

Summary of Platinum

SUPPLY & DEMAND IN 2017

SUMMARY: PLATINUM

- Declines in jewellery and investment demand moved the platinum market into a modest surplus.
- A slight fall in mine shipments was offset by growth in recycling, leaving total supplies little changed.
- Auto demand fell by 1%, in line with small declines in European diesel output and loadings.
- Industrial consumption rose strongly to almost 2 million oz, with firm demand in most sectors.
- With the Chinese market facing stiff headwinds, global jewellery fabrication demand fell by 8%.
- Platinum investment fell by over 260,000 oz on significantly lower Japanese bar sales.

Demand for platinum slowed during 2017, in line with sharp falls in jewellery demand in China and investment buying in Japan. Chinese jewellery fabrication contracted, as platinum lost market share to karat gold jewellery, while purchases of platinum bars by Japanese investors returned to more normal levels following two years of exceptionally strong demand. However, the autocatalyst market proved more robust than expected, declining only marginally versus 2016, while industrial platinum usage increased. With growth in recycling offsetting weaker mine supply, our expectations of a modest surplus in 2017 have been confirmed.

We estimate that global primary supplies of platinum in 2017 fell just short of 6 million oz, a decline of 2%. Russian shipments fell by 7.5%, due to lower sales from inventory and weaker output from alluvial deposits, while North American output was affected by some changes in processing routes. In South Africa, the world's two largest primary platinum producers, Anglo American Platinum and Impala Platinum, both experienced technical issues at their processing facilities, causing fluctuations in inventories of unrefined pgm. This has had the effect of deferring some refined platinum output into 2018. At the time of writing, final production and sales figures for 2017 were not yet available, so our estimates of mine supply are provisional.

Mine output of platinum in South Africa was little changed last year. Two of the largest platinum mining operations in South Africa – Sibanye-Stillwater's Rustenburg platinum mines and Impala Platinum's Rustenburg lease area – both saw production gains, while the Mogalakwena open pit (Anglo American Platinum) put in another record performance. However, the operating environment in South Africa remained difficult, with producers continuing to experience sporadic disruptions to their mining activities, mainly due to safety stoppages and community unrest.

There were two further mine closures during 2017: Platinum Group Metals Ltd's Maseve mine ceased producing in mid-year, while Atlatza Resources' Bokoni mine was mothballed at the end of September. Surface assets at Maseve are to be sold to Royal Bafokeng Platinum, which operates the neighbouring BRPM and Styldrift mines.

Platinum Supply and Demand '000 oz			
Supply	2015	2016	2017 ⁹
South Africa	4,572	4,392	4,364
Russia	670	703	650
Others	865	988	962
Total Supply	6,107	6,083	5,976
Gross Demand			
Autocatalyst	3,228	3,327	3,285
Jewellery	2,746	2,412	2,227
Industrial	1,753	1,855	1,978
Investment	451	620	356
Total Gross Demand	8,178	8,214	7,846
Recycling	-1,715	-1,929	-1,980
Total Net Demand	6,463	6,285	5,866
Movements in Stocks	-356	-202	110

Refined production in South Africa was affected by a series of processing interruptions last year. Anglo American Platinum began 2017 with in-process stocks above normal levels following a furnace run-out at its Waterval smelter the previous year; the refining of this inventory was delayed by a high-pressure water leak at its convertor plant in June 2017, although most of the pgm had been processed by year end. In October, the company announced that seepage had been detected on the tailings dam wall at its Mototolo joint venture (with Glencore), and that concentrating activities at the



“Refined production in South Africa was affected by a series of process interruptions.”

site had been suspended. Newly mined ore will be added to stockpiles until processing resumes, deferring around 45,000 oz of platinum production.

At Impala Platinum, maintenance work was undertaken at two of the group's South African furnaces and at the Zimplats smelter in Zimbabwe. As a result, the group's in-process inventories were above normal levels at the year end. Northam Platinum also accumulated some stocks of pgm in concentrate ahead of the commissioning of a new furnace. In contrast, refined output from Lonmin exceeded production from its mines, as the company continued to process pgm-containing materials sourced from a clean-up of its smelter plant. After accounting for these stock movements, we estimate that South African producers supplied around 4.36 million oz of platinum last year, down marginally compared with 2016.

In Zimbabwe, all three producers continue to make incremental gains in mine production. However, our supply estimate for 2017 shows a modest year-on-year decline, because the record total achieved in 2016 included an additional 20,000 oz from the smelting of a concentrate backlog at Zimplats. With another smelter outage affecting production last year, it may be that some of Zimplats' 2017 pgm output will in fact be refined in 2018. We will adjust our supply estimates in our next report, due for publication in May, in line with final year-end production reports.

“Norilsk Nickel supplemented pgm output by processing old copper concentrate.”

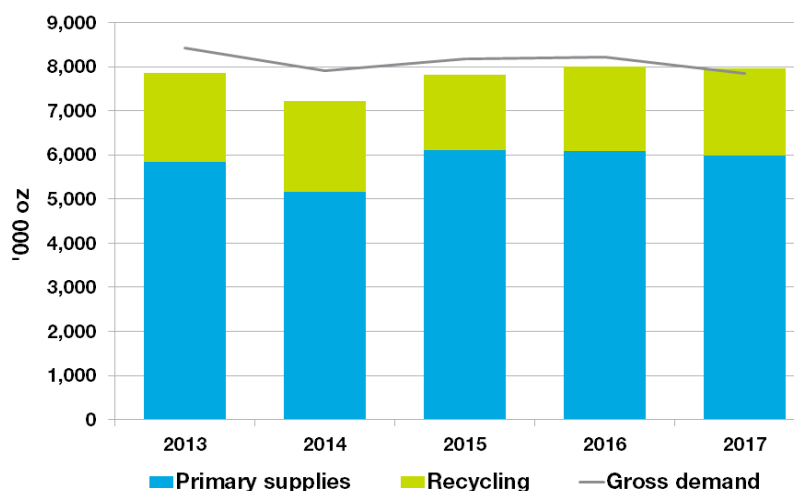
Our preliminary estimate of Russian platinum supplies in 2017 is 650,000 oz, down 7.5% on the previous year, when Norilsk supplied some metal from inventories. While alluvial production from the Kondyor and Koryak mines in the Far East of the country continues to decline, in line with a steep fall in the volume and platinum grade of sands processed, refined output from Norilsk Nickel has recovered following a temporary dip in the first quarter of 2017. This fluctuation was caused by a short-term increase in work-in-progress during the transfer of some pgm concentrating activities from the Norilsk mine site to the company's Kola Peninsula processing complex.

In recent years, Norilsk Nickel's production has been augmented by the refining of pgm from old pyrrhotite concentrate stored at the Norilsk mine site. Stocks of this material have

now been depleted, but in 2017 the company began to extract pgm from copper concentrate derived from mining activities in the Norilsk area in the 1980s. This material was purchased from the state-controlled corporation Rostec in December 2016.

We estimate that North American supplies totalled 318,000 oz in 2017, down 6% compared with the previous year. During the first nine months, both Vale and Glencore reported double-digit declines in platinum output, reflecting lower copper and nickel production from their Canadian operations. Our full-year figure reflects our belief that there is potential for an improved final quarter, with some pgm output having been delayed by smelter maintenance and changes to the flowsheet at Vale's Sudbury smelter earlier in the year.

Platinum supply and demand



“ The Sibanye-Stillwater Blitz project began production on 29th September 2017. ”

In the USA, the Stillwater and East Boulder mines in Montana were incorporated into the renamed Sibanye-Stillwater group from May 2017, and output has improved modestly compared with 2016. The company is proceeding with its Blitz expansion project, which achieved its first production on 29th September 2017.

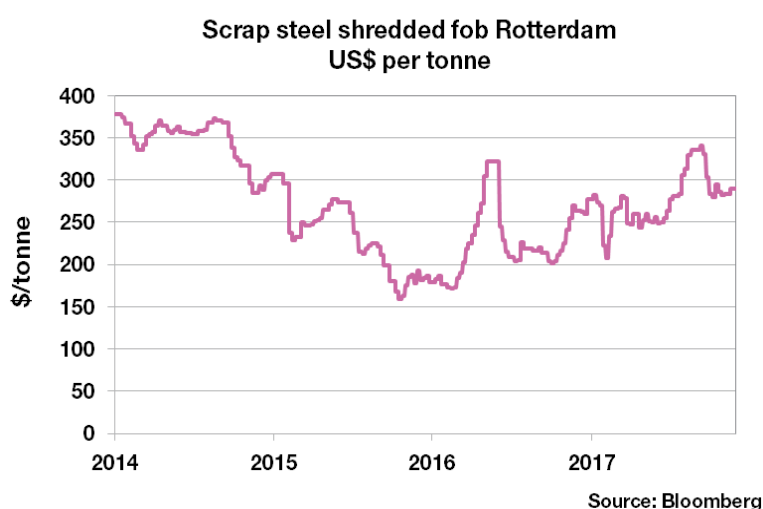
Overall, primary shipments of platinum contracted slightly, but secondary supplies moved in the opposite direction, climbing 3% to nearly 2 million oz. While jewellery recycling declined, there was a surge in autocatalyst recycling which lifted platinum recoveries from automotive scrap to record levels.

Autocatalyst scrap volumes were unusually depressed during 2015 and 2016: weak steel prices prompted a significant decline in the number of end-of-life vehicles (ELVs) reaching scrapyards, while fluctuations in pgm prices resulted in periodic hoarding by collectors betting on a rise in catalyst scrap values. However, the scrap market began to show signs of recovery starting in late 2016, and this trend accelerated over the course of last year, with some major recyclers reporting double-digit increases both in the volume of catalyst scrap processed and in pgm recoveries.

“ The recycling of platinum from automotive scrap was lifted to record levels. ”

This rebound was primarily a function of a sharp increase in the number of ELVs being dismantled for scrap, rather than any underlying change in the platinum content of spent autocatalyst. We had expected to see significant growth in the platinum grade of catalyst scrap this year, particularly in the European market, reflecting the steep gains in platinum consumption on diesel vehicles that occurred starting in 2000. However, there has been little evidence of any significant increase in platinum assays in the past year; our analysis suggests that this is because average vehicle age has risen over time.

There are also some technical challenges associated with the processing of the silicon carbide substrate used for most diesel particulate filters. Silicon carbide scrap must be treated under oxidising conditions, whereas most European scrap smelters use arc furnaces which operate under reducing conditions. As a result, a shortage of local capacity to treat some types of diesel scrap has contributed to longer shipment and processing times.



We estimate that global jewellery recycling fell by 15% to 623,000 oz, reflecting a fall in recycling in both major jewellery scrap markets, Japan and China. In Japan, the recycling of platinum jewellery reached a peak in 2012–2013, as higher gold prices sparked a boom in precious metals recycling, but activity has since returned to more normal levels.

In China, the jewellery recycling sector is undergoing some significant changes. In the past, recycling took place almost exclusively via the jewellery distribution network: consumers took their unwanted platinum jewellery items to retail outlets, exchanging them for new and usually heavier designs, while retailers and wholesalers periodically returned excess or outdated stock to manufacturers to be reworked into new

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“ Industrial consumption rose by 7% to just short of 2 million ounces. ”

jewellery pieces. Over the past decade, metal recycled in this fashion has typically accounted for about a quarter of the platinum used in Chinese jewellery fabrication.

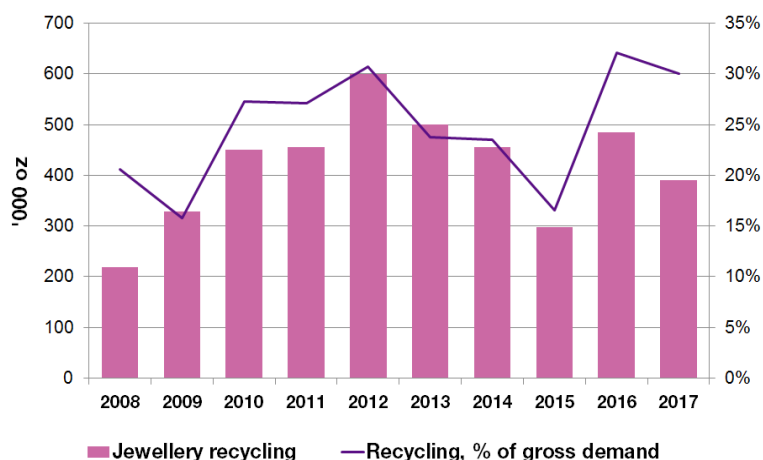
However, more recently, recycling has been taking place outside of this established ‘closed-loop’ network, with consumers who do not wish to exchange their platinum jewellery for a new platinum piece preferring to sell directly to scrap collection booths for cash. This metal is processed at local refineries for sale to either jewellery fabricators or other consumers. We believe that the amount of platinum jewellery being recycled via this route increased significantly in 2017.

In contrast, the quantity of unsold stock returned for refabrication via the usual ‘closed-loop’ distribution network was down sharply, following unusually high volumes the previous year. Since 2015, there has been some rationalisation of the jewellery distribution chain in China, while platinum has also lost market share to karat gold in the fashion jewellery segment. This has had an impact on the amount of stock that retailers and wholesalers are prepared to hold, and led to extensive destocking throughout the distribution chain during 2016. While there were some further inventory reductions last year, partly as a function of a decline in the amount of counter space devoted to platinum jewellery, the impact was much smaller.

Gross demand for platinum fell by 4% to 7.85 million oz, mainly due to the steep fall in Chinese jewellery manufacturing and lower Japanese investment bar sales. These declines were partly offset by firm demand in most industrial sectors, with total industrial consumption rising by 7% to just short of 2 million oz – matching the previous record set in 2011. Changes in autocatalyst demand last year were comparatively minor, with total platinum use down 1% to 3.29 million oz.

In our last report, we predicted that demand for platinum in autocatalysts would shrink by 5% in 2017. However, light duty diesel vehicle production held up better than expected, falling marginally in Europe and rising 2% globally, while there were only small changes in average platinum loadings. Consumption in the heavy duty diesel sector increased modestly, leaving total use of platinum in diesel applications virtually unchanged compared with the previous year. However, there was some further slight erosion of platinum demand in gasoline vehicle catalysts.

Chinese platinum jewellery recycling



The next stage of European light duty diesel emissions legislation, known as Euro 6d-TEMP, was introduced in September 2017. During the phase-in period of these regulations, we expect to see a progressive shift away from the use of platinum-rich lean NOx traps (LNTs) to control NOx, and greater adoption of selective catalytic reduction (SCR) technology, which does not contain pgm. SCR will be used alongside platinum-containing bricks such as oxidation catalysts and particulate filters, but on average we expect Euro 6d-TEMP aftertreatment systems to contain less platinum than their Euro 6b equivalents. However, the new legislation applied only to new models launched in the final four months of 2017, and the impact on average platinum loadings was therefore small.



PGM MARKET REPORT FEBRUARY 2018

Platinum Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017 ^a	2015	2016	2017 ^a	2015	2016	2017 ^a
Europe	1,668	1,821	1,766	-477	-501	-558	1,191	1,320	1,208
Japan	395	391	396	-62	-66	-68	333	325	328
North America	368	346	326	-460	-470	-565	-92	-124	-239
China	136	145	157	-14	-18	-23	122	127	134
Rest of World	661	624	640	-99	-104	-108	562	520	532
Total	3,228	3,327	3,285	-1,112	-1,158	-1,322	2,116	2,168	1,963

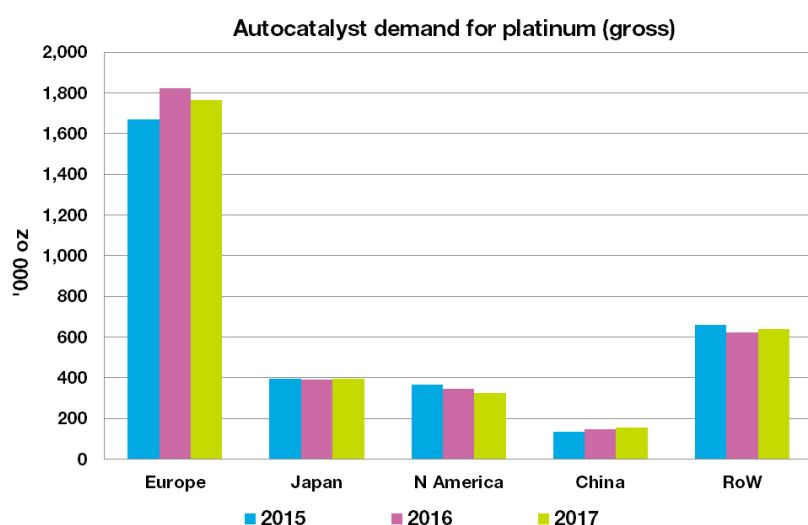
World demand for platinum in heavy duty catalysts rose by an estimated 3% in 2017, reflecting higher truck output in major markets such as Japan and the USA, and greater use of diesel oxidation catalysts (DOCs) on heavy vehicles in China. Globally, we estimate that around 60% of heavy duty diesel vehicles were equipped with platinum-containing catalysts last year, up from 54% the previous year.

“ Chemical demand was boosted by China's 'One Belt and One Road' initiative. ”

Chemical industry demand for platinum remained buoyant, with demand firm in all regions. China remains the largest single user of platinum in the majority of chemical applications, and investment by Chinese companies in their overseas markets – encouraged under the government's 'One Belt and One Road' initiative – also contributes significantly to demand in other regions.

Many of platinum's chemical applications are in the form of catalysts that are used, but not consumed, in the manufacture of chemical products. Most purchasing therefore occurs at the time of plant construction, when an initial catalyst charge is purchased, with only small amounts of 'top-up' metal required thereafter. Last year saw particularly strong demand for platinum as a result of paraxylene capacity additions in the Rest of World region, and from new propylene dehydrogenation plants in China.

Platinum demand in the speciality silicones sector differs from the general rule, in that the platinum catalyst is consumed during the manufacturing process and the metal ends up, in extremely low concentrations, in the final product. These end-products include a wide range of consumer and industrial products, such as seals and packaging, medical appliances, release liners for labels, and dental impression materials. The Chinese market for silicones has been growing rapidly in recent years, in line with strong economic growth, and this has stimulated the construction of new domestic silicones production capacity.



Investment in petroleum refining in China also remained strong in 2017, as the industry upgraded its facilities in order to produce higher quality products to meet new vehicle emissions legislation. New demand in the country is also being generated by large projects integrating crude refining with downstream petrochemicals production, as China aims to be self-sufficient in certain chemicals.

Last year also saw growth in demand for platinum in the electrical sector. We estimate that platinum usage in hard disks grew by more than 10% last year; while hard disk drives (HDDs) face stiff competition from solid state data (SSD) storage in consumer applications, there has been steady expansion in the use of HDDs in 'server farms' for



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PGM MARKET REPORT FEBRUARY 2018

Platinum Demand: Industrial '000 oz			
	2015	2016	2017 ⁹
Chemical	502	527	521
Electrical	228	230	258
Glass	227	246	306
Medical & Biomedical	215	218	220
Petroleum	140	176	198
Other	441	458	475
Total	1,753	1,855	1,978

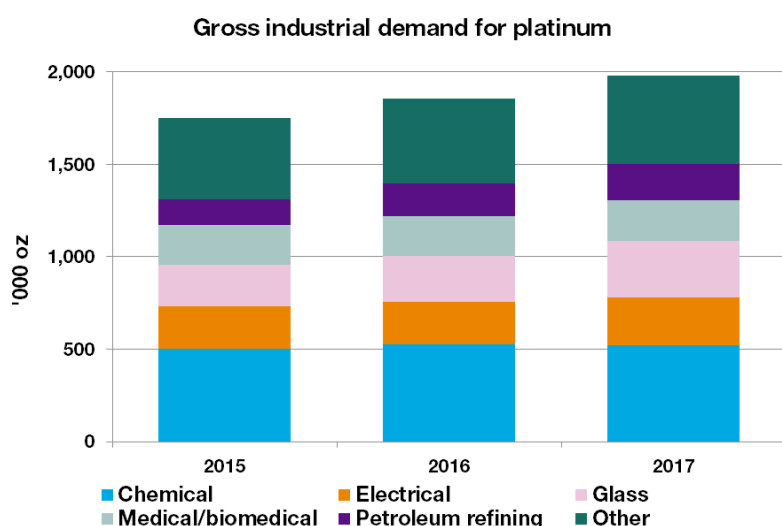
“Sales to glass makers were the strongest for six years at over 300,000 oz.”

cloud and enterprise data storage. Along with greater numbers of drives for server applications, there is also a trend to increasing numbers of disks per drive to meet rapidly growing data storage requirements. The potential for SDD memory to encroach on hard disk market share in this segment is limited by price and capacity issues.

Fuel cell demand is included in our electrical industry number, and accounted for just under 50,000 oz of demand in 2017. Demand from the Japanese residential fuel cell market (known as 'Ene-Farm') was weaker than previously expected: proton exchange membrane (PEM) fuel cells have lost market share to solid oxide fuel cells, which do not contain platinum. In contrast, the use of platinum in fuel cell electric vehicles (FCEV) rose by over 300% last year. Sales of fuel cell cars (mainly in California and Japan) more than doubled in 2017, while several hundred fuel cell buses were deployed in China. See page 11 for a more detailed discussion of the developing Chinese market for FCEVs.

Sales of platinum to the glass-making sector were the strongest for six years at over 300,000 oz. While there was some modest purchasing of pgm for LCD glass expansions, the booming glass fibre sector accounted for the bulk of new platinum requirements. With momentum building in major Western economies, and the Chinese economy continuing to expand at around 6% per annum, global demand for fibre-reinforced plastics is growing rapidly. This has stimulated significant investment in new fibreglass production capacity, especially in China. While the Chinese domestic market accounts for the largest share of new investment, Chinese companies have also been adding to capacity outside their home country, in order to avoid anti-dumping duties in their overseas markets, and in order to qualify for local incentives and tax reduction programmes.

Demand for platinum in other applications rose by around 4% in 2017, with rising platinum use in vehicle components such as sensors used in engine management and emissions control systems. Demand for platinum in coatings used on turbine blades and other aero engine components was also firm.



While developments in platinum's industrial markets were generally positive, the opposite was true in the jewellery sector: the Chinese platinum jewellery market has faced significant headwinds over the past three years, and there is little immediate prospect of an improvement in business conditions. According to the World Gold Council, Chinese demand for gold jewellery fell by 17% in 2016, and there were further declines in the first six months of 2017. Gold amounts for the majority of jewellery sales in China, usually in the form of heavy, pure metal items that are purchased as a store of value; this collapse in revenues has led to consolidation of the retail network, with stores closing and their inventory being distributed among other outlets in the same retail chain, or returned for recycling (see pages 3



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PGM MARKET REPORT FEBRUARY 2018

Platinum Demand: Jewellery '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017 ⁹	2015	2016	2017 ⁹	2015	2016	2017 ⁹
Europe	203	177	174	-5	-5	-5	198	172	169
Japan	314	310	309	-256	-241	-224	58	69	85
North America	227	220	225	-11	-3	0	216	217	225
China	1,796	1,510	1,303	-298	-485	-391	1,498	1,025	912
Rest of World	206	195	216	-4	-4	-4	202	191	212
Total	2,746	2,412	2,227	-874	-738	-624	2,172	1,674	1,603

“ Platinum is facing strong competition from karat gold fashion jewellery in China.”

is now facing significant competition from karat gold products in the fashion jewellery segment. Chinese consumers have historically been wary of karat gold, because of its relatively low precious metal content (75% or below) compared with pure gold or platinum jewellery. The latter are usually sold by weight, with retailers displaying metal prices in their stores; this enables consumers to be confident of the inherent value of their purchase, and facilitates the exchange of jewellery for newer items at a later date. In contrast, karat gold jewellery is sold by piece, usually at a much greater mark-up compared to the inherent metal value, and retailers do not typically offer exchanges on these items. In the past this might have proved a significant barrier to the development of a karat gold market in China.

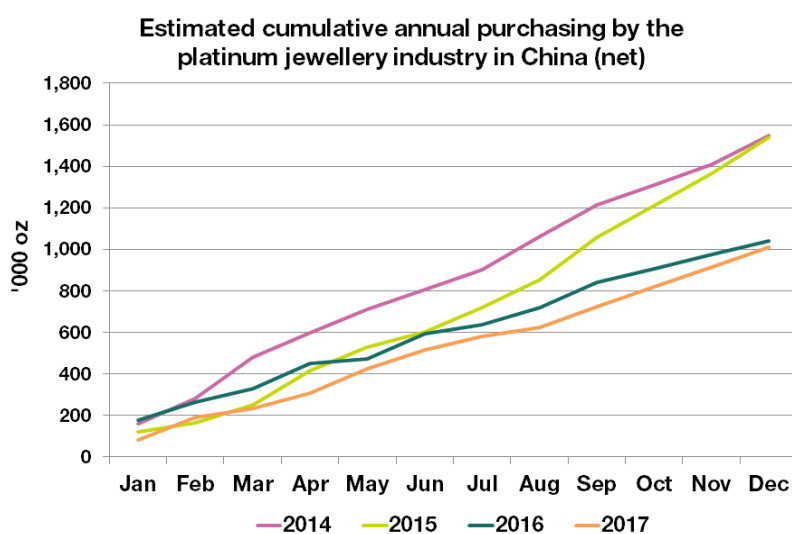
However, in the last two years, with the Chinese jewellery market struggling, retailers have reacted to financial pressures by increasing the amount of counter space devoted to karat gold items, on which they are able to achieve much better margins than on pure gold or platinum. The commission structure for jewellery store employees often reflects these margins, providing a strong incentive for workers to market karat gold jewellery to customers, instead of platinum.

While the karat gold trend appears to have been initiated primarily by retailers hoping to mitigate financial pressures, it is now clear that retail marketing efforts have been successful in tapping into evolving consumer tastes. This is particularly true amongst younger people, who are typically less concerned about exchange values than older generations of jewellery

purchasers. In turn, retail-led growth in karat gold has created a strong demand pull at manufacturer level, often at the expense of platinum.

Johnson Matthey undertakes twice-yearly surveys of fabrication demand in China. Our factory survey for the first half of 2017 showed that gross platinum use had fallen by 17% compared with the same period of the previous year. We believe that the rate of decline slowed in the second half, leaving gross platinum consumption down 14% at 1.3 million oz for the full year. These are preliminary figures, which will be updated in our May 2018 report following the completion of our latest factory survey.

In contrast, we estimate that the Indian market grew by 15% last year, after faltering in 2016 following severe flooding in the Chennai region (a



Johnson Matthey
Precious Metals Management

“ We estimate that the Indian market for platinum jewellery grew by 15% in 2017. ”

major centre for platinum jewellery fabrication), some changes in the customs regime which caused significant uncertainty for the jewellery trade, and the implementation of the government's 'demonetisation' policy. Although the broader context remained negative for Indian jewellery demand last year, platinum is a new market, very small relative to gold, and benefited from positive demographic factors such as rising personal wealth and an expanding middle class.

In terms of the number of pieces sold, couple rings and lighter pieces such as earrings and pendants are the most popular items, as in other regional platinum jewellery markets. However, India is unusual in the size and importance of its men's jewellery market, with platinum neck chains and bangles proving increasingly popular. These items typically weigh around 25 grams for a chain and 50 grams for a bangle – compared to around 8 grams for an average ring – and account for a significant proportion of total Indian fabrication demand.

With industrial demand strong, jewellery demand weak, and autocatalyst demand little changed, last year saw only a modest decline in total world demand for platinum in 'consuming' applications, i.e. excluding investment. However, after accounting for investment, world demand fell by 4% or around 370,000 oz, with most of this decline occurring in the Japanese investment bar sector. World investment totalled 356,000 oz in 2017, a 43% decline compared with the previous year.

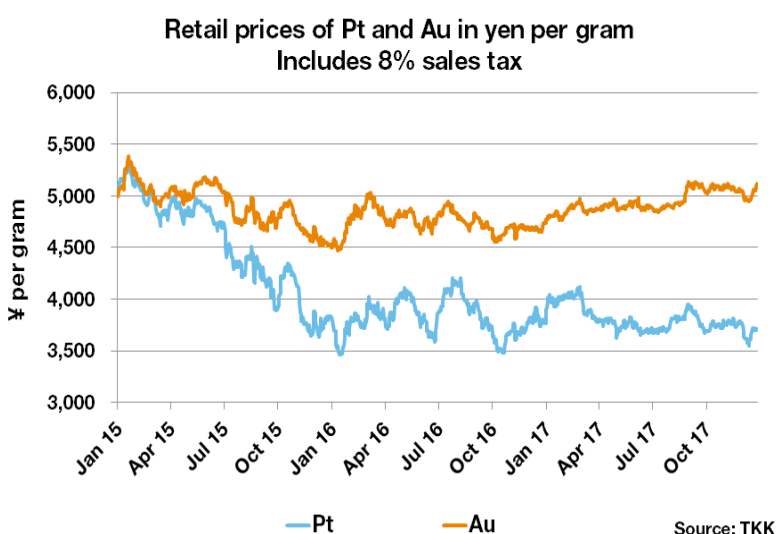
“ The boom in Japanese bar sales ended in 2017 but investment stayed positive. ”

During 2015 and 2016, Japanese retail investors accumulated around 1.15 million oz of platinum, primarily in the form of platinum bars purchased over-the-counter from bullion houses. This surge in investment was linked to a series of falls in yen platinum prices, which coincided with a dramatic widening of platinum's discount to gold. This created a perception among Japanese retail investors that platinum represented particularly good value, both compared to historic prices and also in relation to gold, and triggered a boom in Japanese bar sales that was unprecedented both in its magnitude and its duration.

This boom period came to an end in 2017, even though the price environment remained favourable for continuing investment: yen platinum prices remained below the

psychologically important ¥4,000 per gram level during 2017, and the discount to gold remained at historically high levels of around ¥1,000/gram. These factors enabled investment activity to remain in positive territory for much of the year, but buying was muted compared to the two prior years.

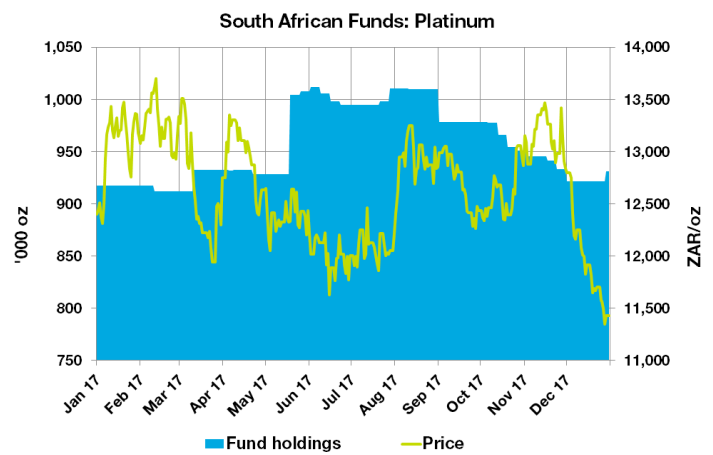
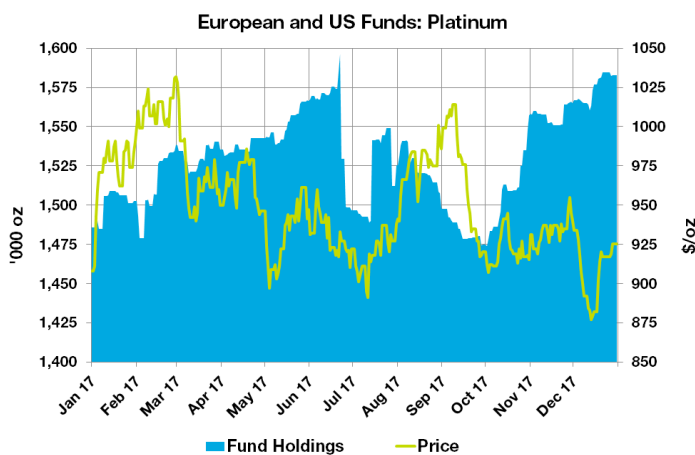
Global investment in platinum ETFs was positive during 2017 for the first time in three years, as holdings in South Africa stabilised after two years of heavy liquidation. There was periodic purchasing into declining prices by South African investors, as movements in the value of the rand created buying opportunities even during periods when dollar platinum price volatility was low. In contrast, the only significant periods of liquidation occurred during the second half of the year, when prices briefly topped ZAR 13,000 per ounce.



“The platinum market moved into a small surplus in 2017, after five years of deficits.”

US ETF demand was positive for a second consecutive year. Historically, North American platinum investment has been positively correlated with price, but there has been some evidence of a change in investor behaviour this year: holdings in the US funds rose by around 62,000 oz in the final quarter of 2017, despite a fall in the platinum price to under \$900/oz.

With platinum investment falling by over 260,000 oz, the platinum market moved into a small surplus in 2017, following five years of successive deficits which contributed to significant depletion of market stocks of platinum held in the UK and Switzerland (see the graph on page 10). There were further inventory drawdowns during early 2017, but the rate of depletion appears to have slowed from mid-year, consistent with a market moving out of deficit.



Outlook for Platinum

SUPPLY & DEMAND IN 2018

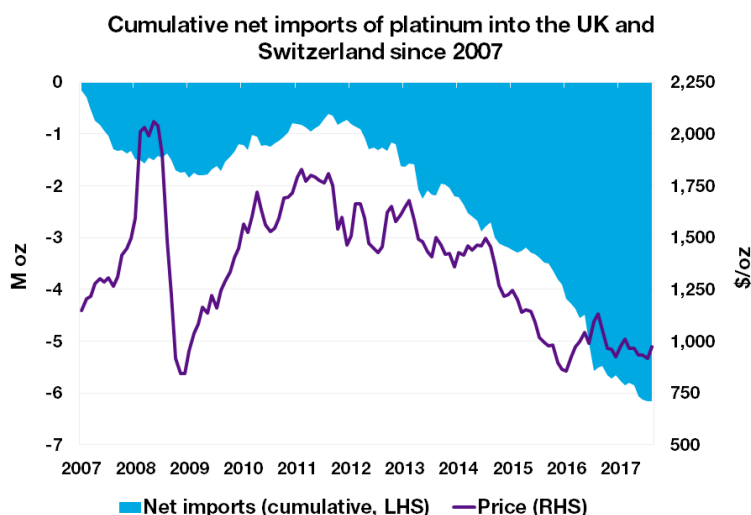
OUTLOOK: PLATINUM

- With primary mine shipments little changed, growth in auto recycling will boost total supplies.
- Record industrial demand will lift global consumption of platinum, excluding investment.
- The glass industry is set to make large platinum purchases for new LCD and fibreglass facilities.
- Auto consumption will fall slightly, with weak diesel demand in Europe partly offset by growth in the USA.
- Platinum jewellery fabrication in China is likely to contract again, but the rate of decline could slow.
- Assuming no change in investment demand, the market should remain in moderate surplus.

In 2018, platinum use in autocatalysts will see further moderate erosion due to a fall in average loadings on European diesels, while jewellery fabrication in China is forecast to contract for a fifth consecutive year. However, this should be more than offset by growth in industrial applications, where demand could beat the all-time record achieved last year. Glass manufacturers are set to purchase unusually large quantities of platinum for new LCD and fibreglass facilities, while chemical demand will remain at historically high levels. Overall, before accounting for investment, we expect global platinum consumption to rise slightly. However, this will be matched by a modest increase in combined primary and secondary supplies, mainly due to rising recoveries from autocatalyst scrap.

World primary supplies of platinum are unlikely to change much in 2018, with the impact of mine closures in South Africa offset by a one-off benefit from the refining of some unprocessed inventory that accumulated last year.

We estimate that the release of metal from stocks of ore and work-in-progress could add as much as 150,000 oz of platinum to refined output in South Africa this year. The Mototolo mine will treat a backlog of unprocessed ore following a concentrator outage, while Impala Platinum will process unrefined inventory that built up during furnace maintenance in 2017, and Northam Platinum will refine concentrate that accumulated ahead of the commissioning of a new furnace. The refining of these materials will provide a temporary boost to South African platinum supplies in 2018. However, this gain will be partly offset by the loss of production from the Bokoni and Maseve mines, which closed during 2017.



Output of pgm at Norilsk Nickel is expected to be broadly flat, but alluvial platinum production in the Far East of Russia will decline once again. These deposits once supplied over 150,000 oz of platinum annually, but output has been contracting for several years and could be as little as 20,000 oz in 2018. In North America, Sibanye-Stillwater's Blitz expansion project should make a meaningful contribution to supplies this year, but pgm grades at the Sudbury nickel mines are on the decline.

While mine output is expected to be lacklustre, secondary production is forecast to benefit from further growth in the volume of spent autocatalyst collected and processed. After a period of unusually muted activity in this sector during 2015 and 2016, especially in the large European

“ Combined primary and secondary supplies could rise by 2–3% in 2018. ”

and North American markets, there is room for further expansion in the number of vehicles being dismantled. We continue to anticipate an increase in the platinum grade of European catalyst scrap, based on the dramatic increase in loadings on diesel vehicles that occurred during the 2000–2007 period.

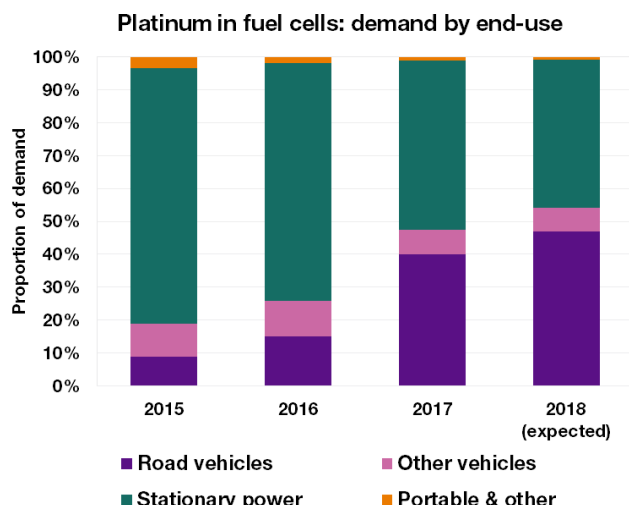
Jewellery recycling in China is expected to fall, although as a proportion of gross jewellery demand it is likely to remain above normal levels. Overall, we think combined primary and secondary supplies could rise by 2–3%.

“ The outlook for fuel cell vehicles in China is increasingly positive. ”

There is potential for platinum demand to increase in 2018, based on a very positive outlook for industrial applications. It is likely to be a bumper year for the glass sector, with glass makers poised to make exceptionally large purchases of platinum for LCD and fibreglass expansions in China. The electrical sector will be boosted by strong growth in the fuel cell segment, where transport applications are forecast to consume more platinum than stationary fuel cells for the first time. Chemical demand will remain robust: new metal requirements from this industry are expected to exceed half a million ounces of platinum for a sixth consecutive year.

Much of this year's growth in platinum consumption in fuel cell electric vehicles (FCEVs) will come from China, mainly due to the roll-out of fuel cell bus programmes in a number of cities. This has generated orders for significant numbers of fuel cell stacks to be delivered over the 2018–2021 period.

The outlook for fuel cells in China is increasingly positive: over the past year, developments in the government's New Energy Vehicle policy have created a favourable environment for the development of a mass market for FCEVs. The use of fuel cells should be favoured by the need to meet strict criteria such as a minimum range and fast charging in order to qualify for the most generous subsidies and incentives available. In contrast, we expect financial support for battery electric and plug-in hybrid vehicles to be reduced, and eventually removed. The Chinese government's aim is to increase the number of FCEVs on Chinese roads to 50,000 units by 2025, and one million by 2030.



In contrast to buoyant industrial demand, the use of platinum in autocatalysts is expected to shrink slightly in 2018. World output of light duty diesel vehicles is forecast to be stable, with growth in North America, India and some Rest of World countries offsetting a 2–3% decline in European production, but platinum demand will be hit by lower average loadings on diesel vehicles built for sale in Europe.

This decline in loadings is based on changing catalyst fitment strategy at some European automakers. The phase-in of Euro 6d-TEMP regulations began in September 2017, and is expected to result in a shift towards non-pgm SCR technology for NOx control, although all diesel vehicles will continue to be fitted with platinum-rich catalysts for the treatment of other pollutants. This will result in a modest decline in average catalyst loadings across the European fleet in 2018.

“ Auto demand will be hit by lower average loadings on European diesel vehicles.”

Lower autocatalyst demand in Europe will be partly offset by a very strong performance from the US diesel market, with North American light diesel production forecast to approach 1 million units, an all-time high. US diesels tend to be much larger than their European counterparts, and catalyst systems therefore have higher pgm loadings, despite the almost universal use of SCR technology instead of LNTs for NOx control in this region.

Platinum jewellery fabrication in China has been contracting for the last four years, and is expected to fall again in 2018, although the rate of decline could slow. During the second half of last year there was some evidence of a recovery in the Chinese gold jewellery market, with the World Gold Council estimating that third-quarter sales rose by 13%. If this trend is confirmed, it will help to relieve the financial pressure on jewellery retailers, and reduce the likelihood of further rationalisation in the distribution chain. There

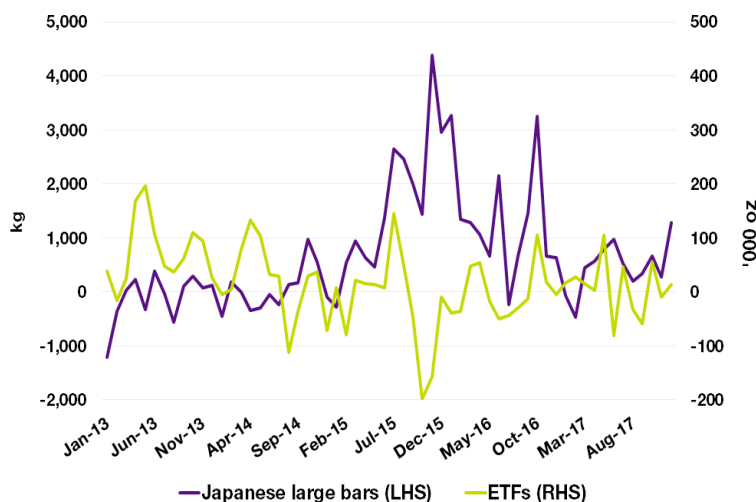
are also signs that the industry is working to improve the design of platinum jewellery, with the aim of moving towards ‘per piece’ pricing, and improving margins. However, it is too early to tell whether this initiative will be successful.

Platinum jewellery demand in Japan peaked at over a million ounces in the 1990s, but in recent years has been stable at just over 300,000 oz per annum. Low platinum prices have generally been supportive for jewellery demand in this region, making it easier for manufacturers to develop new ranges of fashion jewellery at attractive price points. In 2018, the wedding of Imperial Princess Mako in November should have a positive influence on the market; the princess is expected to wear platinum jewellery at wedding-related events and the resulting exposure has the potential to stimulate platinum sales among younger consumers, with whom she is very popular. However, the impact is likely to be small compared to the decline in Chinese fabrication.

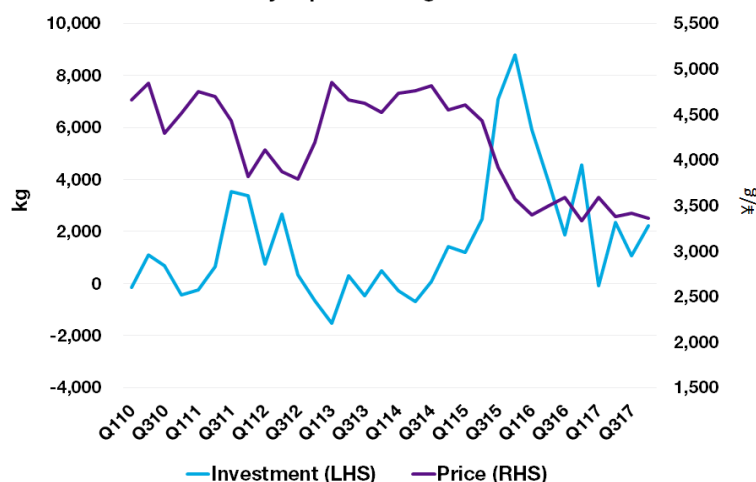
Notwithstanding declines in the jewellery and auto sectors, we expect total use of platinum in ‘consuming applications’ (i.e. excluding investment) to increase slightly in 2018. This means that investment will once again be a key factor in determining the direction of change in total platinum demand.

Over the eleven years since platinum ETFs were first launched in 2007, combined physical investment demand in ETFs, bars and coins has averaged around 500,000 oz per annum. However, over this period the two major components of investment demand have moved in opposite directions: in years when ETF purchases were unusually strong, Japanese retail bar demand tended to fall, and vice versa.

Monthly large bar and ETF investment



Quarterly Japanese large bar investment



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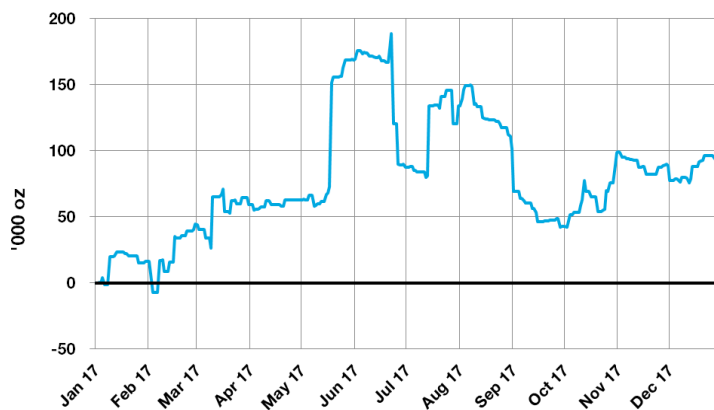
Retail investors in Japan tend to buy into low and declining prices, with periods of strong purchasing sparked by a steep decline in yen-denominated prices, as occurred during 2008 and 2015. In this market, profit-taking in response to price gains tends to be outweighed by purchasing into low prices, leading to a natural accumulation of metal over time.

In contrast, ETF investment has historically been associated with rising prices: strong investment in US and European funds over the 2008–2010 period occurred at a time when the dollar-denominated platinum price was generally increasing, while the peak of South African buying in 2013 and early 2014 occurred during a period of rand depreciation that boosted platinum prices in local terms. As a result, many ETF investors are 'out of the

money', and this has placed a natural cap on redemptions. However, unlike the Japanese bar market, ETFs are not a market of natural accumulation, as shown by heavy profit-taking in palladium ETFs over the last three years.

Looking forward, we are unlikely to see any widespread profit-taking in ETFs this year unless there are significant gains in price. On the other hand, while platinum continues to trade between \$900 and \$1,000 per ounce – as it did for almost the whole of 2017 – the conditions are not in place for a return to strong buying by either ETF investors or Japanese bar purchasers. Assuming that investment demand in 2018 is similar to last year, the market is likely to remain in modest surplus.

Net investment in platinum ETFs since January 2017



Summary of Palladium SUPPLY & DEMAND IN 2017

SUMMARY: PALLADIUM

- Primary palladium supplies fell by 2%, but this was balanced by sharp growth in auto recycling.
- Gross palladium consumption rose by 8%, as autocatalyst demand surged to an all-time high.
- Global gasoline car sales rose 1.5%, while US catalyst loadings were boosted by Tier 3 legislation.
- Buoyant demand from the Chinese chemicals industry kept industrial consumption firm.
- Investment was negative for a third year in a row, but the volume of liquidation fell.
- The market remained in large fundamental deficit, reflected in poor liquidity and higher prices.

The use of palladium in autocatalysts surged by nearly half a million ounces in 2017, setting a new record of 8.4 million oz. With purchasing by chemicals producers also at historical highs, and a sharp fall in the rate of redemptions by ETF investors, total palladium demand rose by 8% to 10.15 million oz. Although there was significant growth in the recovery of palladium from scrapped autocatalysts, world mine supplies fell slightly, leaving combined primary and secondary shipments up only modestly. As a result, the market deficit widened to over 600,000 oz.

We estimate that world primary supplies of palladium declined by 2% in 2017, reflecting lower shipments from Russia following sales from inventory the previous year, and weaker output in North America, where there have been some changes in the route to market for producers in the region; this has contributed to fluctuations in pipeline inventory.

Supplies of palladium from South Africa were stable in 2017, despite a new round of mine closures, and a number of maintenance outages and technical problems at processing plants, which caused a build-up in stocks of unrefined palladium at the year end (see pages 1–2). This metal will be processed during 2018.

Russian supplies have also been affected by some fluctuations in the amount of palladium in work-in-process over the last year. During the first quarter of 2017, refined production from Norilsk Nickel was affected by a reconfiguration of the company's processing flowsheet, involving the closure of the nickel smelter at the Norilsk mine site and the transfer of most nickel and pgm processing activities to the Kola Peninsula. However, output recovered in subsequent quarters, leaving palladium production from the group's Russian operations up on the previous year during the first nine months of 2017.

It is likely that the processing of pgm from some above-ground materials contributed to this gain. In December 2016, Norilsk Nickel entered into a transaction with the state-controlled corporation Rostec to purchase 1.5 million tonnes of old copper concentrate that derived from mining activities in the Norilsk area during the Soviet period. The refining of this material has helped compensate for a decline in the recovery of pgm from stored pyrrhotite concentrate, stocks of which have now been depleted.

However, although production rose, we estimate that Russian supplies fell last year; our 2016 figure was inflated by the inclusion of sales from refined stocks of palladium that Norilsk had accumulated the previous year.

Norilsk Nickel announced last November that total holdings in its Global Palladium Fund could amount to as much as 600,000 oz by the end of 2017. The fund purchases palladium from Russia's Central Bank and other market

Palladium Supply and Demand '000 oz			
Supply	2015	2016	2017 ⁹
South Africa	2,684	2,574	2,569
Russia	2,434	2,773	2,652
Others	1,337	1,413	1,376
Total Supply	6,455	6,760	6,597
Gross Demand			
Autocatalyst	7,622	7,948	8,424
Jewellery	222	191	180
Industrial	1,956	1,877	1,934
Investment	-659	-646	-386
Total Gross Demand	9,141	9,370	10,152
Recycling	-2,418	-2,503	-2,926
Total Net Demand	6,723	6,867	7,226
Movements in Stocks	-268	-107	-629



“ **Secondary supplies of palladium surged as auto scrap volumes bounced back.** ”

participants, with the aim of easing market shortages and guaranteeing metal availability for customers. It should be noted that market purchases by Norilsk Nickel are considered to represent a change in ownership of existing market stocks, so they do not feature in our supply or demand estimates, and do not affect our estimate of the market balance.

Secondary supplies of palladium surged in 2017, as scrap autocatalyst volumes bounced back following two years of weak activity in this sector. At the same time, the palladium content of scrap continued to rise, reflecting the dramatic increase in palladium use that occurred over the 1995–2005 period, as many automakers moved away from platinum in three-way catalysis. The fastest growth was seen in North America, the first region to make widespread use of palladium catalysts, starting in the mid-1990s. Although emissions legislation was significantly less strict than today, palladium catalyst technology was also much less advanced, and palladium loadings were often extremely high by modern standards.

Despite growth in recycling, combined primary and secondary supplies rose by less than 3%. In contrast, demand climbed by 8%, or nearly 800,000 oz, as autocatalyst consumption soared to an all-time high and ETF redemptions fell. Meanwhile, buoyant demand from the chemicals sector contributed to a firm picture for industrial demand in 2017, despite continued gradual erosion of demand in the electrical and dental sectors.

“ **Chemicals industry demand was stimulated by the Made in China 2025 initiative.** ”

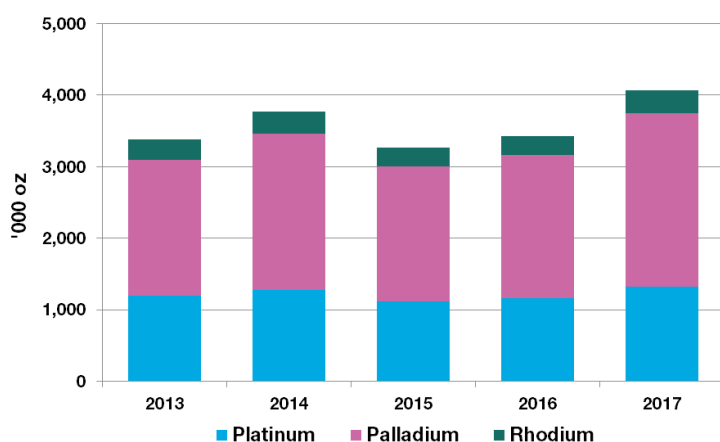
Palladium purchasing by the chemicals industry was exceptionally strong in 2017, with demand robust in all regions and at record levels in China, where the government’s ‘Made in China 2025’ initiative – designed to reduce the country’s reliance on imports of chemical feedstocks – has stimulated massive investment in new integrated petrochemical facilities.

Palladium catalysts are used in a wide range of chemical processes, ranging from bulk petrochemicals to speciality products such as pharmaceuticals. Historically, palladium’s largest single use in the chemicals sector was in the production of purified terephthalic acid (PTA), an intermediate that is used to make polyethylene terephthalate (PET) for textiles and packaging applications. However, in the last few years there has been dramatic growth in several other bulk chemicals processes that use palladium catalysts.

These include the manufacture of hydrogen peroxide, used in paper-making, waste water treatment and as a chemical intermediate; mono ethylene glycol (MEG), using a process known as ‘coal to MEG’, or CTMEG; and caprolactam, an intermediate used in nylon production.

Global demand for hydrogen peroxide is estimated to be rising at over 5%, with growth concentrated in Asia and particularly in China. Environmental concerns are encouraging the replacement of plastic with paper in packaging applications, and stimulating the treatment of waste water, lifting requirements for hydrogen peroxide as a bleaching and oxidation agent. There is also growing demand for hydrogen peroxide as a feedstock in the production of propylene oxide. The primary use of propylene oxide is the production of polyether polyols

Autocatalyst recovery by metal



Palladium Demand: Industrial '000 oz			
	2015	2016	2017 ⁹
Chemical	451	425	537
Dental	468	430	407
Electrical	903	871	853
Other	134	151	137
Total	1,956	1,877	1,934

used in the synthesis of polyurethanes, which find application in a wide range of consumer products.

Last year saw exceptionally strong investment in new CTMEG capacity in China, with the aim of reducing the country's reliance on ethylene glycol imports. MEG is usually produced from oil using a non-pgm catalyst. However, because China has abundant coal supplies but is a net oil importer, it has invested heavily in CTMEG plants, which require a palladium catalyst. Demand for this application was particularly strong in 2017, but going forward we expect to see a slowdown in CTMEG capacity additions.

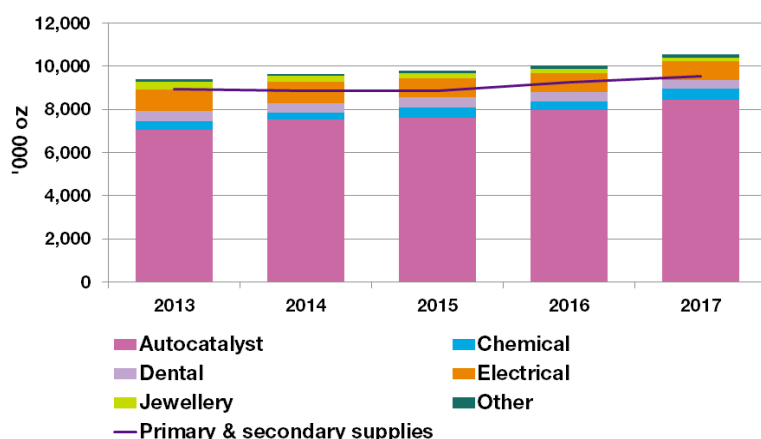
Last year saw Chinese chemical companies invest heavily in caprolactam production capacity via the hydroxylamine phosphate oxime (HPO) process, after a pause in plant construction in 2016. Caprolactam is used to make nylon, which is best known for its use in fabrics. However, it also finds growing use in industrial applications such as lightweight composite nylon resins for automotive components, plastics for 3D printing, and nylon 'tyre cords' which improve the performance and durability of vehicle tyres.

Demand for palladium in autocatalysts also saw exceptionally strong growth, rising by 6% to set another all-time high of 8.42 million oz – up nearly half a million ounces in a single year. While China and the Rest of World region posted significant gains, the strongest growth came from North America, where a 5% drop in production of cars and light trucks was easily outweighed by growth in palladium loadings on both diesel and gasoline vehicle catalysts.

These higher loadings were associated with US Tier 3 Federal emissions regulations, implementation of which began in 2017 and will extend to 2025. Under this legislation, automakers are able to certify their vehicles to a range of different benchmarks, or 'bins', as long as they comply with fleet average emissions limits that become progressively tighter each year. This has already resulted in an increase in the number of vehicles equipped with catalyst systems capable of meeting the 2025 SULEV30 target. This had a significant impact on palladium demand last year, with average loadings on US gasoline cars rising at double-digit rates.

“Average loadings on US gasoline cars rose at double-digit rates.”

Palladium demand in consuming applications (excluding investment)



In the USA, emissions limits are identical for both diesel and gasoline vehicles, so the light duty diesel sector also saw growth in pgm loadings as Tier 3 standards began to take effect. In this region, the use of diesel engines in the light duty segment is mainly restricted to the heaviest categories of vehicles, such as large pick-up trucks and sports utility vehicles. This means that almost all US diesels use SCR technology rather than LNTs for NOx control. Nevertheless, because of vehicle size and weight, loadings are substantially higher than for European diesels, while the technical detail of US legislation tends to favour additional palladium use in diesel. The platinum:palladium ratio on North American diesel catalysts is now close to 1:1, compared with over 3:1 in other light duty diesel markets.



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Palladium Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017 ⁹	2015	2016	2017 ⁹	2015	2016	2017 ⁹
Europe	1,613	1,640	1,665	-413	-424	-489	1,200	1,216	1,176
Japan	760	792	805	-106	-110	-122	654	682	683
North America	2,032	1,956	2,121	-1,110	-1,152	-1,443	922	804	678
China	1,654	2,036	2,164	-56	-75	-100	1,598	1,961	2,064
Rest of World	1,563	1,524	1,669	-212	-240	-269	1,351	1,284	1,400
Total	7,622	7,948	8,424	-1,897	-2,001	-2,423	5,725	5,947	6,001

Overall, the use of palladium on North American vehicles rose by 8% to a new record of 2.12 million oz. Nevertheless, the Chinese market retained its position as the world's largest palladium consumer, with autocatalyst demand up 6% to 2.16 million oz. This gain was primarily a result of an increase in palladium loadings, following the nationwide implementation of China 5

emissions limits for gasoline vehicles starting in January 2017. Changes in vehicle production volumes had only a modest impact on demand: growth slowed to low single-digit rates, in the wake of a 16% gain the previous year.

Investment demand was negative for a third consecutive year in 2017, although the volume of liquidation was lower than in 2015–2016. European holdings saw a bout of heavy disinvestment in January, when palladium gained more than \$100/oz over a two-week period, and investors responded by selling over 150,000 oz. There was further selling in mid-year, but this liquidation was partly reversed by heavy South African buying in August. During the final quarter, the rand-denominated palladium price reached a series of all-time highs, and this triggered sustained liquidation by South African investors.

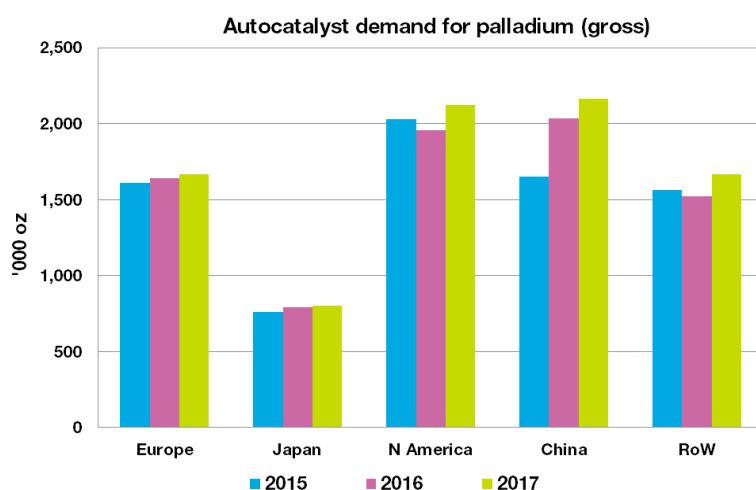
“ Palladium traded at a premium to platinum for the first time in sixteen years.”

Most physical palladium investment occurs in the form of ETFs, but small quantities of palladium coins are produced by national mints. Last year the US Mint issued a palladium version of its Eagle coin for the first time, but this new demand was partly offset by the return of some old palladium coins and small bars to the market by investors cashing in as palladium prices approached record levels.

Over the past three years, investors have returned nearly 1.7 million oz of palladium to the market, helping to support market liquidity at a time of booming autocatalyst demand and lacklustre primary supply. However, during 2017, the persistent market deficits of the last six years began to have a significant impact on the market, with palladium rising from

under \$700 per ounce at the beginning of the year to trade either side of \$1,000 during the final quarter, at a premium to platinum for the first time in sixteen years. Traders reported periodic difficulty in sourcing ingot, and this tightness was reflected in a sharp increase in lease rates, which spiked over 15% in mid-year. Although availability improved slightly in the second half of 2017, the market remained tight, with lease rates consistently above 5%.

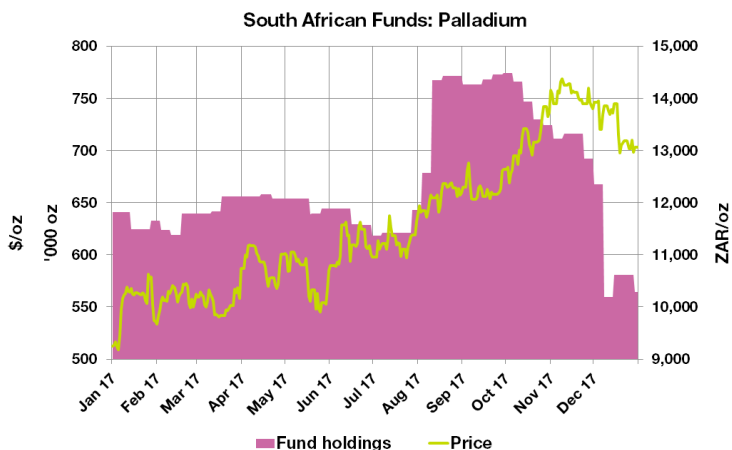
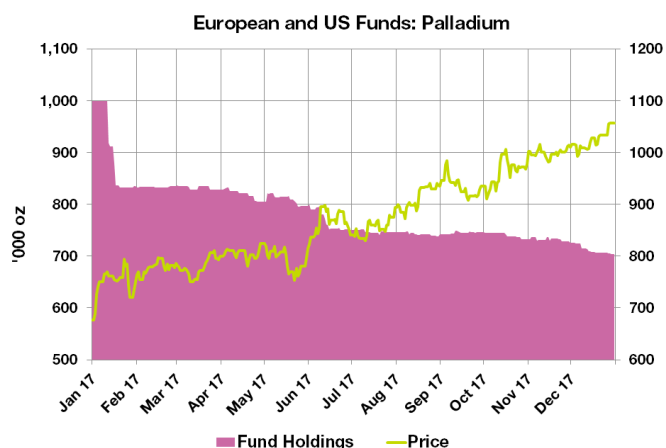
Based on our supply and demand estimates, we calculate that between 2012 and 2017, around 4.3 million oz of palladium was consumed from market stocks. This is supported by analysis of trade data, which provides compelling evidence for a market in large fundamental deficit: net withdrawals from Swiss and UK inventories



Johnson Matthey
Precious Metals Management

PGM MARKET REPORT FEBRUARY 2018

totalled at least 7 million oz over this six-year period (see the graph on page 19). Although part of this inventory movement may reflect a movement in palladium stocks from west to east, it is clear that the market overhang that was created by Russian government sales during the 1990s and early 2000s is being consumed at an unsustainable rate.



Johnson Matthey
Precious Metals Management

Outlook for Palladium

SUPPLY & DEMAND IN 2018

OUTLOOK: PALLADIUM

- North American mine expansions and growth in auto recycling will lift total supplies.
- Auto demand will hit a new all-time high, in line with modest growth in gasoline vehicle output.
- Petrochemical expansions in China will underpin industrial palladium consumption.
- The palladium market will remain in large deficit, even if ETF investors continue to take profits.

Following significant growth in gross autocatalyst demand and recycling in 2017, we expect this year to see much smaller changes in palladium fundamentals. Combined primary and secondary supplies are expected to rise by around 2%, while demand in ‘consuming applications’ (excluding investment) is predicted to rise by around half that rate. The market will almost certainly remain in deficit, but the size of the shortfall will be determined primarily by the investment sector, where demand has been negative for the last three years.

Palladium ETF holdings peaked at around 3 million ounces between mid-2014 and mid-2015, but since then selling has been heavy and prolonged. Investors have taken advantage of a steep rise in palladium prices to take profits, with the result that holdings fell to around 1.3 million oz at the end of December 2017.

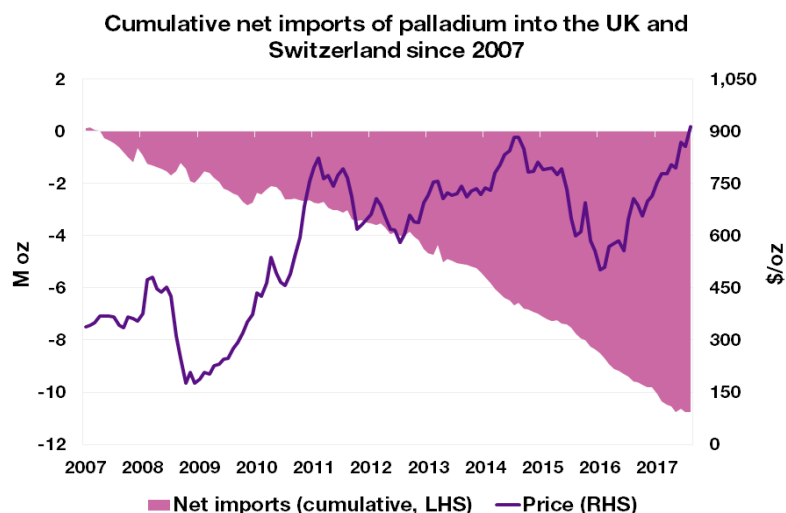
Given recent price rises to over \$1,000/oz, it is likely that most remaining palladium investors are ‘in the money’, but it is difficult to predict how they will respond to price movements over the next year. Our view is that there is still potential for further profit-taking, but it may be that remaining ETF holders are prepared to wait for higher prices before they liquidate their holdings. There is also scope for rising prices to stimulate fresh interest among investors; prior to 2015, palladium ETF investment was positively correlated with price.

Primary supplies may rise slightly, reflecting a release of pipeline stocks in South Africa, but the outlook for mine production remains lacklustre, with potential for further shaft closures.

Only in North America is there scope for near-term expansion: Sibanye-Stillwater’s output should rise this year as the Blitz project begins to make a significant contribution, while North American Palladium has returned to full-time mill operations and should see higher palladium production in 2018 as a result.

Norilsk Nickel expects its output to remain flat over the 2017–2020 period. There is some prospect of expansion in the longer term, if a project to develop the ‘Southern Cluster’ goes ahead. A feasibility study is being conducted, and the results are due to be announced in 2018, but this project is unlikely to contribute to supplies within the next five years.

The recovery of palladium from scrapped catalytic converters is forecast to expand again, although at



“ Combined primary and secondary supplies should grow by around 2%. ”

a lower rate than in 2017. Growth will again be concentrated in North America, where automakers were the first to make widespread use of palladium in three-way catalysts, and where loadings in the early 2000s were particularly high. We also expect to see a ramp-up in autocatalyst recovery in China, albeit from a low base, reflecting the extraordinary growth in palladium use over the last fifteen years. As a result, combined primary and secondary supplies should grow by around 2%.

Demand in ‘consuming applications’, i.e. excluding investment, should increase modestly, although the final total will depend upon the timing of purchases by the Chinese chemicals industry. The government’s ‘Made in China 2025’ initiative – designed to reduce the country’s reliance on imports of chemical feedstocks – has stimulated massive investment in new integrated petrochemical facilities, and some of these plants will begin to come on-stream over the next two years. Overall palladium demand from the chemicals industry may fall slightly short of the exceptional total seen in 2017, but is predicted to remain well above historical levels.

“ The behaviour of ETF investors will determine the size of the shortfall in 2018. ”

The use of palladium in autocatalysts is expected to hit another all-time high, on the back of modest growth in global production of gasoline vehicles. Average palladium loadings on gasoline vehicles are predicted to be broadly flat in 2018, but legislative change in Europe and China is expected to have a significant impact in the coming years.

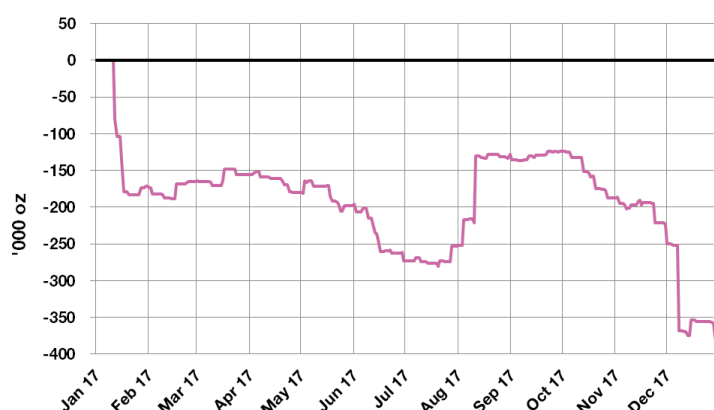
In Europe, the phased implementation of RDE testing under Euro 6d-TEMP and Euro 6d is expected to be positive for palladium loadings on gasoline vehicles: from September 2018, all new vehicles must meet a particle number conformity factor of 1.5, while the NOx conformity factor of 2.1 will apply to all new cars starting in September 2019. Chinese manufacturers are also gearing up to meet new legislation: China 6a is scheduled for implementation in July 2020, but some provinces will move directly to the stricter China 6b limits (although initially without the RDE component).

Other palladium applications are expected to experience some thrifting, in particular dental – where demand could fall below 400,000 oz for the first time in our historical demand series – and electronics, where miniaturisation and substitution with base metals

continues to erode palladium usage. Jewellery demand is likely to stabilise, now that Chinese fabrication has almost completely disappeared; the use of palladium is mainly confined to platinum jewellery alloys in Japan, and white gold alloys in most major jewellery markets, although there is still a small market for men’s palladium jewellery in North America and Europe.

While total demand in industrial and autocatalyst applications is expected to rise at a slower rate than combined primary and secondary supply, the market is forecast to remain in significant deficit. The behaviour of ETF investors will be critical to determining the size of the shortfall, but even if they continue to take profits, this is unlikely to be enough to bring the market into balance.

Net investment in palladium ETFs since January 2017



Rhodium Summary & Outlook

SUPPLY & DEMAND: 2017/18

SUMMARY: RHODIUM

- A fall in primary rhodium shipments was offset by sharp growth in autocatalyst recovery in 2017.
- Rhodium demand was boosted by growth in gasoline car output plus higher US loadings.
- The market remained in surplus but speculative and strategic purchasing absorbed liquidity.
- Supply and demand will be little changed in 2018.
- Tighter emissions limits are set to lift auto demand significantly over the next few years.

Gross demand for rhodium increased by 3.5% in 2017, reflecting growth in global output of gasoline vehicles, and higher loadings on North American cars. Consumption in the chemical and glass sectors was also buoyant, but investment demand turned negative. Combined primary and secondary supplies rose by 3%, with lower sales by primary rhodium producers more than offset by an increase in autocatalyst recycling. Although the market remained in fundamental surplus, liquidity was reduced by speculative and strategic purchasing, and the rhodium price doubled during 2017 to a six-year high of over \$1,700/oz.

Supplies of rhodium fell slightly in 2017, despite another strong year for South African producers, who continued to reduce stocks of work-in-progress at their smelters and refineries. In contrast, rhodium output at Norilsk Nickel is thought to have declined sharply in 2017, following the depletion of stocks of stored pyrrhotite concentrate, which the company has been reprocessing over the last few years, and which were relatively rich in rhodium. While the company continues to supplement mine production with the treatment of above-ground materials, notably stocks of old copper concentrate purchased from Rostec in December 2016, we believe that these contain only small amounts of rhodium.

Secondary supplies, almost entirely from autocatalyst scrap, rose by nearly 20% last year. Growth was particularly strong in North America, as the number of vehicles dismantled rose sharply after two years of unusually muted activity in the auto recycling market. Rising recoveries also reflect the steep increase in rhodium usage in three-way catalysts that occurred during the early 2000s: global rhodium demand rose from just over 500,000 oz in 1999 to an all-time record of around 880,000 oz in 2007. Although emissions limits were less strict than they are today, average rhodium loadings were substantially higher; it was only after the 2007–2008 price spike that automakers ramped up their efforts to thrift the rhodium content of three-way catalysts. A large proportion of vehicles dismantled during 2017 were built during this eight-year period when rhodium loadings reached their peak.

Combined primary and secondary supplies rose by around 3%, while gross demand expanded at a slightly faster rate to an all-time-record 1.05 million oz. The auto sector remained the primary driver of demand growth, with light duty vehicle output rising in all major markets except North America. Globally, gasoline car production increased by over 2% to exceed 75 million units.

Rhodium Supply and Demand '000 oz			
Supply	2015	2016	2017 ⁹
South Africa	611	615	618
Russia	80	85	65
Others	62	72	67
Total Supply	753	772	750
Gross Demand			
Autocatalyst	762	822	858
Other	158	191	190
Total Gross Demand	920	1,013	1,048
Recycling	-262	-271	-324
Total Net Demand	658	742	724
Movements in Stocks	95	30	26

Demand for rhodium in autocatalysts broadly reflected changes in light duty gasoline vehicle production, except in the USA, where the implementation of Tier 3 Federal emissions legislation boosted average pgm loadings on gasoline cars. US legislation is unusual in that it enables automakers to certify vehicles to a range of different standards, as long as they comply with fleet



“ In 2017, gross demand rose to an all-time record of 1.05 million ounces.”

average emissions limits that tighten progressively between 2017 and 2025. There has already been a significant increase in the number of vehicles equipped with heavily-loaded catalyst systems meeting the 2025 SULEV30 target, and this has had a marked impact on the average rhodium content of US vehicles. We estimate that rhodium usage in this market rose by 5% despite a sharp fall in US production of gasoline cars.

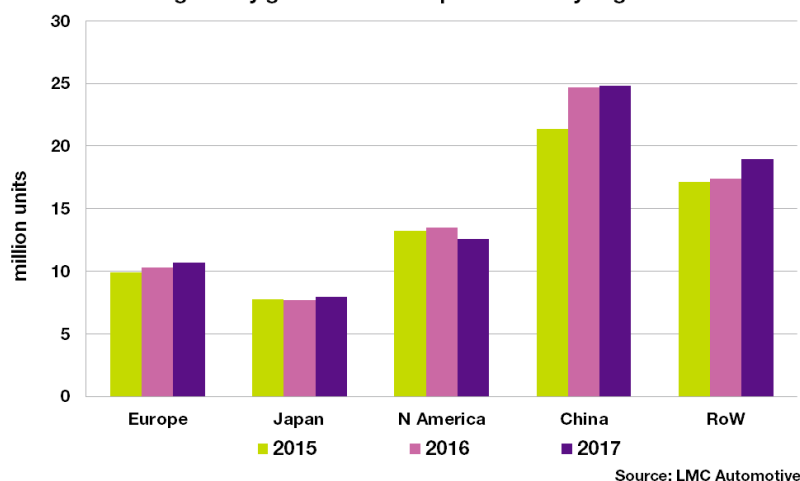
Although North America loadings are typically as much as 50% higher than in other major vehicle markets – a function of differences in emissions legislation and greater average vehicle size – it is only the second largest regional consumer of rhodium. China remains by far the biggest regional producer of gasoline vehicles and consequently the world’s leading user of rhodium in autocatalysts. Demand in China also rose by around 5% last year, reflecting a modest increase in gasoline car output accompanied by a marginal uplift in the average rhodium content of a vehicle.

The use of rhodium in chemical, glass, electrical and other applications was flat in 2017. Demand from chemical and glass producers was unusually robust, primarily as a result of strong buying by Chinese companies, both for domestic expansions and for overseas plants. However, this was partly offset by negative investment demand, as holders of ETFs took advantage of the steep rise in rhodium prices in order to take profits.

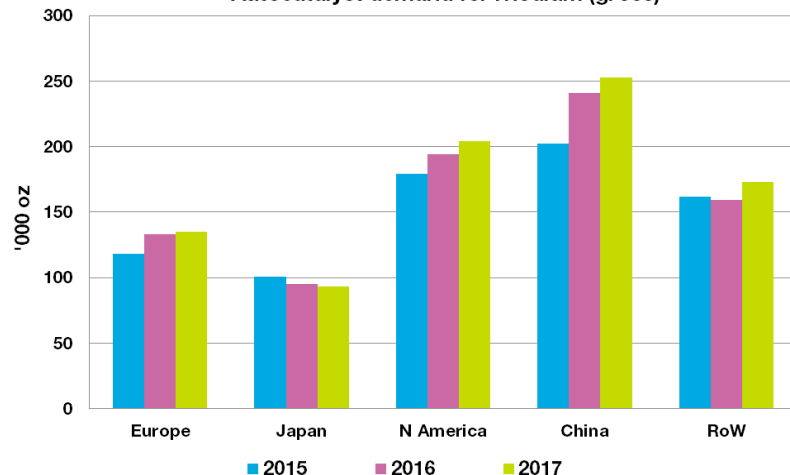
Despite overall demand growth, the market remained in a modest surplus in 2017. However, availability of rhodium tightened significantly, reflecting speculative and strategic purchasing of rhodium, especially in Asia. We do not count this in our demand figures, as it cannot be attributed to a specific industry, and occurred outside measurable investment media such as ETFs. Because the rhodium market is relatively small and illiquid, this purchasing had a very significant impact on prices, which more than doubled during 2017, reaching a six-year peak of \$1,715 at the time of writing.

Looking forward, we expect to see little change to the fundamental supply–demand picture in 2018. Supplies are expected to be flat to slightly down; mine output in South Africa will be impacted by last year’s mine closures, although refined production should be supported by the processing of metal from pipeline stocks. However, this is likely to be the last year in which rhodium output can be sustained in this way, and shipments from South Africa could fall back below 600,000 oz per annum in the near term. Meanwhile, autocatalyst recycling should rise, although at a much lower rate than in 2017.

Light duty gasoline vehicle production by region



Autocatalyst demand for rhodium (gross)



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Demand is expected to be stable in 2018. We do not expect any significant changes in average rhodium loadings on gasoline vehicles this year, so consumption trends will reflect the rate of growth in gasoline car production – forecast at around 2%. These gains will be offset by a fall in rhodium usage on diesel vehicles in Europe, where fewer cars will be equipped with rhodium-containing lean NOx traps.

Beyond 2018, we expect to see an upward trend in rhodium loadings, as legislation tightens in most major automotive markets. In Europe, automakers are predicted to increase rhodium loadings to comply with Euro 6d-TEMP and Euro 6d legislation, which imposes a NOx conformity factor of 2.1 on all new cars starting in 2019. This conformity

factor falls to 1.5 starting in 2020. In North America, fleet average emissions limits will fall steadily over the period to 2025, while China is entering a period of major legislative change with the introduction of China 6a and 6b regulations over the 2020–2023 period. Some provinces are expected to move directly to the stricter 6b limits (although initially without the RDE component), and this will have a significant impact on average rhodium loadings in the coming years.

The prospect of further increases in automotive demand may stimulate further speculative and strategic buying. If this should occur, rhodium availability would remain tight, even though our supply–demand estimates suggest that the market is likely to remain in a modest surplus in 2018.



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PLATINUM '000 oz - Supply and Demand							
2017 Numbers are Preliminary Estimates ⁹							
Supply ¹		2012	2013	2014	2015	2016	2017
	South Africa	4,110	4,208	3,547	4,572	4,392	4,364
	Russia ²	801	736	700	670	703	650
	North America	306	318	339	314	337	318
	Zimbabwe ³	337	410	401	400	489	486
	Others ³	126	174	167	151	162	158
Total Supply		5,680	5,846	5,154	6,107	6,083	5,976
Demand ⁴							
	Autocatalyst ⁴	3,158	2,937	3,057	3,228	3,327	3,285
	Chemical	452	522	576	502	527	521
	Electrical ⁴	176	219	225	228	230	258
	Glass	153	102	143	227	246	306
	Investment	450	871	277	451	620	356
	Jewellery ⁴	2,783	2,984	2,839	2,746	2,412	2,227
	Medical and Biomedical ⁵	223	217	214	215	218	220
	Petroleum	112	146	172	140	176	198
	Other	395	419	434	441	458	475
Total Gross Demand		7,902	8,417	7,937	8,178	8,214	7,846
Recycling ⁶							
	Autocatalyst	-1,120	-1,199	-1,280	-1,112	-1,159	-1,322
	Electrical	-22	-24	-27	-29	-32	-34
	Jewellery	-895	-790	-762	-574	-738	-624
Total Recycling		-2,037	-2,013	-2,069	-1,715	-1,929	-1,980
Total Net Demand ⁷		5,865	6,404	5,868	6,463	6,285	5,866
Movement in Stocks ⁸		-185	-558	-714	-356	-202	110



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PLATINUM '000 oz - Gross Demand by Region

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	1,323	1,280	1,472	1,668	1,821	1,766
	Chemical	110	98	111	120	123	123
	Electrical	17	15	12	13	13	12
	Glass	2	7	11	11	11	11
	Investment	135	-40	-73	-88	109	36
	Jewellery	179	217	204	203	177	174
	Medical and Biomedical	78	74	72	71	71	70
	Petroleum	-3	-12	22	-4	4	14
	Other	115	106	108	105	107	110
	Total	1,956	1,745	1,939	2,099	2,436	2,316
Japan	Autocatalyst	591	503	448	395	391	396
	Chemical	35	42	41	43	41	40
	Electrical	21	27	31	33	32	33
	Glass	-3	-20	-96	4	2	19
	Investment	98	-40	19	700	543	171
	Jewellery	312	310	313	314	310	309
	Medical and Biomedical	20	19	16	16	16	16
	Petroleum	3	-1	3	3	3	2
	Other	63	70	71	79	74	74
	Total	1,140	910	846	1,587	1,412	1,060
N. America	Autocatalyst	395	339	356	368	346	326
	Chemical	106	102	113	114	103	112
	Electrical	21	19	18	22	26	36
	Glass	7	7	10	10	29	45
	Investment	187	57	7	-32	109	127
	Jewellery	187	213	218	227	220	225
	Medical and Biomedical	89	85	85	85	86	87
	Petroleum	46	23	21	40	37	18
	Other	118	122	125	116	121	122
	Total	1,156	967	953	950	1,077	1,098
China	Autocatalyst	93	130	130	136	145	157
	Chemical	89	133	155	131	121	126
	Electrical	31	36	39	38	39	47
	Glass	53	93	144	178	134	109
	Investment	0	0	0	0	0	0
	Jewellery	1,950	2,100	1,935	1,796	1,510	1,303
	Medical and Biomedical	15	17	18	19	19	20
	Petroleum	21	56	30	32	61	81
	Other	40	48	53	58	71	79
	Total	2,292	2,613	2,504	2,388	2,100	1,922
RoW	Autocatalyst	756	685	651	661	624	640
	Chemical	112	147	156	94	139	120
	Electrical	86	122	125	122	120	130
	Glass	94	15	74	24	70	122
	Investment	30	894	324	-129	-141	22
	Jewellery	155	144	169	206	195	216
	Medical and Biomedical	21	22	23	24	26	27
	Petroleum	45	80	96	69	71	83
	Other	59	73	77	83	85	90
	Total	1,358	2,182	1,695	1,154	1,189	1,450
	Grand total	7,902	8,417	7,937	8,178	8,214	7,846



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PLATINUM Tonnes - Supply and Demand							
2017 Numbers are Preliminary Estimates ⁹							
		2012	2013	2014	2015	2016	2017
Supply¹	South Africa	127.8	130.9	110.3	142.2	136.6	135.7
	Russia ²	24.9	22.9	21.8	20.8	21.9	20.2
	North America	9.5	9.9	10.5	9.8	10.5	9.9
	Zimbabwe ³	10.5	12.7	12.5	12.4	15.2	15.1
	Others ³	3.9	5.4	5.2	4.7	5.0	4.9
Total Supply		176.6	181.8	160.3	189.9	189.2	185.8
Demand⁴	Autocatalyst ⁴	98.2	91.2	95.0	100.5	103.6	102.2
	Chemical	14.1	16.3	18.0	15.5	16.4	16.1
	Electrical ⁴	5.5	6.8	7.1	7.1	7.1	8.0
	Glass	4.7	3.2	4.4	6.9	7.7	9.5
	Investment	13.9	27.2	8.6	14.1	19.3	11.1
	Jewellery ⁴	86.6	92.8	88.4	85.5	75.0	69.2
	Medical and Biomedical ⁵	7.0	6.7	6.6	6.6	6.8	6.8
	Petroleum	3.5	4.5	5.4	4.4	5.5	6.2
	Other	12.3	13.1	13.6	13.8	14.2	14.8
Total Gross Demand		245.8	261.8	247.1	254.4	255.6	243.9
Recycling⁶	Autocatalyst	-34.9	-37.3	-39.9	-34.5	-36.1	-41.1
	Electrical	-0.7	-0.7	-0.8	-0.9	-1.0	-1.0
	Jewellery	-27.9	-24.6	-23.7	-17.9	-23.0	-19.4
Total Recycling		-63.5	-62.6	-64.4	-53.3	-60.1	-61.5
Total Net Demand⁷		182.3	199.2	182.7	201.1	195.5	182.4
Movement in Stocks⁸		-5.7	-17.4	-22.4	-11.2	-6.3	3.4



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PLATINUM Tonnes - Gross Demand by Region

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	41.1	39.8	45.8	51.9	56.7	55.0
	Chemical	3.4	3.0	3.5	3.7	3.8	3.8
	Electrical	0.5	0.5	0.4	0.4	0.4	0.4
	Glass	0.1	0.2	0.3	0.3	0.3	0.3
	Investment	4.2	-1.2	-2.3	-2.7	3.4	1.1
	Jewellery	5.6	6.8	6.4	6.3	5.5	5.4
	Medical and Biomedical	2.4	2.3	2.2	2.2	2.2	2.2
	Petroleum	-0.1	-0.4	0.7	-0.1	0.1	0.4
	Other	3.6	3.3	3.4	3.3	3.3	3.4
	Total	60.8	54.3	60.4	65.3	75.7	72.0
Japan	Autocatalyst	18.4	15.6	13.9	12.3	12.2	12.3
	Chemical	1.1	1.3	1.3	1.3	1.3	1.2
	Electrical	0.6	0.8	1.0	1.0	1.0	1.0
	Glass	-0.1	-0.6	-3.0	0.1	0.1	0.6
	Investment	3.0	-1.2	0.6	21.8	16.9	5.3
	Jewellery	9.7	9.6	9.7	9.8	9.6	9.6
	Medical and Biomedical	0.6	0.6	0.5	0.5	0.5	0.5
	Petroleum	0.1	0.0	0.1	0.1	0.1	0.1
	Other	2.0	2.2	2.2	2.5	2.3	2.3
	Total	35.4	28.3	26.3	49.4	44.0	32.9
N. America	Autocatalyst	12.3	10.5	11.1	11.5	10.8	10.1
	Chemical	3.3	3.2	3.5	3.5	3.2	3.5
	Electrical	0.7	0.6	0.6	0.7	0.8	1.1
	Glass	0.2	0.2	0.3	0.3	0.9	1.4
	Investment	5.8	1.8	0.2	-1.0	3.4	4.0
	Jewellery	5.8	6.6	6.8	7.1	6.8	7.0
	Medical and Biomedical	2.8	2.6	2.6	2.6	2.7	2.7
	Petroleum	1.4	0.7	0.7	1.2	1.2	0.6
	Other	3.7	3.8	3.9	3.6	3.8	3.8
	Total	36.0	30.0	29.7	29.5	33.6	34.2
China	Autocatalyst	2.9	4.0	4.0	4.2	4.5	4.9
	Chemical	2.8	4.2	4.8	4.1	3.8	3.9
	Electrical	1.0	1.1	1.2	1.2	1.2	1.5
	Glass	1.6	2.9	4.5	5.5	4.2	3.4
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	60.7	65.3	60.2	55.9	47.0	40.5
	Medical and Biomedical	0.5	0.5	0.6	0.6	0.6	0.6
	Petroleum	0.7	1.7	0.9	1.0	1.9	2.5
	Other	1.2	1.5	1.7	1.8	2.2	2.5
	Total	71.4	81.2	77.9	74.3	65.4	59.8
RoW	Autocatalyst	23.5	21.3	20.2	20.6	19.4	19.9
	Chemical	3.5	4.6	4.9	2.9	4.3	3.7
	Electrical	2.7	3.8	3.9	3.8	3.7	4.0
	Glass	2.9	0.5	2.3	0.7	2.2	3.8
	Investment	0.9	27.8	10.1	-4.0	-4.4	0.7
	Jewellery	4.8	4.5	5.3	6.4	6.1	6.7
	Medical and Biomedical	0.7	0.7	0.7	0.7	0.8	0.8
	Petroleum	1.4	2.5	3.0	2.2	2.2	2.6
	Other	1.8	2.3	2.4	2.6	2.6	2.8
	Total	42.2	68.0	52.8	35.9	36.9	45.0
	Grand total	245.8	261.8	247.1	254.4	255.6	243.9



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PALLADIUM '000 oz - Supply and Demand

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Supply¹	South Africa	2,359	2,464	2,125	2,684	2,574	2,569
	Russia: Primary ²	2,627	2,528	2,589	2,434	2,773	2,652
	Russia: State Stock Sales ²	260	100	0	0	0	0
	North America	811	831	912	874	892	865
	Zimbabwe ³	266	322	327	319	392	381
	Others ³	162	152	160	144	129	130
	Total Supply	6,485	6,397	6,113	6,455	6,760	6,597
Demand⁴	Autocatalyst ⁴	6,673	7,069	7,515	7,622	7,948	8,424
	Chemical	524	378	315	451	425	537
	Dental	510	457	464	468	430	407
	Electrical ⁴	1,190	1,017	970	903	871	853
	Investment	467	-8	943	-659	-646	-386
	Jewellery ⁴	442	354	272	222	191	180
	Other	104	109	111	134	151	137
	Total Gross Demand	9,910	9,376	10,590	9,141	9,370	10,152
Recycling⁶	Autocatalyst	-1,675	-1,899	-2,185	-1,897	-2,001	-2,423
	Electrical	-443	-463	-474	-475	-481	-482
	Jewellery	-194	-157	-89	-46	-21	-21
	Total Recycling	-2,312	-2,519	-2,748	-2,418	-2,503	-2,926
	Total Net Demand⁷	7,598	6,857	7,842	6,723	6,867	7,226
	Movement in Stocks⁸	-1,113	-460	-1,729	-268	-107	-629



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PALLADIUM '000 oz - Gross Demand by Region

		2017 Numbers are Preliminary Estimates ⁹					
		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	1,427	1,502	1,583	1,613	1,640	1,665
	Chemical	79	71	-23	77	80	82
	Dental	81	80	77	70	66	60
	Electrical	151	112	113	101	99	95
	Investment	163	-14	-74	-200	-269	-287
	Jewellery	64	61	60	59	58	57
	Other	24	24	25	27	22	22
	Total	1,989	1,836	1,761	1,747	1,696	1,694
Japan	Autocatalyst	799	782	794	760	792	805
	Chemical	17	18	16	15	15	15
	Dental	220	184	205	227	200	191
	Electrical	320	220	212	231	227	222
	Investment	0	-4	-2	4	-3	-3
	Jewellery	70	70	67	66	64	61
	Other	9	9	9	9	9	9
	Total	1,435	1,279	1,301	1,312	1,304	1,300
N. America	Autocatalyst	1,803	1,770	1,963	2,032	1,956	2,121
	Chemical	87	68	71	76	76	78
	Dental	190	168	156	145	138	130
	Electrical	163	159	140	131	128	124
	Investment	304	10	-205	-181	-71	-19
	Jewellery	44	43	44	41	38	34
	Other	39	43	43	60	46	47
	Total	2,630	2,261	2,212	2,304	2,311	2,515
China	Autocatalyst	1,325	1,499	1,608	1,654	2,036	2,164
	Chemical	213	144	160	208	169	265
	Dental	3	8	8	8	7	7
	Electrical	176	168	170	158	156	156
	Investment	0	0	0	0	0	0
	Jewellery	238	155	78	34	10	9
	Other	14	15	16	17	41	44
	Total	1,969	1,989	2,040	2,079	2,419	2,645
RoW	Autocatalyst	1,319	1,516	1,567	1,563	1,524	1,669
	Chemical	128	77	91	75	85	97
	Dental	16	17	18	18	19	19
	Electrical	380	358	335	282	261	256
	Investment	0	0	1,224	-282	-303	-77
	Jewellery	26	25	23	22	21	19
	Other	18	18	18	21	33	15
	Total	1,887	2,011	3,276	1,699	1,640	1,998
Grand total		9,910	9,376	10,590	9,141	9,370	10,152



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PALLADIUM Tonnes - Supply and Demand							
2017 Numbers are Preliminary Estimates ⁹							
		2012	2013	2014	2015	2016	2017
Supply¹	South Africa	73.4	76.6	66.1	83.5	80.1	79.9
	Russia: Primary ²	81.7	78.6	80.5	75.7	86.3	82.5
	Russia: State Stock Sales ²	8.1	3.1	0.0	0.0	0.0	0.0
	North America	25.2	25.9	28.4	27.2	27.7	26.9
	Zimbabwe ³	8.3	10.0	10.2	9.9	12.2	11.9
	Others ³	5.0	4.7	5.0	4.5	4.0	4.0
Total Supply		201.7	198.9	190.2	200.8	210.3	205.2
Demand⁴	Autocatalyst ⁴	207.5	219.9	233.7	237.0	247.1	262.0
	Chemical	16.3	11.8	9.8	14.1	13.3	16.6
	Dental	15.8	14.1	14.5	14.6	13.4	12.6
	Electrical ⁴	37.1	31.5	30.2	28.1	27.2	26.5
	Investment	14.6	-0.2	29.3	-20.5	-20.1	-12.0
	Jewellery ⁴	13.8	11.0	8.5	6.9	6.0	5.7
	Other	3.2	3.4	3.5	4.2	4.7	4.4
Total Gross Demand		308.3	291.5	329.5	284.4	291.6	315.8
Recycling⁶	Autocatalyst	-52.2	-59.1	-68.0	-59.0	-62.2	-75.4
	Electrical	-13.7	-14.4	-14.8	-14.8	-15.0	-15.0
	Jewellery	-6.0	-4.9	-2.7	-1.4	-0.7	-0.6
Total Recycling		-71.9	-78.4	-85.5	-75.2	-77.9	-91.0
Total Net Demand⁷		236.4	213.1	244.0	209.2	213.7	224.8
Movement in Stocks⁸		-34.7	-14.2	-53.8	-8.4	-3.4	-19.6



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PALLADIUM Tonnes - Gross Demand by Region

		2017 Numbers are Preliminary Estimates ⁹					
		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	44.4	46.7	49.2	50.2	51.0	51.8
	Chemical	2.5	2.2	-0.7	2.4	2.5	2.5
	Dental	2.5	2.5	2.4	2.2	2.1	1.9
	Electrical	4.7	3.5	3.5	3.1	3.1	2.9
	Investment	5.1	-0.4	-2.3	-6.2	-8.4	-8.9
	Jewellery	2.0	1.9	1.9	1.8	1.8	1.8
	Other	0.7	0.7	0.8	0.8	0.7	0.7
	Total	61.9	57.1	54.8	54.3	52.8	52.7
Japan	Autocatalyst	24.8	24.3	24.7	23.6	24.6	25.0
	Chemical	0.5	0.6	0.5	0.5	0.5	0.5
	Dental	6.8	5.7	6.4	7.1	6.2	5.9
	Electrical	10.0	6.8	6.6	7.2	7.1	6.9
	Investment	0.0	-0.1	-0.1	0.1	-0.1	-0.1
	Jewellery	2.2	2.2	2.1	2.0	2.0	1.9
	Other	0.3	0.3	0.3	0.3	0.3	0.3
	Total	44.6	39.8	40.5	40.8	40.6	40.4
N. America	Autocatalyst	56.1	55.1	61.1	63.2	60.8	66.0
	Chemical	2.7	2.1	2.2	2.4	2.4	2.4
	Dental	5.9	5.2	4.9	4.5	4.3	4.0
	Electrical	5.1	4.9	4.4	4.1	4.0	3.8
	Investment	9.5	0.3	-6.4	-5.6	-2.2	-0.6
	Jewellery	1.4	1.3	1.4	1.3	1.2	1.1
	Other	1.2	1.3	1.3	1.9	1.4	1.5
	Total	81.9	70.2	68.9	71.8	71.9	78.2
China	Autocatalyst	41.2	46.6	50.0	51.4	63.3	67.3
	Chemical	6.6	4.5	5.0	6.5	5.3	8.2
	Dental	0.1	0.2	0.2	0.2	0.2	0.2
	Electrical	5.5	5.2	5.3	4.9	4.9	4.9
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	7.4	4.8	2.4	1.1	0.3	0.3
	Other	0.4	0.5	0.5	0.5	1.3	1.4
	Total	61.2	61.8	63.4	64.6	75.3	82.3
RoW	Autocatalyst	41.0	47.2	48.7	48.6	47.4	51.9
	Chemical	4.0	2.4	2.8	2.3	2.6	3.0
	Dental	0.5	0.5	0.6	0.6	0.6	0.6
	Electrical	11.8	11.1	10.4	8.8	8.1	8.0
	Investment	0.0	0.0	38.1	-8.8	-9.4	-2.4
	Jewellery	0.8	0.8	0.7	0.7	0.7	0.6
	Other	0.6	0.6	0.6	0.7	1.0	0.5
	Total	58.7	62.6	101.9	52.9	51.0	62.2
Grand total		308.3	291.5	329.5	284.4	291.6	315.8



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PGM MARKET REPORT FEBRUARY 2018

RHODIUM '000 oz - Supply and Demand

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Supply¹	South Africa	577	554	470	611	615	618
	Russia ²	90	80	80	80	85	65
	North America	22	23	24	22	24	22
	Zimbabwe ³	28	36	36	35	43	40
	Others ³	3	8	7	5	5	5
	Total Supply	720	701	617	753	772	750
Demand⁴	Autocatalyst ⁴	775	753	769	762	822	858
	Chemical	80	79	90	73	64	74
	Electrical	6	5	3	3	3	3
	Glass	35	47	49	52	85	95
	Other	63	87	38	30	39	18
	Total Gross Demand	959	971	949	920	1,013	1,048
Recycling⁶	Autocatalyst	-252	-281	-306	-262	-271	-324
	Total Recycling	-252	-281	-306	-262	-271	-324
	Total Net Demand⁷	707	690	643	658	742	724
	Movement in Stocks⁸	13	11	-26	95	30	26



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PGM MARKET REPORT FEBRUARY 2018

RHODIUM Tonnes - Supply and Demand							
2017 Numbers are Preliminary Estimates ⁹							
		2012	2013	2014	2015	2016	2017
Supply¹	South Africa	17.9	17.2	14.6	19.0	19.1	19.2
	Russia ²	2.8	2.5	2.5	2.5	2.6	2.0
	North America	0.7	0.7	0.7	0.7	0.7	0.7
	Zimbabwe ³	0.9	1.1	1.1	1.1	1.3	1.2
	Others ³	0.1	0.2	0.2	0.2	0.2	0.2
Total Supply		22.4	21.7	19.1	23.5	23.9	23.3
Demand⁴	Autocatalyst ⁴	24.1	23.4	23.8	23.7	25.5	26.7
	Chemical	2.5	2.5	2.9	2.3	2.0	2.3
	Electrical	0.2	0.0	0.0	0.0	0.0	0.0
	Glass	1.0	1.4	1.5	1.7	2.6	3.0
	Other	2.0	2.8	1.2	1.0	1.3	0.6
Total Gross Demand		29.8	30.1	29.4	28.7	31.4	32.6
Recycling⁶	Autocatalyst	-7.8	-8.7	-9.5	-8.2	-8.4	-10.1
	Total Recycling	-7.8	-8.7	-9.5	-8.2	-8.4	-10.1
Total Net Demand⁷		22.0	21.4	19.9	20.5	23.0	22.5
Movement in Stocks⁸		0.4	0.3	-0.8	3.0	0.9	0.8



PGM MARKET REPORT FEBRUARY 2018

IRIDIUM '000 oz - Demand							
2017 Numbers are Preliminary Estimates ⁹							
Demand		2012	2013	2014	2015	2016	2017
	Chemical	19	21	22	22	23	23
	Electrical	28	35	49	89	112	88
	Electrochemical	73	41	39	41	44	69
	Other	75	68	71	77	81	84
Total Demand		195	166	182	228	259	264

IRIDIUM Tonnes - Demand							
2017 Numbers are Preliminary Estimates ⁹							
Demand		2012	2013	2014	2015	2016	2017
	Chemical	0.6	0.7	0.7	0.7	0.7	0.7
	Electrical	0.9	1.1	1.5	2.8	3.5	2.7
	Electrochemical	2.3	1.3	1.2	1.3	1.4	2.2
	Other	2.3	2.1	2.2	2.4	2.5	2.6
Total Demand		6.1	5.2	5.7	7.1	8.1	8.2

PGM MARKET REPORT FEBRUARY 2018

RUTHENIUM '000 oz - Demand

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Demand	Chemical	134	321	332	444	340	419
	Electrical	247	336	361	458	433	438
	Electrochemical	172	145	136	151	172	188
	Other	79	105	108	149	154	160
Total Demand		632	908	936	1,202	1,100	1,204

RUTHENIUM Tonnes - Demand

2017 Numbers are Preliminary Estimates⁹

		2012	2013	2014	2015	2016	2017
Demand	Chemical	4.2	10.0	10.3	13.8	10.6	13.0
	Electrical	7.7	10.5	11.2	14.3	13.5	13.6
	Electrochemical	5.3	4.5	4.2	4.7	5.4	5.8
	Other	2.5	3.3	3.4	4.6	4.8	5.0
Total Demand		19.7	28.2	29.1	37.4	34.2	37.5



NOTES TO TABLES

¹**Supply** figures represent estimates of sales by the mines of primary pgm and are allocated to where the initial mining took place rather than the location of refining.

²Our **Russian supply** figures represent the total pgm sold in all regions, including Russia and the CIS. Demand in Russia and the CIS is included in the Rest of the World region. Russian supply figures for palladium have been split into sales from primary mining and sales of stocks.

³Supplies from **Zimbabwe** have been split from Others' supplies. Platinum group metals mined in Zimbabwe are currently refined in South Africa, and our supply figures represent shipments of pgm in concentrate or matte, adjusted for typical refining recoveries.

⁴**Gross demand** figures for any given application represent the sum of manufacturer demand for metal in that application and any changes in unrefined metal stocks in that sector. Increases in unrefined stocks lead to additional demand, reductions in stock lead to a lower demand figure.

⁵Our **Medical and Biomedical** category represents combined metal demand in the medical, biomedical and dental sectors.

⁶**Recycling** figures represent estimates of the quantity of metal recovered from open loop recycling (i.e. where the original purchaser does not retain control of the metal throughout). For instance, autocatalyst recycling represents the weight of metal recovered from end-of-life vehicles and aftermarket scrap in an individual region, allocated to where the car was first registered, rather than where the metal is finally recovered. These figures do not include warranty or production scrap. Where no recycling figures are given, open loop recycling is negligible.

⁷**Net demand** figures are equivalent to the sum of gross demand in an application less any metal recovery from open loop scrap in that application, whether the recycled metal is reused in that industry or sold into another application. Where no recycling figure is given for an application, gross and net demand are identical.

⁸**Movements in stocks** in any given year reflect changes in stocks held by fabricators, dealers, banks and depositories but excluding stocks held by primary refiners and final consumers. A positive figure (sometimes referred to as a 'surplus') reflects an increase in market stocks. A negative value (or 'deficit') indicates a decrease in market stocks.

⁹**Figures for 2017 are preliminary estimates.**



GLOSSARY

ASC	Ammonia slip catalyst
CF	Conformity factor
CO	Carbon monoxide
CO ₂	Carbon dioxide
DOC	Diesel oxidation catalyst
DPF	Diesel particulate filter
EEC	European Economic Community
ELV	End-of-life vehicle
ETF	Exchange traded fund
FCEV	Fuel cell electric vehicle
GPF	Gasoline particulate filter
HC	Hydrocarbon
HDD	Heavy duty diesel
LAB	Linear alkyl benzene
LDG	Light duty gasoline
LDD	Light duty diesel
LEV	Low emission vehicle
LNT	Lean NOx trap
NOx	Oxides of nitrogen
NO	Nitrogen monoxide
NO ₂	Nitrogen dioxide
NRMM	Non-road mobile machinery
NYMEX	New York Mercantile Exchange
PM	Particulate matter or soot
PN	Particle number
PNA	Passive NOx adsorber
ppm	Parts per million
PTA	Purified terephthalic acid
PX	Paraxylene
RDE	Real driving emissions
RoW	Rest of World region
SCR	Selective catalytic reduction
SGE	Shanghai Gold Exchange
SUV	Sports utility vehicle

EMISSIONS LEGISLATION: LIGHT DUTY

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026					
N America (EPA)	Tier 2						Tier 3															
N America (CARB)	LEV II			LEV III phase-in																		
Europe	Euro 5	Euro 5b/b+		Euro 6b		Euro 6c / Euro 6d-TEMP												Euro 6d				
Japan	Japan 2009 (JC08)						Japan 2018 (WLTC)															
China gasoline (Beijing)	China 4		China 5																			
China gasoline (Nationwide)	China 3	China 4		China 5														China 6a		China 6b		
China diesel (Nationwide)	China 3		China 4		China 5														China 6a		China 6b	
India (Main cities)		BS 4															BS 6					
India (Nationwide)	BS 2	BS 3		BS 4		BS 6																
Russia	Euro 4		Euro 5																			
Brazil	PROCONVE L5		PROCONVE L6																			
S Korea gasoline	K-LEV II			K-LEV III phase-in															PROCONVE L7 (to be confirmed)			
S Korea diesel	Euro 5		Euro 6b		Eu 6d-TEMP		Euro 6d															
Thailand	Euro 3	Euro 4															Euro 5					

Dates shown are for New Vehicle Type Approvals for passenger cars. China dates are subject to frequent change; dates shown represent best available current view.



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EMISSIONS LEGISLATION: HEAVY DUTY DIESEL

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		
North America	EPA10			GHG Regulation Phase 1											GHG Regulation Phase 2				
Europe	Euro V			Euro VI															
Japan	Japan 2009			Japan 2016 (WHTC)															
China (Beijing / main cities)	China IV			Beijing V			BJ VI+ Jan 2016 China V Apr 2016 11 provinces			Beijing VI (expected)			China VI a and VI b main cities - dates TBC						
China (Nationwide)	China III			China IV			China V			China VIa			China VIb						
India (Main cities)				BS IV			BS VI (expected)												
India (Nationwide)	BS II		BS III			BS IV			BS VI (expected)										
Russia	Euro IV			Euro V															
Brazil	PROCONVE P6			PROCONVE P7													PROCONVE P8 (TBC)		
S Korea	Euro V			Euro VI															

China dates are subject to frequent change; dates shown represent best available current view.



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