support the development of the North American battery industry.

Amid this "green tidal wave", some American carmakers have started partnering with the battery cell makers to build gigafactories meeting their future requirements. These collaborations include GM and LG Energy Solution, Ford and SK Innovation, Stellantis and LG Energy Solution, Stellantis and Samsung SDI. While a year ago, there were only eight existing and announced plants in North America with Tesla leading the way, today, there are around 20 new and expansion projects in the US and Canada with the expected total capacity of over 750 GWh by 2030.

Considering the significant influx of the end of life batteries in the next decade as well as massive demand for raw materials by the gigafactories, battery recycling is becoming a key legislative priority in the West. The EU is currently adopting a new Battery Regulation to create a legal framework for a circular economy in batteries and make certain recycled contents (for Ni, 4% as of 2030 and 12% as of 2035) mandatory for battery producers, inter alia. At the same time, the US Bipartisan Infrastructure Deal authorises a USD 3 billion grant programme for the development of the domestic and North American battery manufacturing and recycling facilities. Increasingly, battery recyclers and carmakers seek to cooperate to form closed loop systems.

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

LCO batteries are principally confined to mobile electronics. The small size of the market, high cobalt prices and low energy density of LCO batteries prevent them from being used in EVs, but other types of batteries are widely used in the sector.

LFP batteries are a cheaper alternative to nickel-containing NCMs and NCAs. Therefore, LFP batteries cost 10%–20% less on average than NCM 5:3:2. Tesla has recently announced that it is shifting to cheaper LFP batteries globally, reaffirming its last year's strategic move to resort to the use of cheap components only to deliver the lower-cost models. Mercedes has also claimed to switch to less powerful LFP batteries for its electric models in the lower price segment from 2024.

However, LFP batteries suffer from a number of serious drawbacks, such as lower energy density, longer charging time, higher self-discharging rate, poor performance in low temperatures, and limited recyclability. They significantly limit the potential for the LFP batteries' deployment in the long-range, high-tier EVs, which have to use the more advanced nickel-intensive NCM 8:1:1 and NCA chemistries.

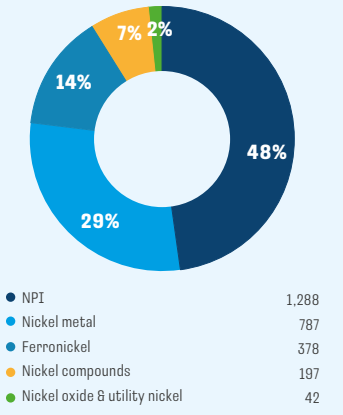
The dominating technologies include nickel-containing NCM and NCA batteries, owing to their higher specific energy and energy density, which increases drive range. Growing nickel consumption in batteries is driven by a higher average nickel content in the cathode material caused by the need to replace expensive cobalt units and increase energy density. In comparison to 2015, when NCM 1:1:1 (with a nickel mass fraction of 20% of the total cathode mass, which is equivalent to about 25 kg of nickel per battery electric vehicle on average) accounted for the lion's share of compounds in cathode materials, 2021 saw nickel-intensive compounds – NCM 5:2:3, NCM 6:2:2 and NCM 8:1:1 (with a nickel share exceeding 50%, about 50 kg per EV) – take the lead. Going forward, conversion to NCMA (nickel, cobalt, manganese, and aluminium) and NCM 9:0.5:0.5 with a higher content of nickel is expected.

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 our base case scenario, we estimate the nickel consumption in batteries to reach 1.5 mln t of nickel by 2030, or 30% of total primary nickel demand (compared to 13% in 2021), which may require further revisions given the continuous introduction of more ambitious carbon neutrality goals, subsidies-driven electrification, and cost optimisation of battery cell production.

In 2021, nickel consumption in other industries (alloys, electroplating, special steels) increased by 9% or 41 kt amid the gradual recovery of business activity after the acute phase of the COVID-19 pandemic with steady strong demand from end users in the automotive, transport engineering, construction, and oil & gas industries.

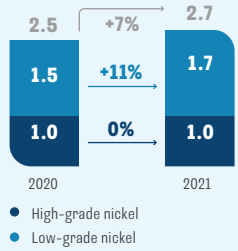
# Production

**Primary nickel production by industry in 2021**
(kt)




Source: Company data

**Primary nickel production**
(mln t)




Source: Company data

Global primary nickel production can be roughly divided into high-grade and low-grade nickel production.

High-grade nickel is produced in the form of nickel cathodes, briquettes, carbonyl shot and powder, rondelles, as well as chemical compounds, both from sulphide and from more common and available lateritic raw materials. 2021's main producers of high-grade nickel were Nornickel, Jinchuan, Glencore, Vale, Sumitomo Metal Mining, and BHP.

Low-grade nickel includes NPI, ferronickel, nickel oxide, and utility nickel, which are produced from lateritic raw materials only. In 2021, the key producers of low-grade nickel were Chinese and Indonesian NPI smelters, as well as the largest ferronickel producers: POSCO, Anglo American, Eramet, South32, Solway, etc.

In 2021, many producers were affected by production restrictions due to the coronavirus pandemic. Nonetheless, primary nickel production in 2021 grew by 167 kt, or 7%, y-o-y to 2.69 mln t, led by higher NPI output in Indonesia. This was accompanied by falling nickel metal production caused by a strike at Vale's Sudbury operation and temporary suspension of production in Norilsk as well as lower ferronickel output at the Koniambo and Doniambo projects in New Caledonia due to production curtailments and high energy prices impacting Kosovo's Ferronikeli.

Production of high-grade nickel decreased marginally by 2 kt to 984 kt in 2021.

Production of nickel metal slipped 6% y-o-y to 787 kt in 2021. Operational issues, labour strikes, and the coronavirus pandemic prevented producers from increasing output to pre-pandemic levels. For example, Vale's production in Canada suffered from a strike at its Sudbury operation. Nornickel's production was affected by temporary suspension of production at the Norilsk Concentrator and flooding of the Oktyabrsky and Taimyrsky Mines, while Glencore reduced production at the Murrin Murrin site in Australia due to prolonged repairs. BHP's nickel production was impacted by scheduled maintenance at its smelting shop, refinery, and concentrators. BHP's nickel metal production also decreased on the back of the switch from nickel briquettes to nickel sulphate crystals production.

On the other hand, the Ambatovy plant in Madagascar ramped up to planned capacity following a year-long closure, and Anglo American delivered strong performance following the restart of its Anglo Convertor Plant (ACP) Phase A unit in South Africa.

Production of nickel compounds, including nickel sulphate from primary sources (excluding sulphate produced by high-grade nickel dissolution), increased by 35% y-o-y to 197 kt in 2021 on the back of robust EV sales and solid nickel demand from the battery sector.

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 (copper chain product) or by dissolving high-grade nickel metal (as nickel briquettes or powder) or from recycled materials.

In 2021, nickel metal dissolution volumes (this source of feedstock is used to compensate for lacking nickel units) more than doubled due to the shortage of nickel intermediates and delays in launching HPAL projects, which produce MHP for export to China, and NPI-to-nickel matte conversion capacities in Indonesia, amid exceptionally strong demand from battery manufacturers remains extremely high. This was one of the main reasons for a major outflow of exchange stocks from LME-approved warehouses in Asia.

Given the growing importance of ESG as well as the global ambition to reach carbon neutrality, Nornickel started producing carbon-neutral nickel in 2021. Production of nickel with a neutral carbon footprint was enabled by efforts to reduce GHG emissions ($CO_2$) across all stages of production from ore mining to beneficiation and refining to finished products. The Company's products boast one of the lowest carbon footprints in the industry with a fully transparent production chain.

Low-grade nickel output grew by 11%, or 169 kt, to 1,708 kt.

Indonesian NPI production was the main driver of low-grade nickel supply growth in 2021; however its growth rates fell significantly short of expectations due to slower commissioning of new capacity, restricted entry of workers due to the coronavirus pandemic, and the conversion of some furnaces to converter matte production. Overall, we estimate the total 2021 NPI production in Indonesia at 862 kt (+46% y-o-y).

China's NPI production continued to decline, dropping 17% y-o-y to 426 kt in 2021. The decline was caused by significantly lower ore inventories due to the robust NPI demand in 2020, lower nickel content in ores imported from the Philippines, falling imports from New Caledonia, and power curtailments in China in the second half of the year.

Ferronickel output in 2021 remained almost unchanged at 378 kt (–1% y-o-y) mainly because of Glencore's Koniambo project operating only one production line out of two due to technical issues and the production cuts at Tagaung Taung's operation in Myanmar due to a military coup. Eramet's Doniambo in New Caledonia production declined as the mine and ferronickel plant were affected by the COVID-related disruptions. Brazilian Onça Puma hasn't yet reached its design capacity because of operational challenges, extended maintenance and a short-term license suspension, while the Greece-based Larco has been gradually reducing its ferronickel output for a few years as it balances on the verge of bankruptcy. Also, production at NewCo Ferronikeli in Kosovo was suspended indefinitely due to high electricity prices.

On the other hand, Colombia's Cerro Matoso facility returned to planned production volumes after an overhaul, while the Falcondo mine in the Dominican Republic increased the output closer to its nameplate capacity. Japan's Pamco was also recovering after the 2020 output cuts.

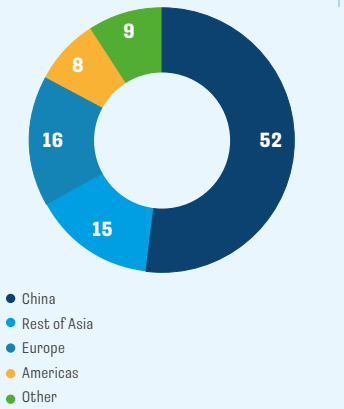
**NPI production** (kt)


Source: Company data

# COPPER (Cu)

**№ 12 in the copper mining industry** (%)


**Refined copper consumption by region in 2021** (%)




Sources: Wood Mackenzie, producer reports, Company analysis

## Key trends in the copper market

In 2021, the global economy continued to recover from the coronavirus pandemic. Whereas China, which was the first to emerge from the most acute phase of the pandemic, showed its biggest recovery progress in 2H 2020, the other leaders of the global economy (US, Europe) rebounded mostly in 2021. These factors as well as growing investments in renewable energy and transport electrification increased the global consumption of refined copper by 4%, while its supply was constrained by the volume of copper in transit due to logistics disruptions. This, as well as growing speculative interest in the metal that can become a pillar of green energy, supported the continued copper rally which began in 2020 and resulted in new all-time highs.

After a moderate correction in January, copper price continued to grow, hitting USD 9,600/t at the end of February on the back of faster than expected global economic recovery after the strictest phase of the lockdown and amid growing investor expectations around green economy, which relies on copper as its vital material.

Trade union protests in Chile and Peru, which created risks for metal supply, and a new, tougher policy on scrap imports in China, which led to a higher consumption of refined copper in the country, also contributed to growth in copper exchange prices.

After a consolidation in March, the price rally intensified in April–May 2021 amid dwindling exchange inventories, higher speculative interest, and announcements of US and Chinese infrastructure development plans. By mid-May, the copper price hit a record high of USD 10,725/t.

However, mid-year sales of metal from China's state reserves, a stronger US dollar, and concerns over the new, Delta variant of COVID-19 pushed prices back to around USD 9,000–9,500/t, where they hovered until early October.

A new rally followed early in the fourth quarter, fuelled by fears of rising inflation, production disruptions in Latin America, logistical problems that stretched the supply chain and increased volumes of stranded metal in transit, energy crisis in China, as well as all-time low global inventories. Speculative investor activity also played a large role in the new price surge. As a result, prices grew close to USD 10,700/t by mid-October. A moderate correction in November–December pushed prices down to about USD 9,700/t.

Warehouse inventories of the Shanghai Futures Exchange, London Metal Exchange, and New York Mercantile Exchange hit record lows in 2021. Over the year, LME copper inventories decreased by 19 kt to 89 kt; SHFE stocks by 48 kt to 38 kt; and NYMEX inventories by 9 kt to 69 kt. Total global exchange inventories of copper shrank by 76 kt to 189 kt.

In 2021, LME copper price averaged at USD 9,317/t vs USD 6,181/t in 2020 (+51%).

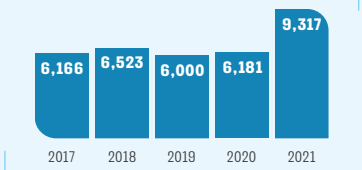
# Market Balance

The LME copper price averaged in 2021

**9,317 USD/t**

**+51%** in 2020

**Average annual copper prices** (USD/t)




Source: London Metal Exchange

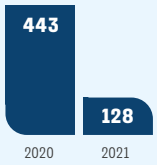
**LME copper price in 2021** (USD/t)


1. End of the Lunar New Year holidays in China, full recovery in production, lifting of COVID-19 restrictions
2. Stagnating consumption in China
3. Announcements of infrastructure plans in the US and China
4. Copper price hitting an all-time high of USD 10,725/t
5. Sale of metal from China's state reserves, growing fears of a new strain of the coronavirus, and a stronger US dollar
6. Union strikes in Chile and Peru, the power crunch in China, announcements of high premiums by Aurubis and Codelco, and record low global inventories

In the reporting period, copper production increased by 2.5% to 21.5 mln t, while refined copper production increased by 3% to 24.6 mln t. In the same period, global refined copper consumption totalled 24.4 mln t, up 4%, or 0.95 mln t, y-o-y. As a result, the market moved to a marginal surplus of less than 1% of annual consumption, or 128 kt.

It should be noted however that due to stretched supply chains, large quantities of metal became unavailable for consumption, which, along with a higher speculative interest in copper due to greater prominence of renewable energy, resulted in dwindling exchange inventories of copper. In 2021, total exchange inventories dropped by 28% to 189 kt (vs 265 kt at year-end 2020), or at little more than six days of global consumption.

**Copper market balance** (kt)




Sources: Company data, Wood Mackenzie

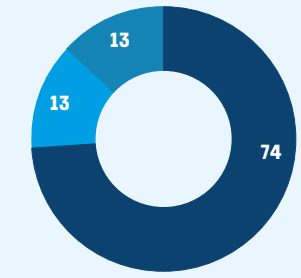
# Consumption

Thanks to 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 to make electrical conductors, including various types of cable and wire. Key copper-consuming industries include construction, electrical and electronic equipment, power industry, transport, machine building, and the production of various equipment and consumer goods.

## REFINED COPPER CONSUMPTION BY INDUSTRY

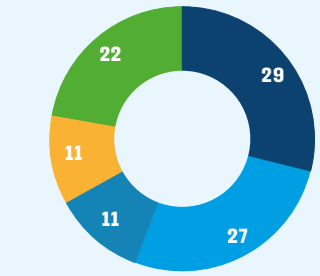
**First use** (%)

**24.4 mln t**




**End use by industry** (%)

**30.6 mln t**




Sources: Company data, Wood Mackenzie

**24.4 mln t**

In 2021, global refined copper consumption

**+4%** 2020 y-o-y

In 2021, global refined copper consumption totalled 24.4 mln t, up 4%, or 0.95 mln t, y-o-y.

China remained the largest copper consumer globally, accounting for 52% of the total in 2021. Following resurgent copper consumption in the first half of the year, demand for copper plateaued out in China as its economy fully recovered after the strictest phase of the lockdown. Refined copper consumption in China grew by 1% to 12.6 mln t for the full year. Imports of refined copper into China totalled 3.4 mln t, down 24% y-o-y, in 2021. Scrap copper imports increased by 80% to 1.7 mln t, indicating that importers were able to adapt to the new regulatory requirements for quality control of imported recyclables, with high refined copper prices as an extra stimulus. Copper concentrate imports rose by 8% to 23.4 mln t.

Copper demand in other key regions also increased in 2021: consumption in Europe (the Company's key market for copper cathodes) increased by 9%; in North America by 11%; in the Middle East by 0.5%; and in Asia excluding China by 7%. Russia increased its copper consumption by 9%.

Notably, in its primary application – wire production – copper is not replaced with aluminium despite high prices, as aluminium prices also hit multi-year highs.

# Production

In 2021, global copper mine output grew by 2.5% to 21.5 mln t on the back of production recovery after the global pandemic as well as the startup of new mines in Peru and the Democratic Republic of the Congo.

In 2021, mining production in Chile, the world's leading producer of copper, declined by 1% y-o-y to 5.75 mln t due to union strikes at some mines. Peru increased its output by 7% to 2.3 mln t.

A 7% growth in Africa's mining production to 2.9 mln t was mainly due to a higher output from mines in the Democratic Republic of the Congo.

China ramped up copper mine production by 5.5% to 1.85 mln t in 2021, while mining production in Indonesia grew 44% to 0.75 mln t.

Production in North America rose by 2% to 2.55 mln t, with US production up by 4%, a marginal growth of 0.1% in Canada and 1% decline in Mexico.

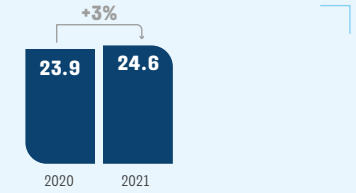
In 2021, global refined copper output rose by 3%, or 0.64 mln t, y-o-y to 24.60 mln t. Most of the key refined copper producers increased their output in 2021: China by 7.0% to 10.0 mln t, the Democratic Republic of the Congo by 10.5% to 1.5 mln t, and the United States by 12.0% to 1.0 mln t. Production in Chile fell by 4.0% to 2.2 mln t; in Japan by 3.0% to 1.5 mln t; and in Russia by 9.0% to 934.0 kt.

In 2021, global refined copper output totalled

**24.6 mln t**

**+3%** y-o-y

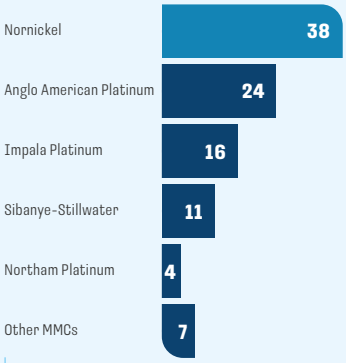
**Production of refined copper** (mln t)




Sources: Company data, Wood Mackenzie

# PALLADIUM (Pd)

## №1
**in palladium production** (%)



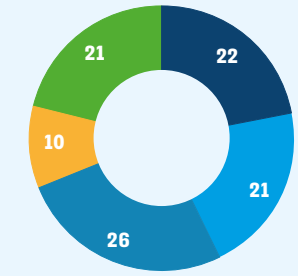

Refined metal output including production from third-party feedstock and production from own feedstock by third parties under tolling agreements.

Sources: producer reports, Company analysis as of 5 March 2022

## Key trends in the palladium market

**Industrial consumption of palladium by region** (%)

**309 t**




Source: Company data

Early in 2021, palladium was trading in the USD 2,300–2,500/oz range, followed by growth which started in mid-March and continued until early May when price hit a new all-time high of USD 2,994/oz. This trend was primarily driven by the recovery in global vehicle production after the strictest phase of the lockdown and expectations of a significant increase in demand for the metal during the year.

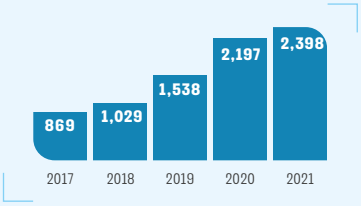
The Company's production cuts due to industrial incidents in the first half of the year also supported the price rally, as the market participants were concerned about a potential physical supply shortage.

In mid-2021, palladium price stabilised in the USD 2,500–2,900/oz range; however, a downward trend began in August driven by revised estimates of the automotive industry's recovery pace. Semiconductor shortages forced automakers to cut vehicle production. Chip shortages prevented automakers from producing a total of about 8–9 million vehicles in 2021, equivalent to a

consumption of ~25–27 tonnes of palladium. The semiconductor crunch has affected both physical metal buying by consumers and the sentiment of speculative market participants. A low of USD 1,592/oz was hit in mid-September, followed by a rebound to about USD 2,000/oz.

On average, the palladium price increased by 9% y-o-y to USD 2,398/oz in 2021.

**Average annual palladium prices** (USD/oz)




Source: LBMA

**LBMA palladium price in 2021** (USD/oz)


1. Industrial incidents in Norilsk.
2. Nornickel lowers its mining production guidance by 15%–20% due to deferred resumption of operations at its mines.
3. Reports of potential metal shortages coupled with expectations of the automotive industry recovery led to a five-month high in net long speculative positions and the price hitting an all-time high.
4. US vehicle sales in June fall short of expectations. Car dealer inventory shortages and low production trigger a negative trend.
5. Vehicle sales in the European Union plummet by more than 20% amid a shortage of vehicles available for purchase.
6. Automotive industry recovery forecasts by leading analytical publications revised, pushing the recovery further out.
7. Net long speculative positions hit a 12-month low.
8. Growth of palladium imports to China and Hong Kong.
9. Rebound amid inflationary concerns.

# Market Balance

Since 2010, there has been a sustained undersupply in the physical palladium market covered by inventories accumulated in previous years The sources of previously accumulated palladium stockpiles include trading companies, financial institutions, government reserves, and consumers' surplus inventories.

In 2021, despite lower consumption compared to pre-pandemic levels, the market was in a small deficit due to a slow recovery in metal supply to 2019 levels.

Consumption decline was driven primarily by a shortage of chips used in the automotive industry and a resulting decrease in metal consumption in the catalytic systems of new vehicles. The automotive industry accounts for over 80% of palladium consumption. Meanwhile, metal consumption in other industries showed a marked recovery growth. 2021 also saw a positive trend in investment demand for palladium from ETF and retail investors.

Palladium production recovery to pre-pandemic levels in 2021 was hampered by temporary production suspension at Nornickel due to industrial incidents, as well as lower secondary palladium production due to a shortage of new vehicles available for purchase and reduced recycling of old vehicles. At the same time, palladium production in South Africa grew significantly, preventing an acute shortage of the metal on the market.

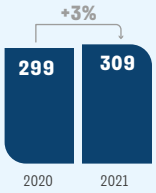
**Palladium market balance in 2021** (t)

| | |
|---|---|
| Production and consumption balance | -2 |
| ETF inflow | 1 |
| Change in other inventories | 2 |
| Supply and demand balance | -1 |

# Consumption

**IN 2021, INDUSTRIAL CONSUMPTION OF PALLADIUM INCREASED BY 10 TONNES (+3%) Y-O-Y TO 309 TONNES.**

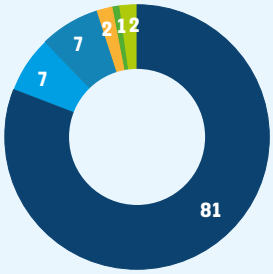
**Industrial consumption of palladium in 2020– 2021** (t)




Source: Company data

**Palladium consumption in 2021 by industry**(%)

**309 t**




Source: Company data

Automotive industry. Exhaust treatment systems account for the bulk of total palladium consumption. In this sector, palladium is used in catalytic converters which are mandatory for road transport and legally regulated in most countries.

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

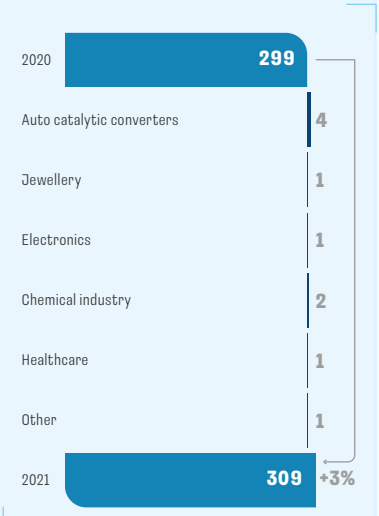
In 2021, palladium consumption in the automotive industry increased by 4 tonnes. The increase was driven by the automotive industry's partial recovery from the pandemic-induced manufacturing constraints. In 2021, a total of 76 million cars were made, up 2% y-o-y. Car production could have recovered much faster had it not been affected by semiconductor shortages, particularly in 2H 2021. Global car production lost a total of 8 to 9 million units because of the shortage of electronic components.

Moreover, demand is further boosted by higher PGM (platinum group metals) loading in autocatalysts. Higher PGM loadings per vehicle were primarily driven by stricter regulations on pollutant emissions. The US continues tightening emission requirements under Tier 3 standard. In China, higher palladium loadings per autocatalyst were driven by tougher environmental requirements of China 6b standard. The Euro-7 standard, which will be announced in 2022 and implemented in 2025, is expected to increase the usage of palladium in cars sold on the European market.

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 (27 EU countries + UK + European Free Trade Association (EFTA) countries) dropped from 35.1% to 21.4% over the year.

Vehicle hybridisation is another trend driving palladium consumption. Production of hybrid-electric vehicles, so called mild, full and plug-in hybrids (PHEVs), increased by 56%, 29% and 79%, respectively. Since hybrids have petrol engines, they mostly use palladium-based catalytic converters. With the same engine displacement as the conventional petrol vehicle, the hybrid has a higher loading of the metal due to more frequent cold starts.

**Change in palladium consumption in 2020–2021 by application** (t)




Source: Company data

Electronics. In 2021, palladium consumption in the electronics industry increased by 1 tonne to 20 tonnes. 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 in these sectors, its consumption is expected to remain flat. Transition to 5G networks and autonomous vehicles should also somewhat offset lower demand elsewhere. Moreover, despite disruptions at electronics assembly facilities due to lockdowns, the work-from-home trend driven by the pandemic bolstered demand for laptops and TV sets.

Chemical industry. In 2021, the use of palladium in chemical catalysts increased by 2 tonnes y-o-y. In the medium term, growing consumption of palladium in the chemical industry will be driven by production capacity additions in China (particularly for caprolactam and monoethylene glycol from coal).

Healthcare. Although demand for palladium from the healthcare sector increased by 1 tonne in 2021 as dental clinics returned to normal operations after the strictest phase of the lockdown, the long-term trend for palladium demand in this industry is negative due to its replacement by alternative composites and products made of gold, which is currently cheaper.

Jewellery. Palladium is used in white gold alloys or in its pure form to make jewellery such as wedding rings. In 2021, palladium consumption in the jewellery industry increased by 1 tonne, edging closer to pre-pandemic levels amid an overall recovery in economic activity. However, it is worth noting that in recent years, demand for palladium in jewellery production has been falling due to palladium overtaking the price of gold.

Investments. Investor demand for palladium increased by 2 tonnes in 2021 on the back of higher demand from exchange-traded funds (ETFs), whose inventories grew by 1 tonne to 19 tonnes. Retail investments into bullion grew by 1 tonne again in the reporting year.

# Production

In 2021, primary refined palladium production increased by 12% y-o-y to 217 tonnes.

Production in the Russian Federation, the key producer of palladium, slipped by 7% to 81 tonnes due to a temporary shutdown of the Oktyabrsky and Taimyrsky Mines flooded by groundwater and suspension of operations at the Norilsk Concentrator.

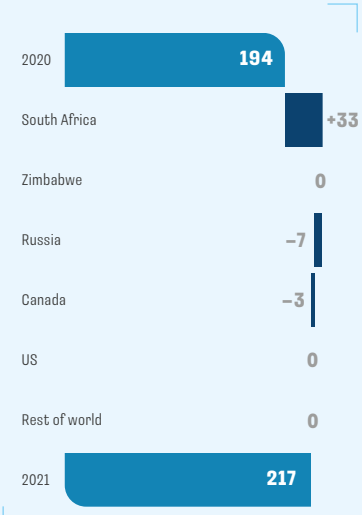
Production in South Africa surged (+33 tonnes) to 90 tonnes in 2021 amid recovery from the nationwide COVID-19 lockdown and the processing of previously accumulated work in progress, primarily by Anglo American Platinum.

Primary palladium output in the United States and Zimbabwe did not change significantly as operations in these regions were less affected by pandemic-related restrictions in 2020.

Primary palladium output in Canada dropped by 3 tonnes, mostly due to a decrease in Vale's output caused by a two-month strike of its employees.

The main sources of recycled palladium supply are scrapped auto catalytic converters, as well as jewellery and electronic scrap. In 2021, recycled output declined by 7 tonnes to 90 tonnes due to COVID-19 restrictions and a drop in new vehicle sales which, in turn, impacted the supply of vehicles for recycling.

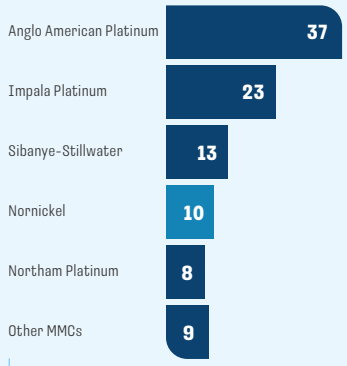
**Annual primary palladium output** (t)




Source: Company data

# PLATINUM (Pt)

## №4
**in platinum production** (%)



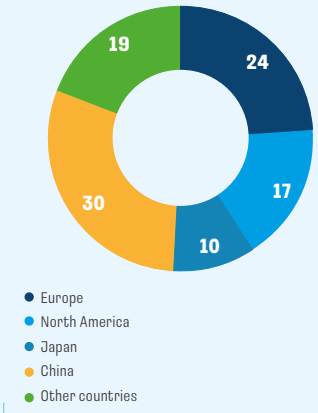

Refined metal output including production from third-party feedstock and production from own feedstock by third parties under tolling agreements.

Sources: producer reports, Company analysis as of 5 March 2022.

## Key trends in the platinum market

**Platinum consumption by region (%)**

**224 t**

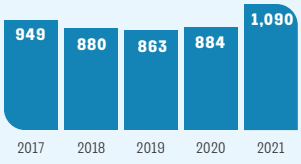



Source: Company data

The platinum price started rising early in the year, hitting a six-year high of over USD 1,300/oz in mid-February in anticipation of automotive market growth and amid the growing prominence of the emerging hydrogen agenda. This was followed by price correction towards the USD 900–1,100/oz range. The lowest price in USD/oz was hit in December, followed by a rebound on growing inflation concerns.

In 2021, average LBMA platinum price grew 23% y-o-y to USD 1,090/oz, much faster than gold, another precious metal with a high investment component. The latter grew by 2% over 2021. The average annual spread between gold and platinum narrowed from 2:1 in 2020 to 1.6:1 in 2021, indicating that investors consider platinum's fundamentals to be more attractive as a metal used in green economy sectors.

**Average annual platinum prices** (USD/oz)




Source: LBMA

**LBMA platinum price in 2021** (USD/oz)


1. Industrial incidents in Norilsk.
2. The highest level of net long speculative positions in 2021.
3. Revision of the Company's production guidance due to incidents in Norilsk.
4. Vehicle sales in the EU plummet by over 20% amid a shortage of vehicles available for purchase.
5. The lowest level of net long speculative positions in 2021.
6. Anglo American Platinum's production report shows accelerated processing of work-in-progress inventories in 2020.
7. Stabilisation due to high inflation.

# Market Balance

Despite demand recovery, the platinum market surplus increased in 2021 due to a temporary increase in South African production caused by processing of previously accumulated work-in-progress inventory and investor outflows from ETF funds.

**Platinum market balance in 2021** (t)

| | |
|---|---|
| Production and consumption balance | 30 |
| Outflows from ETFs | -7 |
| Change in other inventories (retail investments) | 11 |
| Supply and demand balance | 26 |

# Consumption

Industrial consumption of platinum in 2021 increased by 27 tonnes (+14%) y-o-y to 224 tonnes.

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

In 2021, platinum consumption by the automotive sector increased substantially (+11 tonnes y-o-y). The increase was driven primarily by the introduction of a new, more stringent environmental standard for trucks (mostly diesel-powered) in China, which led to a significant increase in platinum loadings per vehicle for trucks in China. Global vehicle production recovery after the COVID-19 lockdown also contributed to higher platinum consumption.

We also saw the continued tightening of environmental regulation of road transport in the US, and a new, more stringent European standard Euro-7 is expected to be announced in 2022 and implemented in 2025.

At the same time, demand for platinum from the automotive industry is negatively affected by the gradual decline in diesel vehicle share of European sales (from 35.1% at the end of 2020 to 21.4% at the end of 2021). Diesel cars are outcompeted by hybrid (petrol) and all-electric vehicles. Furthermore, platinum consumption recovery was slowed by a 2% y-o-y decline in global production of light diesel vehicles due to stricter regulation in the European Union, the US and China. The decline was particularly prominent in Europe at 19% y-o-y.

The jewellery industry — is the second largest platinum consumer, accounting for a third of demand for this metal. In 2021, jewellers' demand for platinum rose by 5 tonnes amid a rebound in demand, store reopenings and a resurgence in trade, with growth led by the US market.

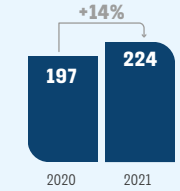
The chemical and petrochemical industries also increased their platinum consumption by 2 tonnes in 2021 on the back of increased usage of platinum catalysts for paraxylene and silicone production in China, as well as growth in oil refining and new gas-to-liquids capacity additions.

In the glass industry, platinum is used to manufacture equipment (bushings) for making glass and optical fibre and optical glass. Demand for the metal from this industry grew by 4 tonnes in 2021 on the back of increased demand for LCD panels and the substitution of rhodium for platinum in the production of bushings for price reasons.

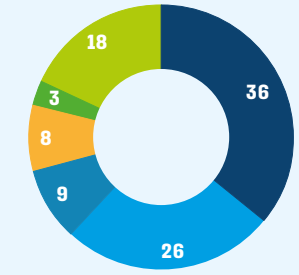
Platinum consumption in the electronics industry, where it is mainly used to produce hard drives for data storage, remained unchanged amid disruptions to operations in Malaysia and other Southeast Asian countries and competition from SSD storage.

Investments. Platinum is widely used as an investment instrument. Physical investments may vary from coins and small bars to investments in physical platinum ETFs. In 2021, demand for platinum bars from retail buyers fell by 7 tonnes to 11 tonnes. Over the year, investments in platinum ETFs also slipped by 7 tonnes. Lower investor interest may be due to profit taking amid a significant increase in metal prices in 2021.

**Platinum consumption in 2021 (t)**



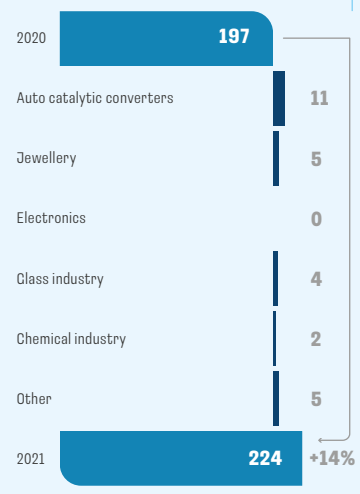

**Platinum consumption in 2021 by industry**




- Exhaust aftertreatment systems
- Jewellery
- Chemical catalysts
- Glass production
- Electronics
- Other

Source: Company data

**Changes in platinum consumption by application (t)**




Source: Company data

# Production

Global production of primary refined platinum grew by 49 tonnes y-o-y to 201 tonnes in 2021.

In the reporting period, South Africa, the key producer of platinum, increased output by 53 tonnes through selling of work-in-progress inventories accumulated in 2020 and steady growth in primary production following employee vaccination and return of mines and processing plants to normal operations.

Platinum production in the Russian Federation decreased by 2 tonnes due to a temporary shutdown of the Oktyabrsky and Taimyrsky Mines flooded by groundwater and suspension of operations at the Norilsk Concentrator. Production in Zimbabwe remained at the 2020 level, while North American production fell by 2 tonnes.

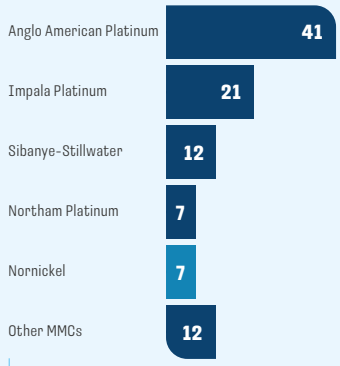
Spent exhaust gas catalysts and jewellery scrap are the key sources of recycled platinum. Secondary production was flat at 53 tonnes in 2021.

**Annual primary platinum output** (t)


Source: Company data

# RHODIUM (Rh)

## № 5
**in rhodium production** (%)

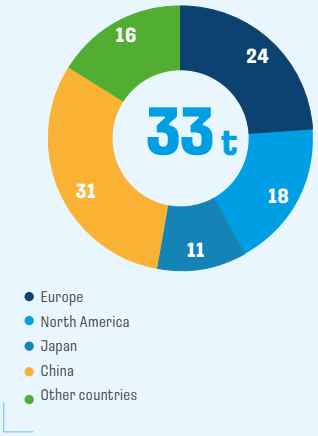



Refined metal output including production from third-party feedstock and production from own feedstock by third parties under tolling agreements

Sources: producer reports, Company analysis as of 5 March 2022

## Key trends in the rhodium market

**Rhodium consumption by region** (%)




Source: Company data

Despite being highly volatile, rhodium prices rose significantly over 2021, reaching a high of USD 28,000/oz in April on the back of strong demand from automakers, growing production following a period of strict pandemic restrictions and concerns over Russian supply after incidents in Norilsk. Amid growing supply from South Africa, where Anglo American Platinum started selling work-in-progress inventories accumulated in 2020, and an acute shortage of semiconductors towards the second half of 2022, price then started to fall, hitting a low of USD 9,500/oz in September and hovering around the USD 13,500/oz mark since then.

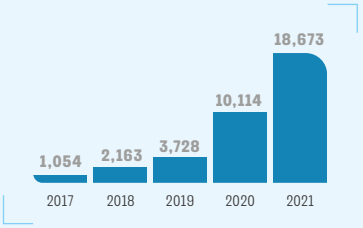
Rhodium prices in 2021 averaged at USD 18,673/oz, up 85% from the 2020 average of USD 10,114/oz.

The rhodium price averaged in 2021

**18,673 USD/oz**

**+85%** from the 2020

**Average annual rhodium prices** (USD/oz)




Source: Platts NY Dealers

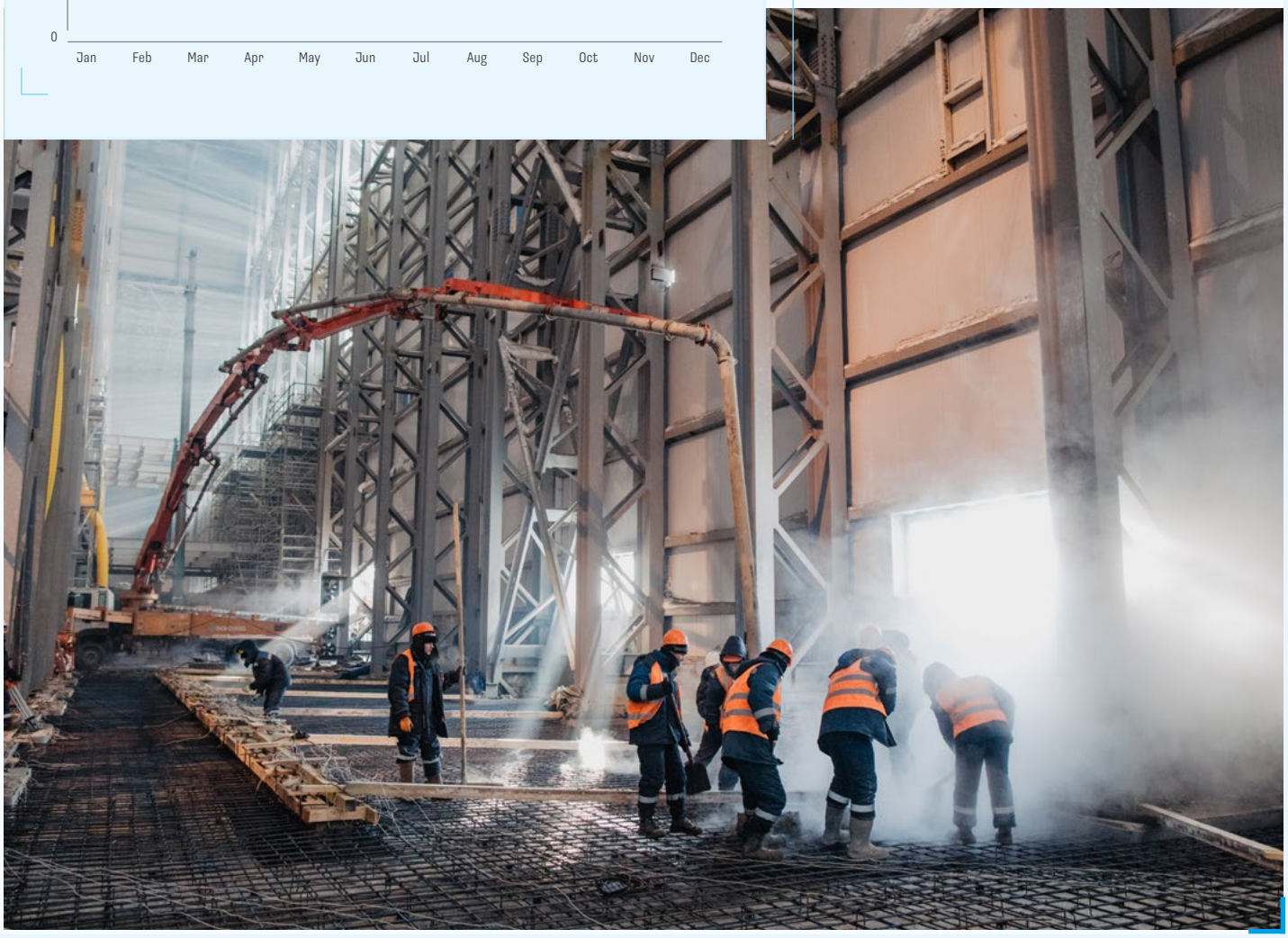
**Rhodium price in 2021** (USD/oz)


# Market Balance

In 2021, the rhodium market moved into a surplus (5 tonnes), primarily due to a large amount of work-in-progress accumulated by Anglo American Platinum in 2020.

**Rhodium market balance in 2021** (t)

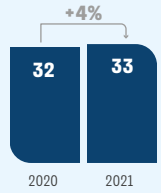
| | |
|---|---|
| Production and consumption balance | 5 |



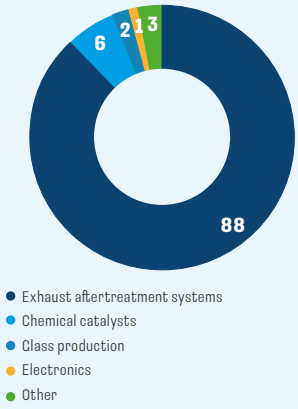
# Consumption

Industrial consumption of rhodium increased by 1 tonne (+4%) y-o-y to 33 tonnes in 2021.

**Rhodium consumption in 2021** (t)

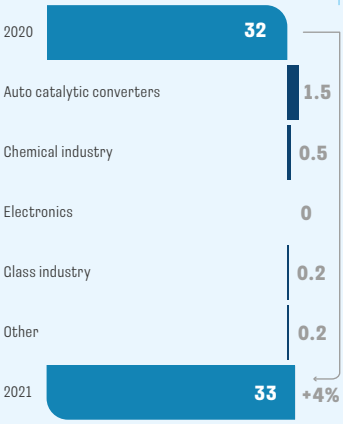



**Rhodium consumption in 2021 by industry**




Source: Company data

**Changes in rhodium consumption by application** (t)




Source: Company data

Automotive industry. At 85% of total consumption, the automotive industry is the key consumer of rhodium, using the metal's unique chemical properties for exhaust emission control in catalytic converters which are mandatory for road transport. Rhodium is considered the best catalyst for nitrogen oxide removal in petrol engines.

In 2021, rhodium consumption by the automotive industry grew by 1.5 tonnes (+6%) to 29 tonnes. The biggest driver of demand growth was restoration of the car market and stricter regulation of vehicle emissions, leading to higher rhodium loadings per vehicle.

Consumption of rhodium in the chemical industry decreased marginally due to its replacement with palladium in nitric acid catalytic gauzes.

Another sector where rhodium consumption plunged in 2021 was the glass industry. Rhodium is used to make bushings for glass melting. In 2021, the industry's demand for rhodium decreased marginally due to its replacement with cheaper platinum. However, due to an overall recovery in economic activity and the launch of new glass projects, the overall change in demand was insignificant.

Consumption in electronics and other industries remained almost flat.

# Production

Global production of primary refined rhodium increased by 11 tonnes y-o-y to 28 tonnes in 2021. In the reporting period, South Africa, the key rhodium producer, increased its output by 11 tonnes on the back of production recovery from a nationwide lockdown and the release of work in progress accumulated in 2020 by Anglo American Platinum. Rhodium production by the Russian Federation remained flat year-on-year despite the production incidents in Norilsk. Rhodium output in the North America and other regions also remained broadly flat.

Used exhaust gas catalysts are the main source of recycled rhodium. In 2021, secondary production declined by 0.5 tonnes to 10 tonnes due to COVID-19 restrictions and a drop in new vehicle sales which, in turn, impacted the supply of vehicles for recycling.

**Primary rhodium production (t)**


Source: Company data