

/ Global Metals Market /

**KEY TRENDS IN THE PALLADIUM MARKET**

**2016:** impressive price recovery from the January lows on the back of sustainably high industrial demand

**Outlook: positive.** The market deficit to grow as a result of stable supply, growth of industrial consumption, and stabilised investor demand.

In January 2016, prices for platinum group metals tumbled to multi-year lows. Palladium prices went down to a five-year low of USD 470 per troy ounce. This continued the downward trend of late 2015 caused by the general weakness of commodity markets, no long-awaited closures of unprofitable South African mines, major investment outflows from palladium exchange-traded funds, and the strengthening of the US dollar against the production countries' currencies. Throughout the year, despite some large fluctuations, prices bounced back reaching maximum since May 2015 in late November (USD 770 per troy ounce) followed by a moderate year-end downward adjustment.

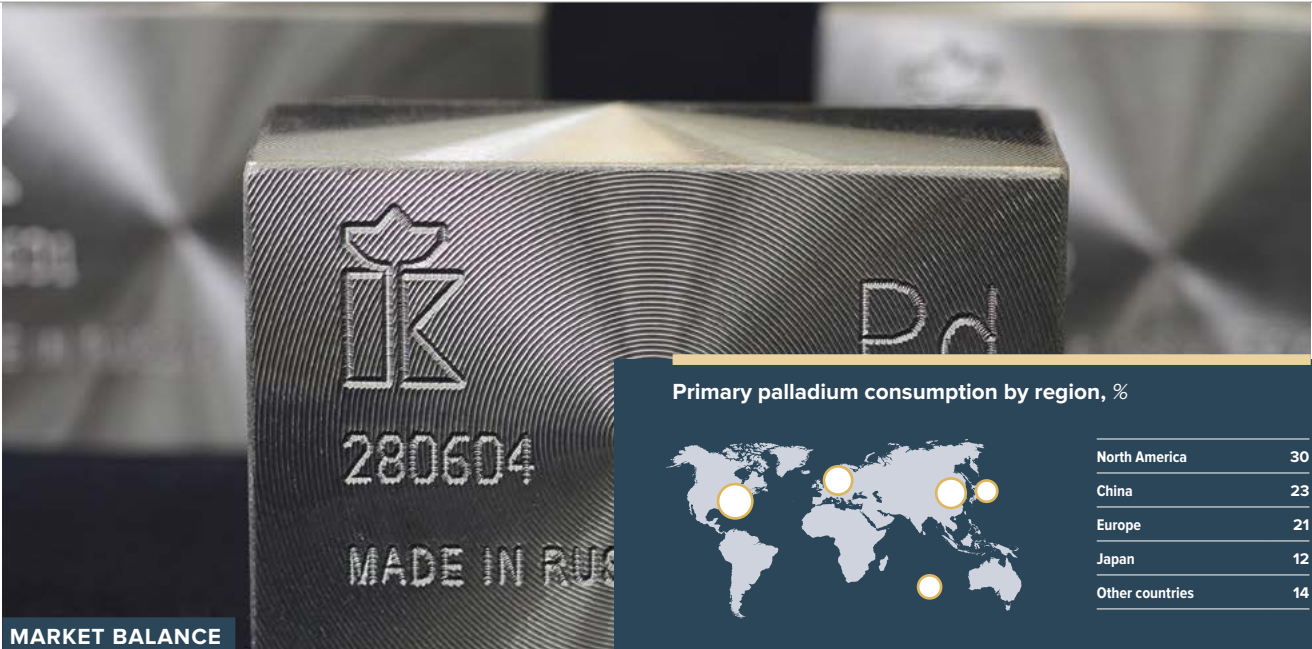
The positive trend throughout the year was driven by the unexpectedly high growth rates of car production in China (+14%) driven by the tax cuts for small engine cars, the growth in US car sales hitting a new record in 2016, and a reported drop in diesel car sales in favour of petrol vehicles with a higher share of palladium-based catalysts. Prices for PGM and other precious metals were also affected by the US Federal Reserve's cautious attitude towards rates hike, uncertainty following the unexpected Brexit vote, the growing demand for defensive assets, as well as the victory of Donald Trump and expectations of higher economic growth and auto sales in the USA. Despite the positive 2016 trend, the average annual palladium prices were at their lowest in six years (USD 613 per troy ounce) on the back of sliding prices in September 2015–August 2016.



# Palladium

# No.1

Nornickel is the world's largest producer of palladium



MARKET BALANCE

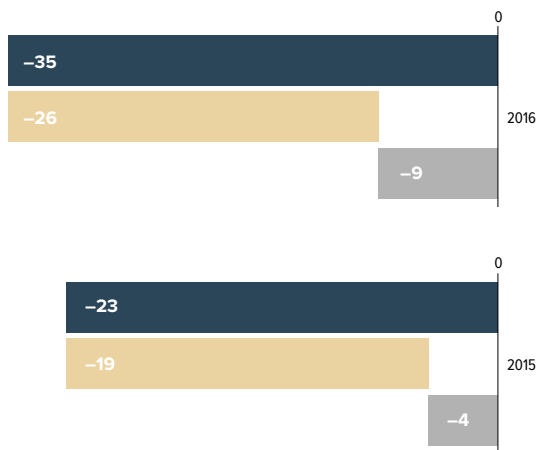
Primary palladium consumption by region, %



North America	30
China	23
Europe	21
Japan	12
Other countries	14

Palladium market balance, t

- Palladium production and consumption balance
- ETF outflows
- Demand and supply balance

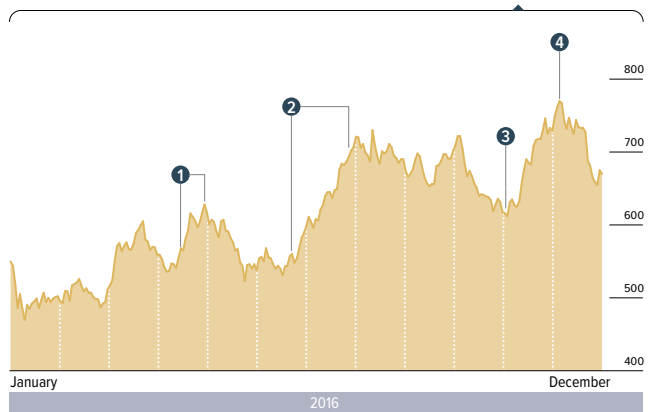
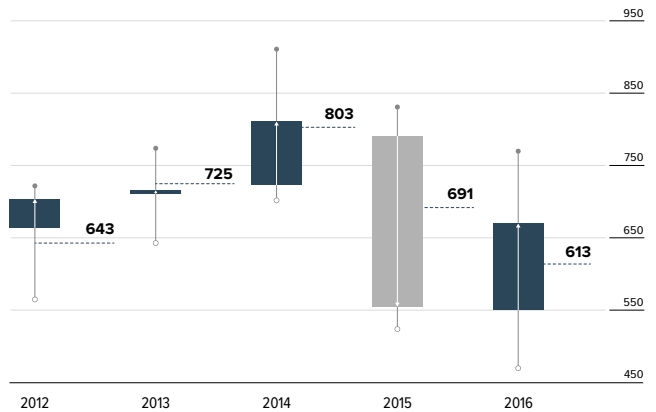


Source: Company data

In recent years, there has been a sustained undersupply in the palladium market covered by the consumption of reserves accumulated in previous periods. During the reporting period, this imbalance was partially offset by withdrawals from palladium ETFs, mainly in the second half of the year.

Palladium price in 2016, USD/oz

- Price increase (start-end of the year)
- Reduction of price (start-end of the year)
- All-year high
- All-year low
- Average annual price



Drivers of the palladium price in 2016

1. Cautious Fed, weak US dollar
2. Rally in precious metals post-Brexit
3. US presidential election results
4. The automotive industry statistics from China exceeded projections, rally after the Fed's interest hike

Source: LBMA Palladium price, Company data

**CONSUMPTION**

Industrial consumption of palladium in 2016 increased by 8 t (+3% y-o-y) to an all-time-high of 316 t. With that, the primary palladium consumption increased by 10 t (+5% y-o-y) on the back of a 2 t decrease in scrap processing volumes, mainly, electronic scrap; automotive and jewellery scrap processing volumes remained flat. This continues the 2015 trend of decreased recycled metal supply in the market.

The automotive industry accounts for over three quarters 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 cars. Due to its unique catalytic properties ensuring effective chemical reactions throughout the entire vehicle life cycle (at least 150,000 miles in the USA), palladium has no substitutes except for platinum, which is more expensive and not economically justified due to the price gap between these metals, and rhodium, which, given the significant share of already produced vehicles and small market size (the world only produces 30 t of the metal) suffers from high price volatility and the risk of physical metal deficit.

In 2016, palladium consumption in the automotive industry grew by almost 10 t, reaching an all-time high of 246 t. The additional demand for the metal was mainly attributed to the growing car production in China (+14% y-o-y), India (+9% y-o-y) and recovery of production in Europe (+17% y-o-y). The US car market saw a modest growth in palladium consumption still hitting a new high since 2015. The increase in palladium consumption was also triggered by the growth of per-vehicle use, a trend that is likely to continue in the years to come due to toughened vehicle emission standards in certain countries.

Palladium consumption in the automotive industry will grow further. Hybridisation involving the use of petrol engines featuring palladium-based exhaust gas catalysts is slated to become a key trend in the development of environmentally friendly transport. Despite strong media attention, the leading analytical agencies forecast that the share of electric vehicles that do not require catalysts is unlikely to exceed 2% of global output by 2022, or 2 mln of electric vehicles against the annual global output of over 107 mln of vehicles. Palladium consumption in the electronics industry continued a moderate downward trend in 2016: lower use of palladium in multi-layer ceramic capacitors was partially offset by an absolute increase in their production and increased use of palladium in the connectors and lead frames.

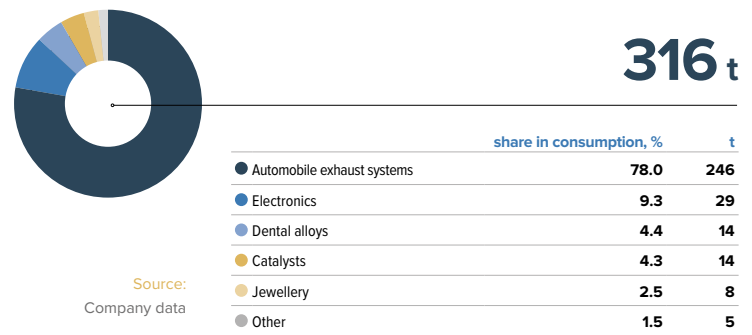
In the healthcare sector, primary palladium demand continued declining on the back of transition to alternative composites and dental scrap processing. While palladium has a number of advantages for jewellery manufacturing, its consumption in the industry dropped by 0.7 t (9%) in 2016 because it does not have a strong brand as a jewellery metal. After a continued fall in palladium consumption in China, now it is used mainly in white gold alloys or for wedding rings (in its pure form), mainly in the European and US markets. The 2016 primary palladium consumption in the production of

Palladium consumption in 2015–2016, t



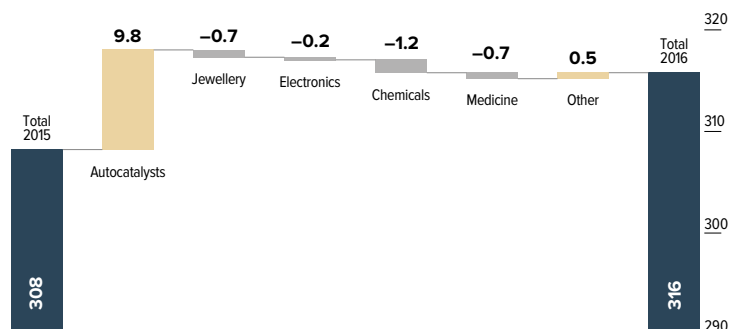
Source: Company data

Palladium consumption in 2016 by industry



Source: Company data

Changes in palladium consumption by application area, t



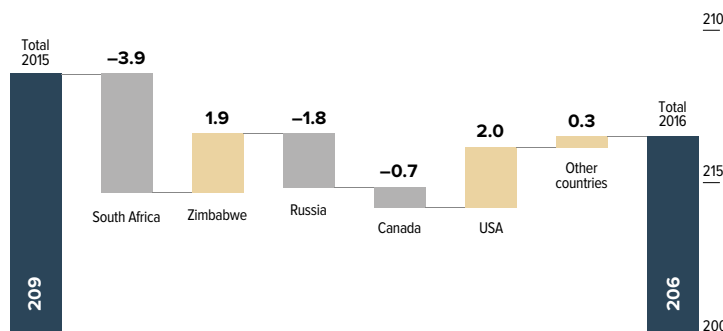
Source: Company data

chemical catalysts decreased by 8% as a result of China's chemical industry slowdown on the back of delayed capacity expansion, increased life cycle of catalysts used in the terephthalic acid production (feedstock to produce fibres, food containers, photo and video films), and reduced palladium content. 2016 saw lower investor demand for palladium. Investor withdrawals from palladium ETFs (mainly in the second half of the year) totalled 20 t. This reduction resulted from the profit taking that followed a significant price surge coupled with investor migration to stocks. Investors are generally positive on the palladium market: as at the end of the reporting period, net speculative positions in palladium on the New York Mercantile Exchange and the Tokyo Commodity Exchange were +47 t. Additional retail demand for palladium bars accounted for 1 t.

**PRODUCTION**

Despite the challenging market conditions and a considerable number of unprofitable mines, 2016 saw only a moderate decline in primary palladium output by key producers. In South Africa, the output of palladium declined primarily due to repairs of a smelter at Anglo American Platinum and scheduled closure of unprofitable shafts at Lonmin. This reduction was partially offset by the launch of new projects, such as Platinum Group Metals (Maseve), and higher output by Northam. Russia recorded a lower output due to the planned reconfiguration of the Company's production facilities. Zimbabwean production grew thanks to restored output volumes at Zimplats. There was also a slight improvement in US output. As a result, global output of primary platinum in 2016 decreased by 3 t, or 1% y-o-y.

Annual primary palladium output in 2015–2016, t



Source: Company data

The main sources of recycled palladium are used exhaust gas autocatalysts, as well as jewellery and electronic scrap. In 2016, recycled output shrank by 3 t, primarily due to reduced collections of electronic scrap as palladium contents lowers because of component miniaturisation. Collection of end-of-life automotive catalysts remained in the lower range owing to low PGM prices.

The sources of previously accumulated palladium stockpiles include trading companies, financial institutions, government reserves, and surplus inventories of consumers. In the 1990s and 2000s, Russia's palladium supply came primarily from the country's government stockpiles. Supply of palladium from these stockpiles had long been the main driver of market surplus. In recent years, Russian stockpiles ceased to be part of the palladium supply, which points to their depletion and marks the transition towards a palladium market that is completely market-driven.