Commodity

Market overview

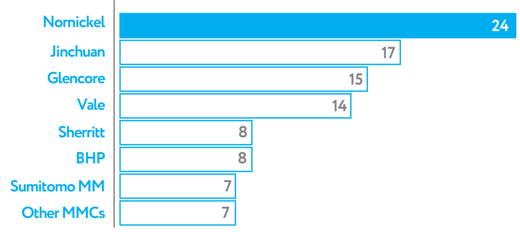
NICKEL (Ni)

KEY TRENDS IN THE NICKEL MARKET

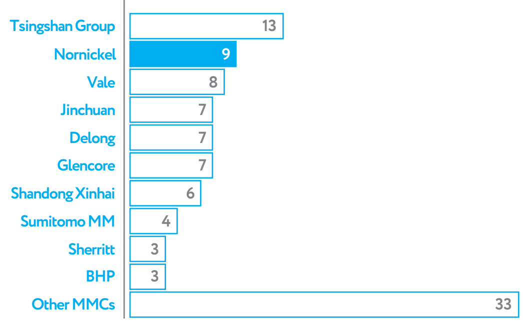
In 2019, nickel deficit in the market narrowed to 42 kt (down from 149 kt in 2018). The commissioning of new facilities in Indonesia and China led to a record increase in nickel pig iron (NPI) production, completely offsetting the nickel consumption growth in stainless steel in China (against weaker consumption outside China) and the higher demand for battery manufacture.

Nickel prices showed mixed trends and high volatility during the first half of 2019. High demand from the stainless steel sector in China and the impact from the Brumadinho dam disaster in Brazil (threatening to reduce nickel output from Vale's assets) were offset by negative macroeconomic effects of the US–China trade war and low global manufacturing PMI.

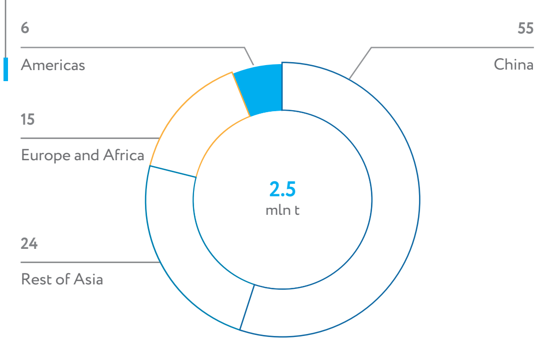
No. 1 in high-grade nickel production (%)



No. 2 in primary nickel production (%)



Primary nickel consumption by region (%)



Source: Company data

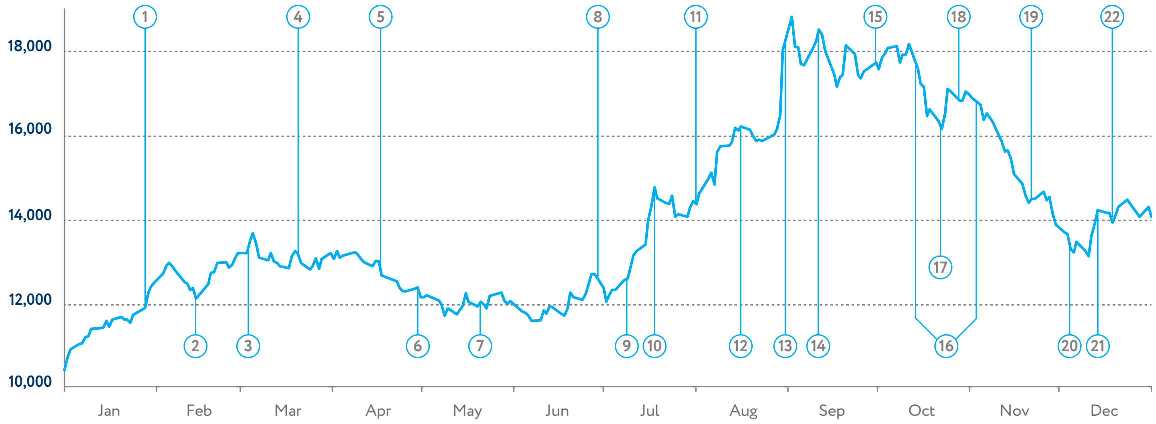
The price went up in the second half of the year after rumours that Indonesia may reintroduce a ban on ore exports, as well as on the news of increased capital intensity of laterite leaching projects. In August, the Indonesian government officially announced a nickel ore export ban effective from 1 January 2020, two years earlier than planned, in an effort to increase domestic processing of mineral resources and capture more value. As a result, the nickel price soared to USD 18,625/t (a five- year high), but this was followed by a period of consolidation. In the fourth quarter, the price dropped on the back of a significant decline in electric vehicle sales in China, caused by reduced government subsidies and stagnation in the stainless steel market, along with falling nickel premiums.

Average annual nickel prices (USD/t)

2014	2015	2016	2017	2018	2019
16,867	11,807	9,609	10,411	13,122	13,936

Source: London Metal Exchange (Cash Settlement)

London Metal Exchange nickel price (USD/t)



Sources: LME, Company data

1/ Dam failure at Vale's iron ore mine in Brazil gives rise to concerns over potential decline in nickel production
2/ Considerable growth in Chinese stainless steel production
3/ Positive market expectations regarding China–US negotiations to resolve trade disputes
4/ Optimistic PMIs in China
5/ SLN given green light to export nickel ore from New Caledonia
6/ US government increases tariffs on Chinese goods worth USD 200 bn from 10% to 25%
7/ Strengthening of the US dollar
8/ Ferronickel production halted at Vale's Onca Puma plant
9/ Indonesian President meets with the CEOs of China's Tsingshan, Huayou and Brunp
10/ News of an increase in the capital intensity of potential laterite leaching projects in Indonesia
11/ First reports of a potential ban on nickel ore exports from Indonesia from the beginning of 2020
12/ Ramu mine in Papua New Guinea closed after an industrial waste spill
13/ Indonesian ban on ore exports officially announced for 1 January 2020
14/ Production at Onca Puma resumed
15/ Nickel inventories dwindle at LME-approved warehouses
16/ Electric vehicle sales in China fall considerably
17/ Off-take agreement with SK Innovation for the supply of nickel sulphate from the Sconi project (Australia) terminated
18/ Market players' concerns over the threat of early termination of ore exports from Indonesia
19/ Reports that Vale would write off USD 1.6 bn from the book value of its Goro nickel asset in New Caledonia
20/ Nickel deliveries to LME-approved warehouses commence
21/ European Commission approves a total EUR 3.2 bn in subsidies to boost battery production in Europe
22/ US -China phase 1 trade deal agreed

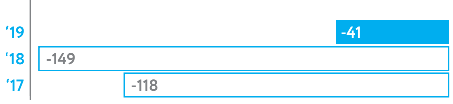
MARKET BALANCE

In 2019, nickel deficit in the market shrank to 42 kt (from 149 kt in 2018), driven primarily by an increased production of nickel pig iron in Indonesia and China (by 32%, or 228 kt) on the back of cheap supplies of high nickel content laterite ores. There were only marginal increases in the production of refined nickel (1%, or 11 kt) and its chemical compounds (22%, or 21 kt), mostly due to higher nickel sulphate production in China for use in the manufacture of lithium batteries. Conversely, production of other forms of low-grade nickel decreased by 4%, or 17 kt.

Consumption grew by 6%, or 133 kt, mostly due to increased demand for nickel in the Chinese stainless steel segment (by 13%, or 127 kt). Total consumption outside China decreased by 5%, or 32 kt. Nickel consumption for cathode precursors used in the manufacture of lithium batteries grew 26%, or 38 kt, driven by the electrification of transport. Demand from special steels and alloys rose by 2%, while consumption in electroplating decreased by 1%.

The combined nickel inventories of the London Metal Exchange (LME) and Shanghai Stock Exchange (SSE) dropped 16% to 191 kt. The two-year long depletion of inventories accelerated markedly in September–October but ceased in December when 85 kt of nickel was delivered to LME-approved warehouses. The key factors behind the metal inventories winding down (117 kt from January to November 2019) included expectations of higher demand from the battery sector in 2020–2021, the Indonesian nickel ore export ban, and delays to laterite leaching projects in Indonesia. However, when the nickel price dropped in the fourth quarter, market traders' "paper profits" began to ebb, and the cost of holding long physical positions mounted, leading to a backflow of metal into the exchange.

Nickel production and consumption balance (kt)



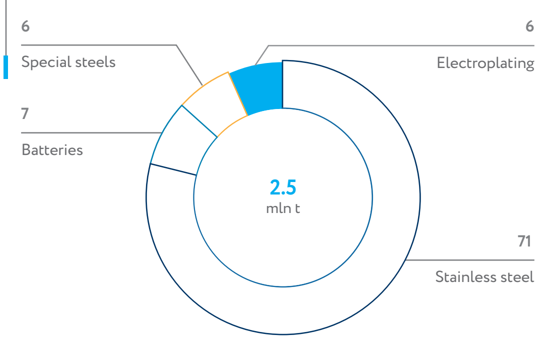
Source: Company data

CONSUMPTION

MAIN CONSUMING INDUSTRIES

The main area of nickel consumption can be found in the production of stainless steel (over 70% in 2019), which comes in several different grades. Austenitic stainless steel is the most common family of stainless steels (over three quarters of the global production) and includes the 200 series and 300 series.

Nickel consumption by industry (%)



The 300 series steels have an increased nickel content, ranging usually between 8% and 12% but reaching 20% in some grades. Nickel in these concentrations improves resistance to corrosion and strength in a broad range of operating temperatures, ensures good ductility, resistance to aggressive environments, and strips the metal of its magnetic properties. This series is the most versatile and sees a wide range of uses in construction, food, transport, the chemical and energy industries, and other sectors.

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 total 200 series steel production.

Although they account for only 1% to 2% of global smelting, 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, washing machines, cutlery, kitchenware, home decor items, and razor blades.

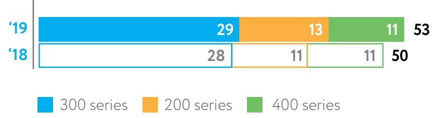
Stainless steel production uses almost all types of nickel feed (except for some special products, such as nickel powder and compounds). As nickel feed quality has practically no impact on the quality of stainless steel, steel mills predominantly use cheaper feeds. It is for this reason that high-grade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

In 2019, total stainless steel output increased by 5% to a record high of 53 mln t. The increase was mostly driven by growing stainless steel production in China, where nickel consumption grew by 13%, or 127 kt, due to higher demand and the restricted stainless exports from Indonesia. Production of nickel-heavy 300 series increased by more than 1.2 mln t, with Tsingshan, the world's largest stainless steel producer, accounting for over 75% of the production growth.

Following a period of strong growth in 2018, Indonesian stainless steel production in 2019 increased by only 50 kt, or 1 kt of nickel. The increase is mostly attributed to growth in 200 series with low nickel content, as 300 series production decreased marginally. This was accompanied by a reshuffle of stainless export flows amid higher trade tariffs on Indonesian products in China and other countries. Exports to China fell by 635 kt, while exports to India, South Korea, Italy, Taiwan and Thailand rose by a total of 650 kt.

With China increasing its output, a growing availability of low-grade nickel, and cheap Indonesian exports, stainless steel production in other countries and regions fell considerably. The fall was particularly prominent in Europe, South Africa, Japan, and Taiwan. The total level of stainless steel smelting in the USA decreased by 7%, but primary nickel consumption went down by only 2%, or 1 kt, due to the declining production of 400 series, which does not contain nickel.

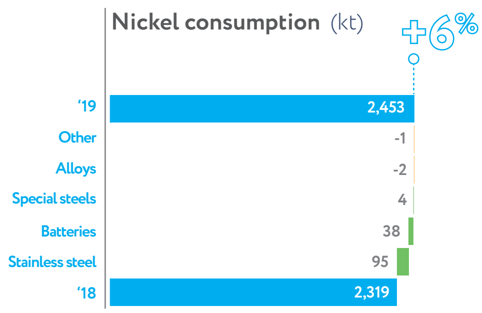
Stainless steel production by series (mln t)



Source: Company data

Thanks to a 2% rise in global 300 series production, a 17% rise in 200 series production, and a marginal reduction in average scrap metal share, primary nickel consumption in stainless steel production grew by 6% to 1.75 mln t. Nonetheless, the use of high-grade nickel in the stainless steel sector decreased by 131 kt, mostly driven by increased supply of nickel pig iron.

Nickel consumption (kt)



Source: Company data

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 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.

Nickel-metal hydride batteries (Ni-MH). Ni-MH batteries were developed in 1989 as a substitute for Ni-Cd batteries, to avoid using 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). The first batteries using nickel were developed back in 1899. These days their use is limited, as the EU prohibited cadmium on grounds of toxicity.

Road transport electrification has been the spark behind the growth in lithium battery production. The 2016–2019 CAGR of electric vehicles (plug-in HEVs and battery electric vehicles) was around 45%. The impetus for transport electrification has come from government incentives, but other key drivers include more stringent environmental regulations, improved battery performance, and lower production costs of battery cells.

In recent years, China has been an important growth centre for EV manufacturing, with plans to increase NEV (electric vehicles and plug-in hybrids) sales to 25% of total vehicle sales by 2025. 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, resulting in the first-ever decline in NEV sales, by 4% y-o-y.

As a result, the centre of battery industry growth is shifting to Europe. 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 42% of total vehicles sold, buyers are exempted from vehicle registration tax and value added tax (VAT).

Europe’s share in global NEV sales grew from 23% in 2018 to 27% in 2019, and is expected to reach 38% by 2025. 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 punishment of fines reaching into the billions. A battery production chain is being developed in anticipation of increased demand in the region. The total announced capacity (CATL, LG Chem, SK Innovation, Samsung, and Northvolt) already exceeds 400 GW•h by 2025, which would be equivalent to 300 kt of nickel.

Battery cell production is one of the final stages of battery manufacturing, preceded by the production of cathode precursors, and when lithium, graphite or silicon are added as the anode, the production of cathode material itself. In 2019, China held its position as the leader in cathode precursor production (61% of global production), while cathode material production was split between China (43%), Japan (30%), and South Korea (26%).

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

LCO batteries are principally confined to mobile electronics, as high cobalt prices, low power, and chemical instability of the compounds used prevent their application in EVs. However, other types of cathodes are widely employed in the EV sector. The current trend is to replace LFP and LMO with nickel-containing NCM and NCA batteries, owing to the higher energy density and specific energy of the latter, which increases vehicle range.

Growing nickel consumption in Li-Ion batteries is driven not only by an increasing share of battery types containing nickel, but also by a higher average nickel content in the cathode material, which, in turn, is caused by the need to substitute expensive cobalt units. 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 nickel-magnesium compounds in cathode materials, 2019 saw nickel-intensive compounds – NCM 6:2:2 (36%) and NCM 5:3:2 (30%) – take the lead. Going forward, conversion to NCM 8:1:1 (with a nickel content of 48%) is expected, and some producers announced plans to launch commercial production of LNO, a cathode material with nickel content exceeding 50%.

The further development of the automotive industry, with the growing popularity of electric and hybrid cars, along with the evolution of cathode technology towards nickel-intensive types make for a major uptick in growth of primary nickel consumption by the industry in the long run.

Changes in demand in other consuming industries were negligible. Demand for nickel used in special steels with improved structural properties and stability grew by 3%, or 4 kt. Nickel consumption for the production of heat-resistant alloys with a high nickel content, which are key materials for the production of aircraft engines, remained unchanged. Even against the backdrop of the grounding of the Boeing 737 Max, major commercial aircraft manufacturers are building their order books 8 to 10 years ahead, which should prop up nickel demand from the sector. Nickel consumption for standard alloys dropped by 1%, or 2 kt, due to low demand from the oil and gas industry on the back of falling oil prices in 2019.

Nickel is widely used for corrosion protection and as an alternative to chrome plating. Having a strong resistance to corrosion, a high level of hardness and aesthetic properties, nickel can be used to apply decorative and protective electroplating to products. Amid a lower availability of high-grade nickel, which is traditionally used in the premium electroplating segment, nickel consumption for electroplating in 2019 decreased slightly (by 1%, or 2 kt), due to reduced demand in China and other Asian countries.

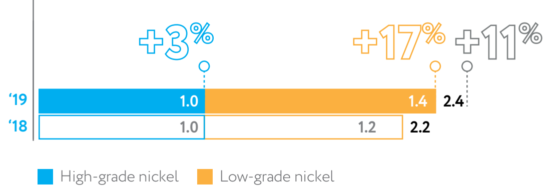
PRODUCTION

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. 2019's main producers of high-grade nickel were Nornickel, Jinchuan, Glencore, Vale, Sherritt, and BHP
- Low-grade nickel (ferronickel, NPI and nickel oxide), produced from laterite feed only. In 2019, the key producers of low-grade nickel included Chinese and Indonesian NPI smelters, as well as ferronickel producers such as Eramet, Posco, South 32, Anglo American, and Pamco

Primary nickel production in 2019 grew by 11%, or 242 kt y-o-y, driven primarily by a surge in low-grade nickel (NPI) output.

Primary nickel production (mln t)



Source: Company data

In 2019, high-grade nickel production increased by 3%, or 32 kt. Despite a marginal decrease in production by Vale and BHP, total smelting of refined metal increased, thanks to higher output by Nornickel and Jinchuan.

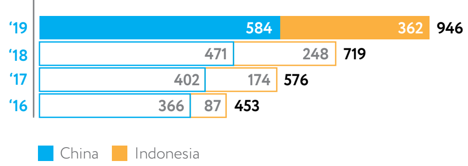
This was coupled with an increased output of nickel sulphate, which is a key feed for the production of cathode precursors used in Li-Ion batteries. Integrated production of nickel sulphate uses nickel matte, but elsewhere, the main feed for nickel sulphate production is hydrometallurgy semi-products (mixed hydroxide residue and mixed sulphide residue) and crude nickel sulphate, a by-product of copper and PMG production. In 2019, the main feeds for sulphate production were hydrometallurgy semi-products, as well as nickel briquettes and powders, which are melted down during shortages of other feeds.

Low-grade nickel production grew by 17%, or 211 kt, boosted by a significant increase in NPI production.

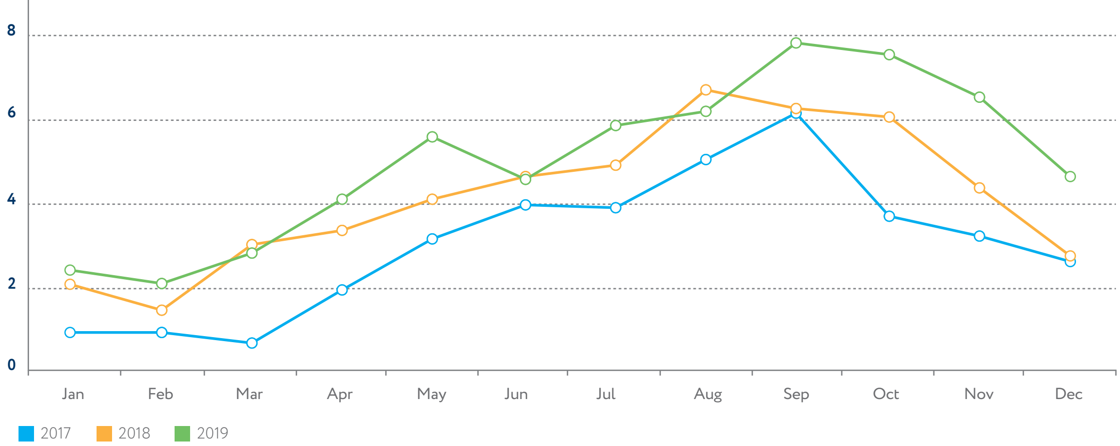
In China, a record level of stainless steel smelting, coupled with a stable growth in ore imports, were the key drivers behind 2019's 24% increase in NPI production to 584 kt. In Indonesia, the startup of new production facilities of Jinchuan, and brownfield expansions at existing smelters using local ores with high nickel content resulted in NPI production growth of 46%, or 114 kt.

In 2019, high-grade nickel production increased by 3%, or 32 kt. Despite a marginal decrease in production by Vale and BHP, total smelting of refined metal increased, thanks to higher output by Nornickel and Jinchuan.

NPI production (kt)



Saleable nickel ore imports into China in 2016–2018 (mln t)



COPPER (Cu)

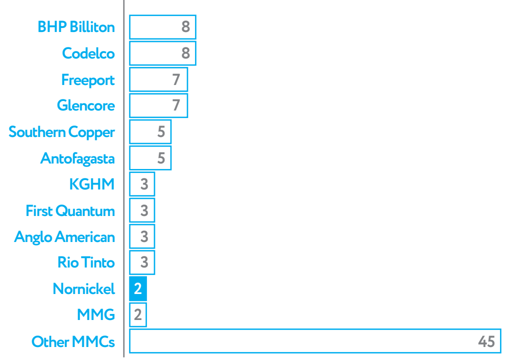
KEY TRENDS IN THE COPPER MARKET

2019: Relatively high prices at the beginning of the year (January–April), supported by reduced extraction from Chilean mines and stable demand for copper from China. Abrupt drop in May–September as escalating trade war between the USA and China gave rise to concerns that demand for metals might fall.

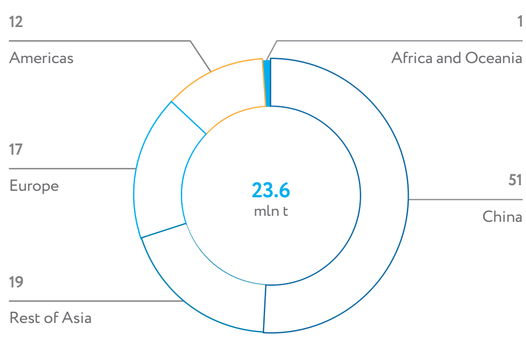
Outlook: Neutral. In the mid-term, the market will remain balanced; a successful outcome of the US–China trade talks and continued global demand may support copper prices in the short term.

Concerns over the possible fallout from the US–China trade war triggered a decline in the price of copper at the end of 2018, which was followed by a period of growth in January and February 2019. The price reached its annual peak of USD 6,572/t in early March. Price growth in 2019 was driven by deficit expectations in the copper market amid production declines in several countries: Chile saw a lower copper content in mined ores, and heavy February rains disrupted production; Indonesia's Grasberg mine (the largest in the country) experienced reduced output as it switched from surface to underground mining; and a number of mines in Africa were closed.

No. 11 in the copper mining industry (%)



Refined copper consumption by region (%)



Early May marked another round of the US–China trade war, when the US government imposed import tariffs on certain Chinese goods, adding to pessimistic sentiment in the market and causing copper prices to plummet to USD 5,750/t in mid-June. However, a strike at the Chuquicamata mine in Chile helped the price to recover to USD 5,970/t by the end of the second quarter. A lack of progress in the trade deal negotiations between the USA and China, along with a new round of tariffs from both sides put pressure on the copper price, plunging it to a two-year low of USD 5,537/t in early September.

In the fourth quarter, the copper price started to recover on the news of strikes and protests at Peruvian and Chilean mines, and amid reports of falling exchange stocks. The growth was further bolstered by a preliminary trade deal between the USA and China, bringing the price up to USD 6,200/t by the end of December.

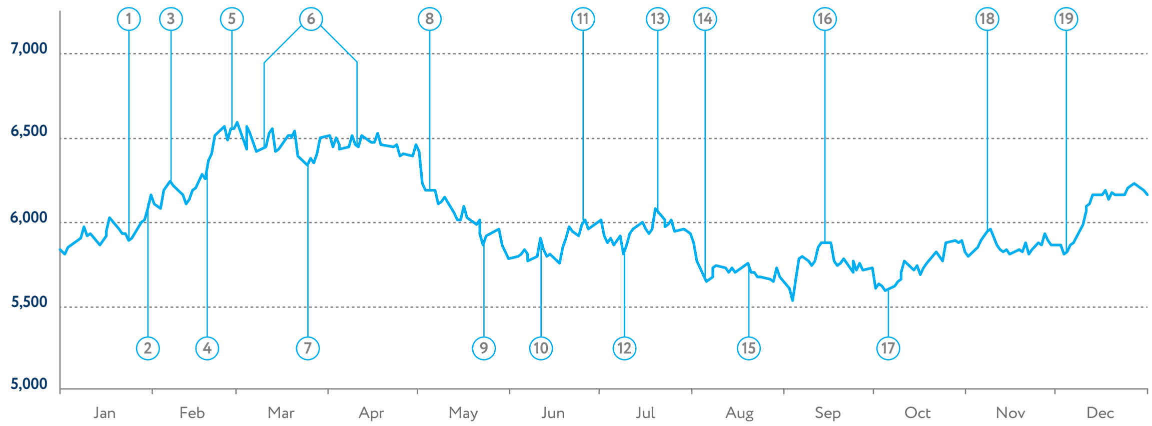
The average copper price on the London Metal Exchange in 2019 was USD 6,000/t, down by 8% from USD 6,523/t in 2018.

Average annual copper prices (USD/t)

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

Source: London Metal Exchange (settlement)

London Metal Exchange copper price in 2019 (USD/t)



Source: LME, Company data

1/ Research groups forecast increasing market deficit
2/ Freeport announces reduced output from its Grasberg mine in Indonesia
3/ Codelco reports a decrease in copper output
4/ Heavy rains halt production at some Chilean mines
5/ Glencore shuts down a number of mines in Africa
6/ Trade talks between the USA and China continue
7/ Falling copper cathode imports to China
8/ The USA imposes import tariffs on Chinese goods worth USD 200 bn
9/ Chinese countersanctions, tariffs on US goods
10/ Reports of declining production in Chile
11/ Strike at Chile's Chuquicamata mine
12/ Chuquicamata strike ends
13/ Increas in copper concentrate imports to China
14/ Extra US tariffs on Chinese imports worth USD 325 bn
15/ Research groups report increasing market deficit
16/ National strike in Peru
17/ News of a reduction in electric grid investment in China
18/ Brief strike at Chile's Escondida mine
19/ The USA and China sign a preliminary trade agreement (phase 1)

MARKET BALANCE

In 2019, the refined copper market remained in balance, as in 2018, with the deficit at just 0.2% of the total market volume, or 50 kt. In 2019, total exchange inventories dropped by 13% to 304 kt (351 kt at end-2018), or at little less than five days of global consumption, with off-exchange inventories going slightly up.

Refined copper market balance (kt)

Source: Company data

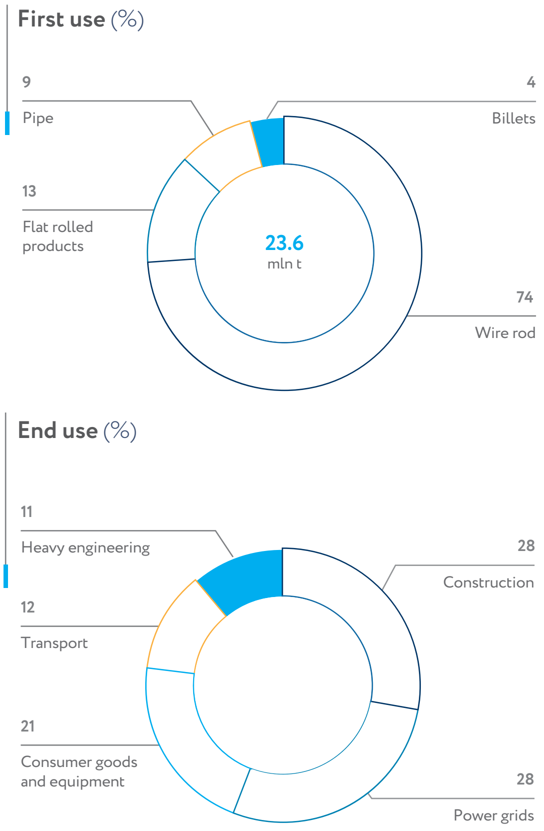
CONSUMPTION

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, engineering, various equipment and consumer goods production.

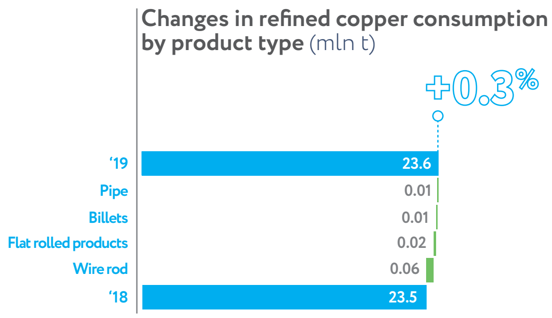
In 2019, global consumption of refined copper totalled 23.6 mln t (up 0,3%, or 0.1 mln t, y-o-y) due primarily to stronger demand from cable and wire manufacturers. Growth in copper consumption in pipe, flat rolled products and billet production segments was marginal.

China remains the largest copper consumer globally, with its market share reaching around 51% in 2019 and demand growing by 2%. Experts' concerns over a potential major slowdown of the country's economy (in part due to the trade war with the USA) proved unfounded. Refined copper imports to China decreased in 2019 by 6% to about 5 mln t, while copper scrap imports were down by 2% after imposition of restrictive quotas on imports by the government.

Refined copper consumption by industry



Sources: Company data, Wood Mackenzie



Sources: Company data, Wood Mackenzie

Copper concentrate imports rose by 12% to 22 mln t, which helped to meet China's growing consumption needs through the expansion of local production capacity.

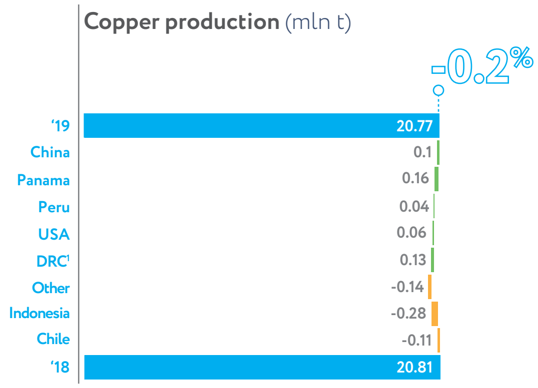
Copper demand trends in developed markets were mixed: consumption in Europe (the Group's key market for copper cathodes) shrank by 3.5% in 2019; in North America and Asia (excluding China), consumption rose by 1%. Russia's domestic copper cathode consumption grew by 4% in 2019.

PRODUCTION

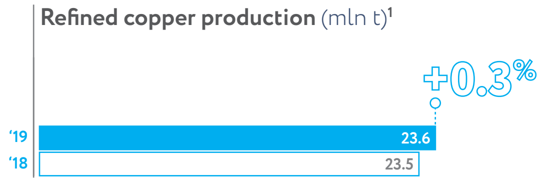
In 2019, global refined copper output rose 0.3%, or by 0.1 mln t, y-o-y to 23.55 mln t. The biggest growth came from China, which is firmly on track to deliver smelting and refining capacity expansions. In 2019, refined copper production in China grew by 5% to 9 mln t, while its share in total global 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.

In the rest of Asia (excluding China), refined copper output dropped 3% (with production declines in India and Japan). In North America, it grew by 3.5% (driven by the USA). In South America, it fell by 8% (due to Chile and Peru ramping up concentrate exports to China). In Europe, it slipped by 2%, driven by Germany and Poland. According to preliminary estimates, Russia's refined copper production declined marginally.

In 2019, global copper production fell 0.2% to 20.7 mln t due primarily to production cutbacks in some Chilean mines and scheduled ramp-down of the Grasberg mine (Indonesia) for technical reasons. The decline was partially offset by the growth of China's domestic mining industry and the commissioning of the new Cobre Panama project in Panama. About 2.8 mln t of refined copper were additionally produced from previously stockpiled scraps and concentrates.



Sources: Company data, Wood Mackenzie



In 2019, mined production in Chile, the world's leading producer of copper, declined by 2% y-o-y to 5.75 mln t due to poor weather conditions and short-lived strikes. The output of the state-owned Codelco continued to decline (1.7 mln t in 2019, down 5% y-o-y) due to a lack of investment in older deposits with declining average copper ore grades and technical challenges. Production in Peru grew by 1.5% to 2.4 mln t on the back of the Toquepala mine development.

A 4% growth in Africa's mined production to 2.5 mln t was mainly due to higher output from mines at the Democratic Republic of the Congo, while Zambia's mined production slipped marginally.

In 2019, China, which is currently developing a number of smaller mines, ramped up its mined production by 6% to 1.7 mln t. Mined production in Indonesia was almost halved to 0.4 mln t as the Grasberg mine operated by Freeport shifted from open-pit to underground mining.

North America's production grew by 4% to 2.7 mln t thanks to resumed operations at multiple smaller mines in the USA, Mexico, and Canada, after technical problems in the previous year. According to preliminary estimates, Russia's copper production increased by about 2%.

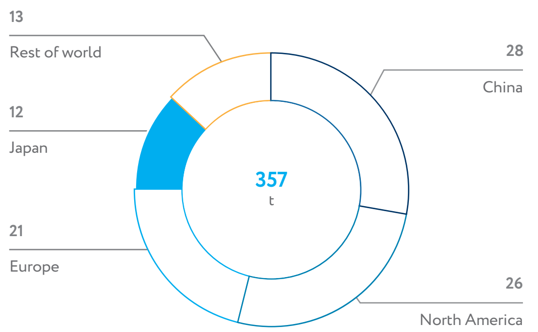
The actual growth in refined copper output in 2019 came short of analysts' forecasts made early in the year due to falling extraction rates. Consumption growth was also below expectations due to the escalation of the US–China trade war. Eventually, the global market remained rather well balanced, with its minor deficit close to initial forecasts.

1/ DRC — Democratic Republic of the Kongo

PALLADIUM (Pd)

KEY TRENDS IN THE PALLADIUM MARKET

Industrial consumption of palladium by region (%)



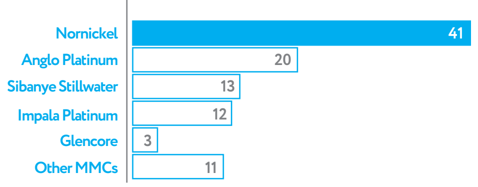
Source: Company data

2019 was another year of growing palladium prices due to the steady increases in consumption from the automotive industry amid tougher environmental standards worldwide. Deficit was offset by primary production growth and improved recovery of automotive catalysts as supplies from previously accumulated stocks were much smaller.

The price growth of palladium that began in the second half of 2018 continued into the first quarter of 2019. At the end of March, the price hit an all-time high of USD 1,604/oz. Palladium benefited from a fundamental market deficit and a continued shortage of metal available for spot buying. Price growth was also supported by macroeconomic factors. At its January and March meetings, the US Federal Open Market Committee (FOMC) decided to put interest rate hikes on hold, which had a positive effect on precious metals prices. Moreover, the revived growth of stock market indices increased interest in palladium as a metal widely used in industrial applications.

March peaks were followed by price correction early in the second quarter to USD 1,350/oz due to additional supply from South African palladium producers and recyclers which had built up significant work-in-progress inventories by the end of 2018. Besides, consumers sold some of their inventories to reduce hedging costs and improve balance sheet structures. Another significant driver was speculators locking in profits at the close of the first quarter of the financial year, which in some countries ends on 31 March.

No. 1 in palladium production (%)[2]



Statements made by the US FED in early June gave rise to expectations of possible interest rate cuts in 2019. This weakened the dollar and had a positive effect on precious metals prices, resulting in resumed growth in palladium prices, which exceeded USD 1,500/oz by the end of the first half of the year. After a moderate correction seen in late July, palladium prices began growing from August to September and came close to a USD 1,700/oz mark. This was, in part, caused by the increased net long speculative positions in NYMEX; however fundamental factors and news of metal shortages in both warehouses and on the spot market contributed the most to the price increase.

The price rally continued into the fourth quarter, with palladium prices hitting another all-time high of USD 1,990/oz amid stronger backwardation in the forward market, increased demand from automakers, and structural deficit in the market. Lease rate increases were moderate and long speculative positions remained at moderate levels.

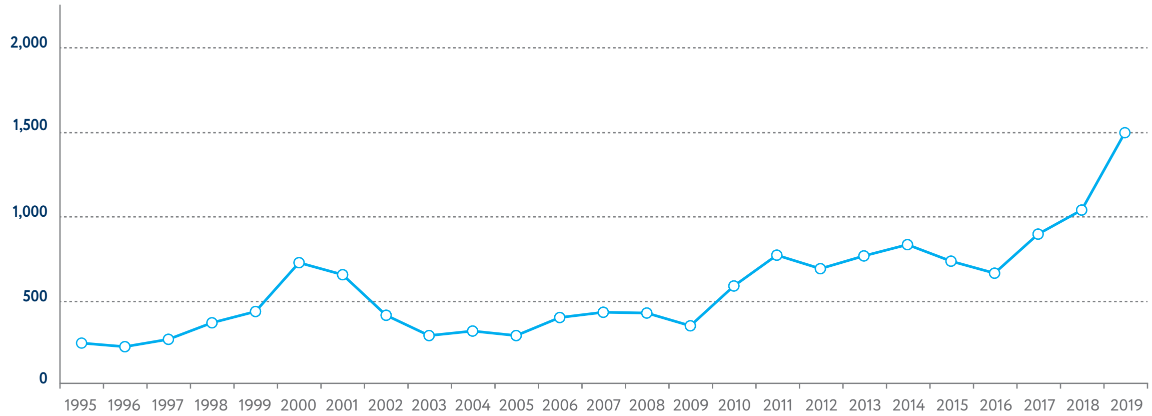
Average annual palladium prices (USD/oz.)

2014	2015	2016	2017	2018	2019
803	691	613	869	1,029	1,538

Source: LBMA

2/ Refined metal including production from own feedstock by third-parties under tolling agreements.

Average annual palladium prices (USD /oz)



Thus, it can be argued that prices were supported by long-term fundamental factors such as a multi-year, persistent market deficit with palladium production lagging behind consumption; an increasing share of petrol cars; a growing production of vehicles with hybrid propulsion systems; and expectations of a surge in palladium use in the catalysts of automobile exhaust treatment systems – a trend initiated by tougher environmental standards in key markets.

However, the negative effect from car production decrease in absolute terms, especially in China, was fully offset by the increased per unit use of palladium in exhaust treatment systems, which was facilitated by new vehicle emissions testing standards (WLTP and RDE tests) and environmental regulations (China 6, Euro 6d, the US's Tier 3, etc.).

The average palladium price in 2019 reached USD 1,538/oz, 49% more than the previous all-time high in 2018.

Palladium, together with rhodium, remained among the strongest performers in the commodity markets, with its premium to platinum rising throughout the year and coming close to 100% by the year-end.

MARKET BALANCE

Since 2010, there has been a sustained undersupply in the physical palladium market covered by the inventories accumulated in previous years. Even though production grew faster than industrial consumption in 2019, market deficit stood at 24 t due to dwindling government reserves of palladium and ETF inventories.

Palladium market balance[1] (t)

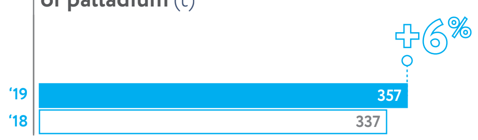
Palladium production and consumption balance	–29
Outflows from ETFs	4
Destocking by mining companies	1
Supply and demand balance	–24

1/ Excluding reallocated other reserves

CONSUMPTION

In 2019, industrial consumption of palladium increased by 20 t (up 6%) y-o-y, hitting a new all-time high of 357 t.

Industrial consumption of palladium (t)



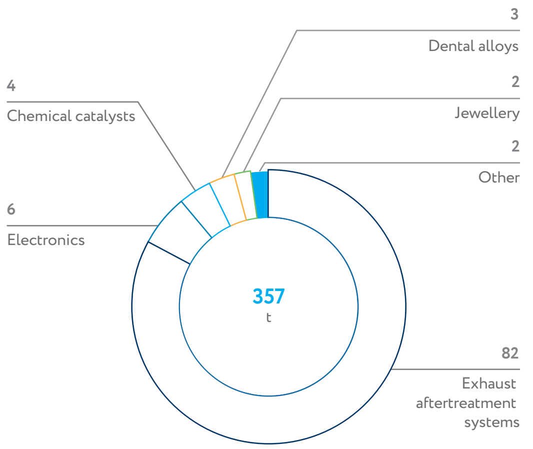
AUTOMOTIVE INDUSTRY

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 constant risk of physical metal shortage.

In 2019, palladium consumption by the automotive industry increased by 25 t, hitting a new all-time high of 294 t. This was mostly driven by tougher

Palladium consumption by industry (%)



Source: Company data

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 is another recently introduced regulation, in effect as of September 2019. These developments forced automakers to implement more sophisticated exhaust treatment systems and expand the use of PGMs per catalytic converter.

The marked increase in palladium consumption by the automotive industry in China 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. About 70% of all cars manufactured in China in 2019 met the new standard.

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. In 2019, the market share of diesel cars in Europe (27 countries) dropped from 36% to 31%, an all-time low since 2000.

Vehicle hybridisation is another trend driving palladium consumption. In 2019, production of mild, full and plug-in HEVs (PHEVs) increased by 22%, 26% and 3%, 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.

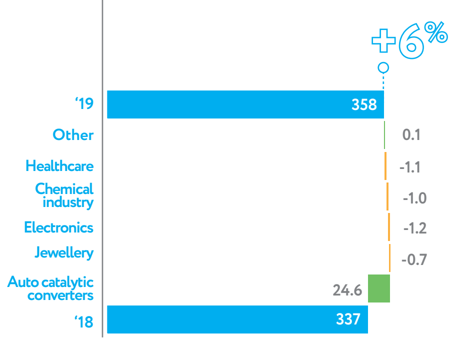
The growing use of PGMs in the automotive industry is also indirectly driven by consumers migrating from sedans to larger-engine crossovers. In 2019, the share of SUVs and pickups in the USA increased by 2% to 64%, completely offsetting the overall decline of the national automotive industry's output in terms of palladium consumption.

Vehicles using batteries without PGM-based exhaust catalytic converters have remained a niche market (under 2% of the global car production), which showed no significant growth in 2019 due to cuts in government subsidies for buyers of electric vehicles in China.

The global automotive industry's overall output and sales declines (down 4% y-o-y) were a drag on the industry's palladium consumption, with the world's largest market, China, showing the biggest decline (down 8%). Vehicle production in the North America, Europe and Japan largely remained flat from 2018, and none of the world's regions saw any significant growth. The negative effect from the decreasing overall global vehicle production was fully offset by more extensive use of palladium per vehicle.

The average premium of palladium vs platinum ranged from USD 400/oz to USD 1,000/oz and stood at USD 950/oz as of the end of the year. Contrary to most players' expectations expressed in the last two years regarding imminent substitution of palladium with platinum in catalytic converters used for petrol engines, no signs of such substitution were observed in 2019.

Change in palladium consumption by application area (t)



Source: Company data

ELECTRONICS

Palladium consumption in the electronics industry continued a moderate downward trend in 2019 (down 1.2 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. However, the use of palladium as an electroplating material for connectors and lead frames continued to decrease due to a decline in the global production of electronic devices.

CHEMICAL INDUSTRY

The use of palladium in chemical catalysts decreased by 1 t y-o-y after significant growth in 2018. In the mid-term, growing consumption of palladium in the chemical industry will be driven by newly launched terephthalic acid projects in China.

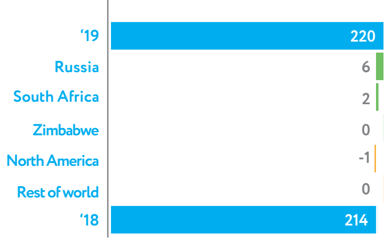
HEALTHCARE

The consumption of palladium in the healthcare sector continued a downward trend and declined by 11%, or 1 t, y-o-y due to the substitution of palladium with composite material alternatives. In Japan, the largest consumer of the metal for dental prostheses, 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 2019, jewellery-related consumption of palladium decreased by another 0.7 t. A drop in Chinese demand for these products amidst a general slowdown in consumer spending

Primary palladium output by countries (t)



Source: Company data

Russia, the leading palladium producing country, posted an output increase (up 6 t)

and a shift to other luxury goods were the primary cause of the continued sales decline. Palladium jewellery sales were also affected by growing prices for the metal.

INVESTMENTS

Investor demand for palladium kept shrinking in 2019 mostly due to outflows from exchange-traded funds (ETFs), which had their inventories reduced by 4 t to 22 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 to benefit from a swing to backwardation.

PRODUCTION

In 2019, primary refined palladium production increased by 3% to 220 t.

South Africa, the world second largest palladium producer, also demonstrated a y-o-y increase (up 2 t). In Zimbabwe, palladium output remained stayed flat from 2018.

Primary palladium production in Canada declined by 1 t, while in the USA it remained largely flat.

The main sources of recycled palladium are scrapped auto catalytic converters, as well as jewellery and electronic scrap. In 2019, recycled output grew by 12 t to 109 t as demand grew for catalytic converter scrap on the back of increased prices for palladium and steel scrap. Recycling capacity utilisation rates are currently near 100%. Jewellery and electronic scrap volumes remained flat.

The sources of previously accumulated palladium stockpiles include trading companies, financial institutions, government reserves, and consumers' surplus inventories. In 2017–2018, Nornickel's Global Palladium Fund (GPF) supplied the market with more than 1 Moz of palladium on top of Nornickel's own output. The stockpile had been created through purchases from third parties.

PLATINUM (Pt)

KEY TRENDS IN THE PLATINUM MARKET

2019: A growing deficit in the market driven by high investor demand which has fully offset the decline in platinum use by the automotive, jewellery, glass, and other industries.

Following a significant drop in late 2018, the price of platinum remained stable throughout 2019 and showed some fluctuation while staying within the range of USD 780/oz to USD 920/oz in the first half of 2019. In the second half of 2019, the price increased as investor demand recovered, triggering sharp inflows into platinum ETFs (31 t in total). At year-end, the price of platinum stood at USD 971/oz.

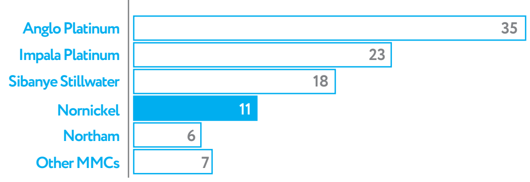
Platinum and gold prices moved closely together in 2019, indicative of platinum prices being highly dependent on macroeconomic factors, which had an overall positive influence on precious metals during the year. The US Fed's decision to put interest rate hikes on hold led to a weaker US dollar and thus bolstered precious metals prices. And as inflation expectations rose compared to 2018, investors were more inclined to move to precious metals as a safe-haven asset.

During the year, platinum traded 40% lower against gold. In April and May, the gap reduced to 30%, driven by recovering investor demand for platinum and an increase in net-long speculative positions in NYMEX. As the price and the speculative sentiment went down at the end of the first half of 2019, the spread soon rebounded to a 40% mark.

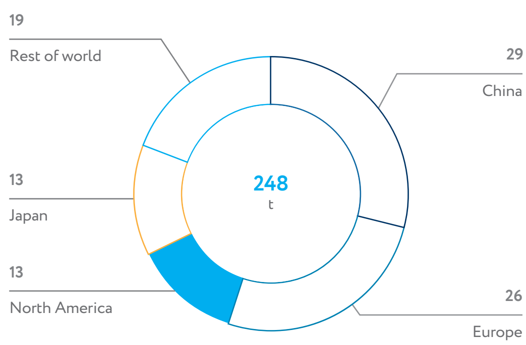
The key fundamentals behind this included a drop in platinum consumption by the automotive industry due to a shrinking share of diesel cars in key markets (primarily, Western Europe), the lack of anticipated recovery in demand from Chinese jewellers due to a threatened trade war between China and the USA, and primary producers not being too sensitive to low prices.

The average platinum price in 2019 was USD 863/oz (a 15-year low), down 2% y-o-y.

No. 4 in platinum production (%)[1]



Platinum consumption by region (%)



Source: Company data

Average annual platinum prices (USD/oz)

2014	2015	2016	2017	2018	2019
1,385	1,053	989	949	880	863

Source: LBMA Platinum price

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

MARKET BALANCE

The platinum market went into a deficit in 2019: even though platinum production exceeded consumption, much of the excess supply was absorbed by investor demand.

Platinum market balance (t)

Platinum production and consumption balance	18
Investor demand	42
Destocking by mining companies	3
Supply and demand balance	–22

CONSUMPTION

Industrial consumption of platinum in 2019 declined to 243 t, down 6 t (or 3%) y-o-y.

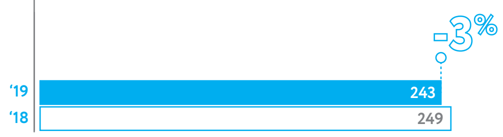
The automotive industry is the predominant consumer of platinum. Over 80% of platinum in this industry is used to manufacture exhaust gas catalysts for diesel vehicles.

In 2019, platinum consumption in the automotive sector marginally decreased y-o-y by 0.4 t mainly due to a decreased share of diesel vehicles in their key market – Europe. In 2019, the market share of diesel cars in Europe (27 countries) dropped from 36% to 31%, an all-time low since 2000.

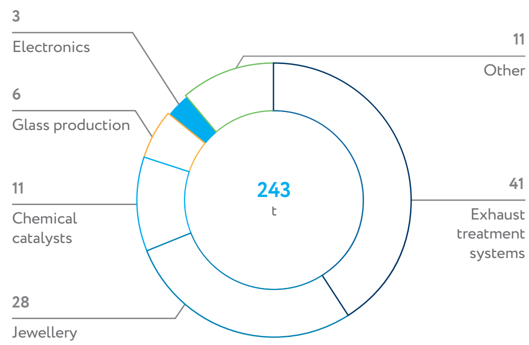
Diesel engines are giving way to petrol-based solutions, while more expensive vehicles utilise petrol-electric hybrids. The lower platinum consumption by car makers was partially offset by increased manufacturing of trucks, the catalytic devices of which still rely on platinum.

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 3.6 t), persisting over the last few years. The decrease was primarily driven 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. While China is currently facing growing competition in the platinum jewellery sector from gold items, other major markets (India, Japan, USA, and Europe) have seen increased platinum jewellery sales.

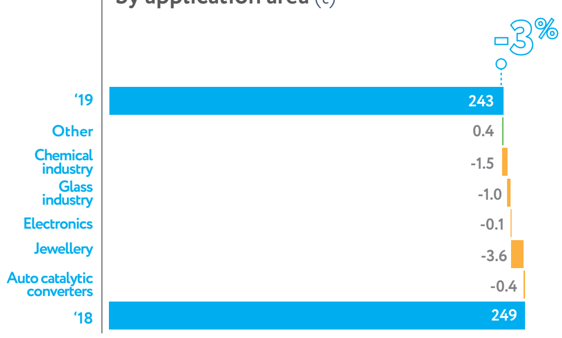
Consumption of platinum (t)



Platinum consumption in 2019 by industry (t)



Platinum consumption by application area (t)



CHEMICAL INDUSTRY

In 2019, primary platinum consumption in industrial catalyst manufacturing decreased by 1.5 t due to lower refining volumes and falling oil prices.

GLASS INDUSTRY

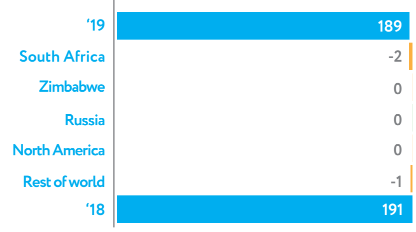
Platinum is needed to produce glass fibre and optical glass. In 2019, the industry's demand for platinum declined (down 1 t) after several years of continuous growth.

Platinum consumption in electronics slightly decreased (down 0.1 t).

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 2018, the demand for platinum bars from retail investors slightly rose (up 9 t) due to low prices coupled with expectations of growth. During the year, investments in platinum ETFs fell by 7 t to 76 t.

Primary platinum production by countries (t)



Source: Company data

PRODUCTION

Global production of primary refined platinum in 2019 decreased y-o-y by 2 t to 189 t.

In the reporting period, supply from South Africa, the world's largest platinum producer, declined by 2 t. Russia recorded a slight increase of 0.3 t in platinum output, with continued production declines at the alluvial deposits in the Far East region driven by a depleting mineral resource base. The negative trend was offset by an increase in Nornickel's output.

The platinum output in other regions remained largely unchanged.

The main sources of recycled platinum include used exhaust gas catalysts and jewellery scrap. Recycled output in 2019 grew by 6 t to 71 t. However, the growth of recycling was hampered by difficulties in using new types of silicon carbide-based diesel catalysts. Being a refractory material, it can damage furnaces unfit to handle it. This requires processors to sort through catalysts and separately process material with a high silicon content, requiring extra time and resources.

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.