Summary of Platinum SUPPLY & DEMAND IN 2016

SUMMARY: PLATINUM

- Lower South African supplies were offset by higher sales from Russia and Zimbabwe.
- Chinese jewellery recycling was up, but weak steel prices limited growth in auto scrap recoveries.
- Autocatalyst demand for platinum rose by 2%, with European consumption at eight-year highs.
- Industrial demand reached a five-year peak, with strong buying by Chinese companies.
- Chinese jewellery demand fell by 16%, with lower retail sales and destocking by distributors.
- Weak yen prices and a large discount to gold supported Japanese investment demand.

The platinum market remained in deficit for a fifth consecutive year in 2016, but the gap between supply and demand narrowed significantly, to just over 200,000 oz. Primary supplies were flat, despite stronger than expected sales from Russia, while there was growth in both autocatalyst and industrial consumption. Investment demand was the highest for three years, with exceptionally strong sales of platinum bars to Japanese purchasers. However, this was more than offset by a sharp contraction in jewellery fabrication in China, in response to lower retail sales and excess stocks in the distribution chain. With Chinese jewellery makers sourcing a greater proportion of their platinum from recycling, net world demand for platinum in jewellery fell by nearly a quarter.

As we noted in our previous report, the last two years have seen a significant transfer of market stocks of platinum into the hands of Asian buyers. During 2015 and 2016, Japanese investors added more than a million ounces to their holdings of platinum bars, taking advantage of weak yen-denominated prices and an unusually large discount to gold. Meanwhile, analysis of trade statistics suggests that platinum inventories held in vaults in the UK and Switzerland continue to fall (see graph on page 2). This movement of metal out of market stocks and into the hands of identified buyers is consistent with our estimates of supply and demand, which show that the market has consistently been in fundamental deficit in recent years.

Primary supplies of platinum were little changed in 2016, at 6.10 million oz. Shipments from South Africa declined by 4%, as net destocking by platinum producers fell sharply after two years of significant stock sales, but the expected fall in Russian deliveries did not materialise. Output at Norilsk Nickel was supplemented by shipments of platinum from stocks of refined metal accumulated during 2015, leaving Russian supplies up 8%. Shipments by North American and Zimbabwean producers were also supported by the release of metal from in-process and refined stocks.

We estimate that South African producers sold a net 70,000 oz of platinum from inventory last year, a steep fall compared to the 2014–2015 period during which we estimate that at least 650,000 oz of metal were supplied from stocks. Nevertheless, producers continue to mobilise their inventories where possible, to support cash flow during a period when both prices and mine output have been lacklustre. For example, a smelter clean-up enabled Lonmin to recover around 73,000 oz of platinum from the reprocessing of refractory bricks, slag and other materials, while Anglo American Platinum sold 70,000 oz of platinum from refined inventories. These stock reductions were partly offset by some modest increases elsewhere: Anglo saw an increase in pipeline inventories following a run-out at its Waterval smelter, while Northam began to build stocks of ore and concentrate ahead of the commissioning of a new smelter due in late 2017.

Platinum Supply and Demand '000 oz

Supply	2015	2016	2017
South Africa	4,571	4,392	4,383
Russia	670	723	668
Others	868	988	960
Total Supply	**6,109**	**6,103**	**6,011**
Gross Demand			
Autocatalyst	3,264	3,318	3,164
Jewellery	2,824	2,446	2,341
Industrial	1,732	1,843	1,881
Investment	451	620	220
Total Gross Demand	**8,271**	**8,227**	**7,606**
Recycling	-1,713	-1,922	-1,897
Total Net Demand	**6,558**	**6,305**	**5,709**
Movements in Stocks	-449	-202	302

Johnson Matthey
Precious Metals Management

“Movement of platinum out of market stocks is consistent with a market in fundamental deficit in recent years.”

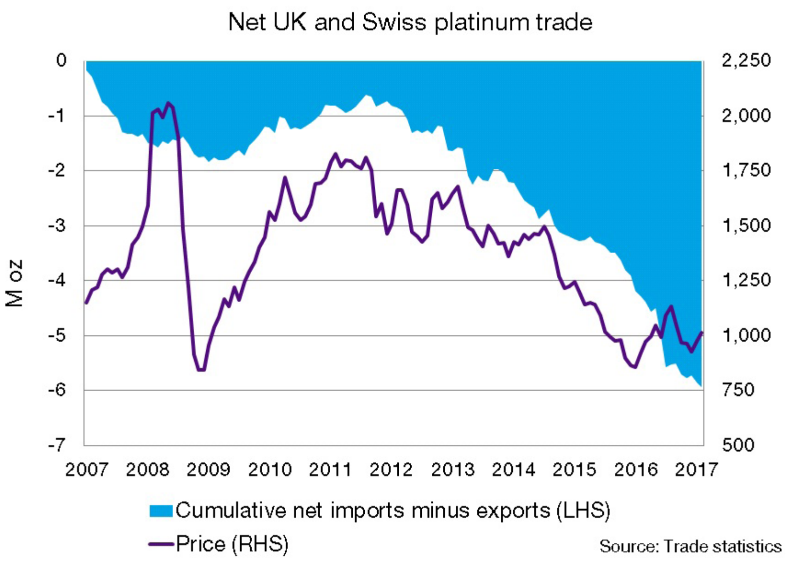
Excluding stock movements, underlying mine production in South Africa fell marginally in 2016. While most platinum operations reported stable or increased production, the three large mining complexes in the Rustenburg area all experienced a difficult year, due to a combination of further shaft closures, safety stoppages, ground conditions, and accidental damage to infrastructure.

Impala Platinum’s Rustenburg lease area was hit by two major incidents in 2016. In January, an underground fire at 14 Shaft caused extensive damage to the lower section of the mine, resulting in a loss of nearly 80,000 oz of platinum output; four months later, in May 2016, a serious fall-of-ground incident occurred at 1 Shaft, affecting production for several weeks. While there were no further incidents on this scale in the second half, safety stoppages continued to weigh upon productivity, with Impala reporting that it had lost around 25,000 oz of platinum due to Section 54 notices in the July to December period alone. These losses were partly mitigated by progress with commissioning and ramp-up at two new mining complexes, 16 Shaft and 20 Shaft, leaving full-year refined platinum output from the Impala lease area down 4% at 620,000 oz.

“Underlying mine production of platinum in South Africa fell marginally in 2016.”

Lonmin’s Marikana operation saw an 11% drop in the quantity of ore treated by its concentrator plants during 2016, as mining activities were wound down at several shafts that are slated for closure once remaining ore reserves have been extracted. The company also reported the loss of around 590,000 tonnes of ore production (equivalent to around 38,000 oz of platinum) due to safety stoppages, although this represented a significant improvement in the stoppage rate compared to the previous year. Output of platinum in concentrate from Lonmin’s mining operations totalled 656,000 oz, a decline of 7% compared with 2015. This figure includes metal from the Pandora joint venture, which is mined and processed by Lonmin. It was announced in November 2016 that the company had agreed to purchase Anglo American’s 42.5% share in Pandora, taking its stake in the project to 92.5%.

At the Rustenburg group of mines, ownership of which was transferred from Anglo American Platinum to Sibanye on 1st November 2016, production fell sharply in the first half due to a combination of safety stoppages and difficult ground conditions, before improving steadily during the third and fourth quarters. For the year as a whole, output fell by 4% to 460,000 oz.



Declines at these large western Bushveld mines were partly offset by an improved performance at most other operations, several of which reported record production levels. These included the Kroondal mine, now jointly owned by Anglo American and Sibanye, and the Two Rivers joint venture between Impala and African Rainbow Minerals, which recorded gains of 4% and 7% respectively. At Anglo’s wholly-owned Mogalakwena mine, output of platinum in concentrate exceeded 400,000 oz for the first time, while Northam’s Booysendal North project completed its ramp-up, delivering over 100,000 oz of platinum.

"Declines at the large western Bushveld mines were partly offset by improvements at most other South African operations."

Elsewhere, Royal Bafokeng Platinum reported an 11% jump in platinum output, with improved mining volumes at the established BRPM operation, and additional tonnage from on-reef development activities at the new Styldrift mine. At Anglo's Amandelbult mines, production of platinum in concentrate rose by 7%, reflecting efficiency improvements at the underground operations, and the start-up of a new UG2 open-cast section. The company's Union section also reported a 7% increase in platinum output, to 151,000 oz. The sale of the latter to Siyanda Resources was agreed in February 2017; as part of the deal, Anglo will continue to refine the mine's pgm output, initially under a concentrate purchase agreement and thereafter on toll treatment terms.

One new project entered production in 2016: Platinum Group Metals Limited's Maseve mine, adjacent to BRPM on the western Bushveld. The mine produced its first concentrate in February 2016, but underground development and mining rates have fallen well behind plan and output totalled under 20,000 oz of combined pgm and gold (4E) in concentrate last year.

"Shipments of platinum from Norilsk Nickel's Russian mining operations rose 15% in 2016."

Overall, production losses due to shaft closures, safety stoppages and technical incidents outweighed gains from improved efficiencies and the ramp-up of new mines and shafts. With sales from inventory also falling, total supplies from South African producers declined by 4% to 4.39 million oz.

Production of pgm from Norilsk Nickel's Russian operations had been expected to fall in 2016, as a result of the reconfiguration of downstream processing facilities, including the closure of the old nickel smelter at the Norilsk mine site and the transfer of most nickel and pgm processing activities to the Kola peninsula. This was forecast to result in a temporary decline in output, due to an increase in the amount of unrefined metal in the processing pipeline.

However, while nickel output from the company's Russian operations fell by 11%, in line with expectations, the company significantly exceeded its targets for refined pgm production. Platinum output from Russian ores was flat in 2016, while palladium output fell by only 2%; it appears that output was supported by the refining of pgm-containing materials recovered during the decommissioning of the nickel and pgm plants at Norilsk.

Furthermore, Norilsk had accumulated some refined pgm inventory in 2015, in anticipation of disruption to production during the restructuring of its processing operations. While the expected fall in output did not occur, the company nevertheless sold this metal during 2016. Overall, we estimate that shipments of platinum by Norilsk Nickel from its Russian mining operations rose by 15% to just over 660,000 oz.

Supplies of platinum from alluvial mining in the Far East of Russia peaked in the mid-2000s, and have since been in steady retreat, reflecting the gradual depletion of these deposits which have now been worked for around two decades. In 2016, the decline accelerated, with output falling by about a third to around 60,000 oz. This fall partly offset higher sales from Norilsk, leaving total Russian shipments up 8% at 723,000 oz.

North American platinum supplies rose by 7% to 338,000 oz, reflecting higher sales of primary pgm by Stillwater Mining Company, and a small increase in by-product platinum output from the Canadian nickel miners.

Johnson Matthey
Precious Metals Management

"Supplies of platinum from Zimbabwe grew by 22% to reach 489,000 oz, an all-time high."

Stillwater reported a 6% increase in platinum output to 125,000 oz from its mines in Montana, USA, reflecting higher mill throughput and improved grades. Sales fell slightly behind reported production, at 119,000 oz, as metal was put to stock for the second year running. In December 2016, it was announced that Sibanye Gold Limited had reached an agreement to acquire the Stillwater Mining Company for $2.2 billion; the transaction was completed in early May 2017. Elsewhere in the USA, small amounts of pgm are produced as a by-product of nickel-copper mining, notably at Lundin Mining's Eagle Mine in Michigan, where the pgm content of the ore is relatively high – up to 1.5 grams per tonne combined platinum and palladium. We estimate that output of pgm in concentrate exceeded 20,000 oz in 2016.

Supplies from Zimbabwe rose by 22% to reach 489,000 oz in 2016, an all-time high. Most of this gain came from the country's largest pgm producer, Zimplats, where output of platinum in matte rose by more than a third to just under 300,000 oz. (Of this, around 20,000 oz was derived from the processing of stockpiled material that accumulated during a smelter outage in 2015). Since the partial collapse of its Bimha mine in August 2014, Zimplats has executed a highly successful turnaround programme, involving the redevelopment of unaffected parts of Bimha, the reopening of open-cast operations, and the ramp-up of production from the new Mupfuti Mine. As a result, mill throughput rose by 14% to a record 6.6 million tonnes in 2016.

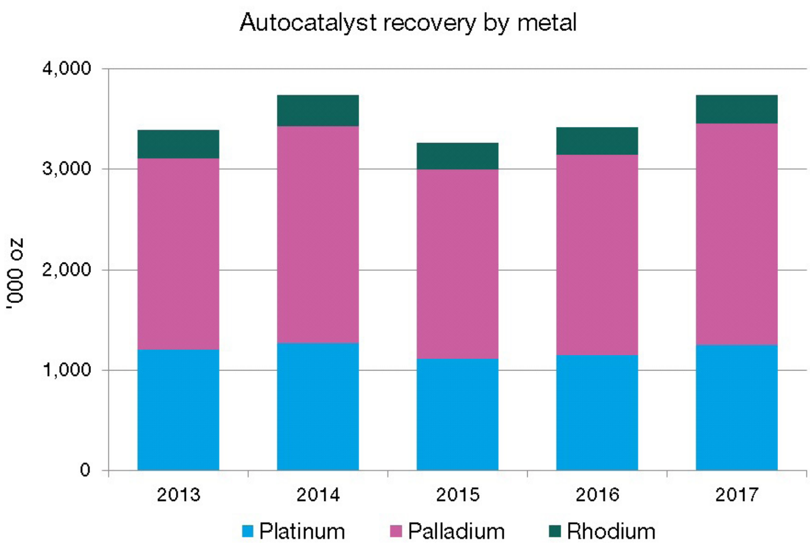
Zimbabwe's two smaller producers also had a record year. Anglo American's Unki mine benefited from a debottlenecking programme at its concentrator plant, while the Mimosa joint venture between Impala and Sibanye also increased mill throughput to a new high.

"Recovery of secondary platinum rose by 12%, largely due to a surge in jewellery recycling in China."

Supplies of platinum from other countries rose modestly. The Kevitsa mine in Finland, acquired by Boliden in mid-2016, had a strong year, with platinum output estimated at around 37,000 oz. There was also an increase in production in Colombia, where platinum is extracted by small-scale alluvial operations, mainly in the Chocó area.

While primary supplies were flat last year, the recovery of platinum from secondary materials rose by 12% to 1.92 million oz, primarily because of a surge in jewellery recycling in China, where disappointing retail sales led to some destocking in the distribution chain. The second half of 2015 had seen growth in inventories held by Chinese manufacturers, wholesalers and retailers; however, when the anticipated consumer demand failed to materialise during 2016, some excess stocks were returned to be reworked into new jewellery items.

Recycling was also affected by some overall contraction in the number of retail jewellery outlets in China. The strength of the Chinese jewellery sector is highly dependent upon demand for gold from private consumers: this market has been negatively affected by factors including a slowdown in economic growth and government anti-corruption measures which have hit sales of



Platinum Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Europe	1,662	1,778	1,664	-473	-495	-551	1,189	1,283	1,113
Japan	413	391	359	-62	-66	-68	351	325	291
North America	390	365	336	-460	-470	-502	-70	-105	-166
China	136	155	156	-16	-17	-18	120	138	138
Rest of World	663	629	649	-99	-104	-108	564	525	541
Total	**3,264**	**3,318**	**3,164**	**-1,110**	**-1,152**	**-1,247**	**2,154**	**2,166**	**1,917**

gold bars and ornaments. This in turn has led to the closure of some jewellery stores. Stocks from these closures are sometimes distributed to other outlets in the same network but, where this is not possible, unsold jewellery is returned to manufacturers.

In contrast, recoveries of platinum from autocatalyst scrap remained subdued last year. We estimate that 1.15 million oz of platinum were refined from spent catalytic converters, an increase of 4% on the previous year, but still well below the peak of nearly 1.3 million oz recorded in 2014.

In theory, platinum returns from the processing of automotive scrap should be rising rapidly at the moment, reflecting significant increases in diesel catalyst loadings since the mid-1990s at a time when diesel car sales in Europe were rising rapidly. However, with steel and pgm prices weak, vehicle scrappage rates remained subdued in 2016, particularly in Europe and North America, while there was also some hoarding of end-of-life vehicles (ELVs), catalysts and refined metal by participants at different points in the recycling chain. This is discussed in more detail on page 22.

"The amount of platinum recovered was boosted by increasing quantities of highly loaded diesel scrap in Europe."

Nevertheless, there was some modest improvement in catalyst scrap volumes during the second half of last year, while the amount of platinum recovered was also boosted by increasing quantities of highly-loaded diesel scrap being collected in Europe. The latter region has overtaken North America to become the largest source of platinum from autocatalyst scrap.

The greater availability of diesel scrap has resulted in some capacity issues for recyclers: silicon carbide, used as a substrate for most diesel particulate filters, is more difficult to treat than the ceramic or metal substrates that are used for most other catalytic converters. This material needs to be treated under oxidising conditions, whereas most European scrap smelters use arc furnaces which operate under reducing conditions. Thus, there has been a temporary shortage of local capacity to treat some types of diesel scrap, which has probably contributed to longer shipment and processing times.

"The gap between platinum supply and demand narrowed significantly in 2016."

Outside Europe, absolute growth was more modest; in these regions, the autocatalyst recycling market is dominated by gasoline scrap, which is becoming increasingly palladium-rich. It should be noted that we have revised our estimates of Chinese recycling volumes for all pgm, in line with new information suggesting that the average pgm loading on spent catalyst is lower than we had previously assumed (see page 22 for further information).

A combination of steady primary sales and higher secondary supplies resulted in an increase in total platinum shipments, up 3% to 8.03 million oz. At the same time, gross demand fell slightly – down 0.5% to 8.23 million oz – as weakness in the platinum jewellery market offset gains in the autocatalyst, industrial and investment sectors. Thus, while the market remained in deficit, the gap between supply and demand narrowed for a second consecutive year.

Platinum Demand: Jewellery '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Europe	203	177	177	-5	-5	-5	198	172	172
Japan	314	306	300	-256	-241	-227	58	65	73
North America	235	230	234	-11	-3	0	224	227	234
China	1,796	1,510	1,405	-298	-485	-380	1,498	1,025	1,025
Rest of World	276	223	225	-4	-4	-4	272	219	221
Total	**2,824**	**2,446**	**2,341**	**-574**	**-738**	**-616**	**2,250**	**1,708**	**1,725**

Between 2012 and 2015, Chinese jewellery demand was at historically strong levels of between 1.8 and 2.1 million ounces per annum, underpinning large deficits in the platinum market in each of these years. However, last year saw a distinct softening of demand for platinum jewellery from Chinese wholesalers, retailers and consumers: as a result, gross sales of platinum to fabricators slumped by 16% to 1.51 million oz.

"Last year saw a distinct softening of Chinese demand for platinum jewellery."

Although the year began strongly, purchasing levels deteriorated as the year progressed, falling significantly behind the previous-year period during the second half. Buoyant platinum demand between mid-2015 and early 2016 was partly driven by manufacturer and retail stocking; however, when consumer sales failed to meet expectations over the Chinese New Year period, retailers and wholesalers were left with a large inventory overhang which caused them to slash their orders to jewellery fabricators. In addition, it appears that some apparent 'jewellery' purchasing during the first half of 2016 was, in fact, speculative buying of metal intended for future supply to the jewellery industry. We do not count this as jewellery demand until the metal moves into the hands of manufacturers.

Market weakness has been confirmed by Johnson Matthey's 2016 surveys of Chinese jewellery makers. Based on this research, we estimate that in the January to June period, fabrication of platinum jewellery shrank by at least 10% compared to the same period of 2015; in the second half, output fell by over 20% versus the same period of the previous year. Overall, we estimate that manufacturing volumes fell by 16%.

While jewellery fabricators describe business conditions as unusually challenging, it is likely that these figures overstate the extent of weakness in the underlying retail platinum jewellery market. As noted above, there was significant restocking activity in the second half of 2015, effectively bringing forward demand that would otherwise have occurred last year. Nevertheless, it is clear that the Chinese jewellery industry is enduring a particularly sharp downturn, with yellow gold affected to an even greater degree than platinum: the result has been a reduction in showroom opening hours and counter space, the closure of some retail outlets and, in consequence, a significant contraction in volumes of inventory held in the distribution chain.

"European platinum jewellery demand was hit by poor sales of Swiss watches to China."

Demand for platinum has also been affected by an increase in the manufacturing and retail stocking of karat gold (mainly 18K) items, which are priced per piece rather than on the basis of metal weight, allowing higher margins to be realised. This trend appears to have been encouraged by changes in consumer behaviour, and in particular a move away from buying a single high-value jewellery item in favour of multiple purchases of lower-value, less ostentatious pieces that can be coordinated with different outfits. Karat gold jewellery is typically lighter and less expensive than similar platinum items, and can be produced in a wider range of colours and designs.

Platinum jewellery fabrication was also weak in other markets in 2016. European demand has been hit by poor sales of Swiss watches to China, where government anti-corruption

“Demonetisation had a significant impact on many sectors in India, including platinum jewellery.”

measures have affected purchasing of luxury items; the number of platinum watch cases hallmarked fell by over 40% last year. In addition, Europe has also seen a fashion trend away from white jewellery and towards yellow and rose gold. Platinum remains popular in the UK, but uncertainty created by ‘Brexit’ led some retailers to delay restocking.

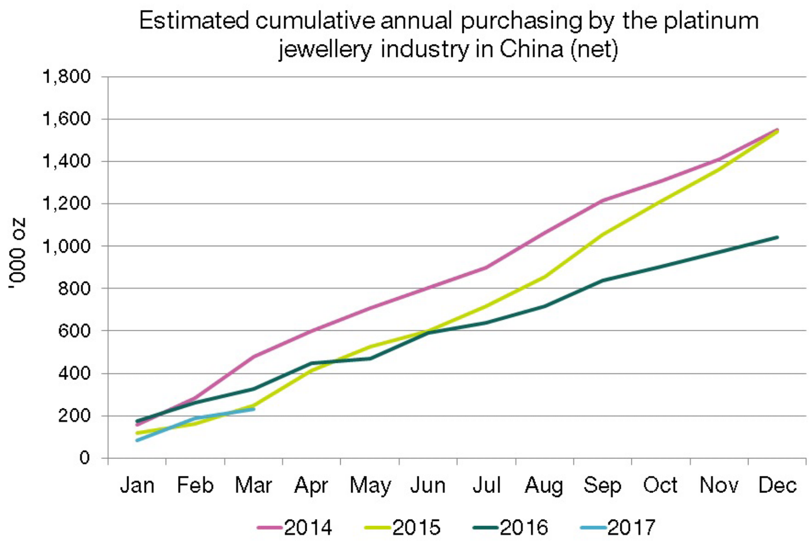
In Japan and North America, the weak platinum price has generally been supportive of demand, allowing fabricators to introduce new products at attractive price points. However, this has been outweighed by negative factors: in Japan, the marriage rate is falling, while the US market has been affected by political uncertainty surrounding the November 2016 presidential election. In addition, there has been some increased ‘offshoring’ by US jewellery manufacturers, with trade statistics confirming an increase of platinum rings from Mexico.

We had expected the Indian market to represent a bright spot for jewellery demand in 2016. However, fabrication was affected by several negative shocks during the year, which gradually wiped out expected gains.

During the early part of the year, the industry suffered ongoing impacts from catastrophic flooding in the Chennai area in late 2015, which caused the postponement of some weddings and damaged jewellery sales in a region which has, in recent years, accounted for around one-fifth of the Indian platinum jewellery market. Next, fabrication was disrupted by nationwide industrial action: jewellers went on strike during March and April in protest at a proposed 1% increase in excise duty on non-silver jewellery (the government subsequently reversed its decision). Finally, expectations of better demand in the second half of 2016 were dashed by the government’s announcement on 8th November of a ‘demonetisation’ policy under which high-denomination currency notes lost their status as legal tender.

“Worldwide sales of platinum to jewellery fabricators dropped to the lowest level since 2011.”

Demonetisation had a significant short-term impact on many sectors of the Indian economy, in particular those which relied heavily on cash transactions, including the jewellery business. It also had a more general effect on consumer behaviour: as cash shortages occurred and queues formed to exchange old bank-notes, consumers prioritised shopping for essential goods over luxuries, leading to a sharp decline in footfall at jewellery stores. However, because the demonetisation policy was enacted close to the year end, it is likely that the negative impact on demand will be spread between 2016 and 2017.



With a series of damaging impacts arriving in quick succession, the platinum jewellery industry had no opportunity to recover before the year end, and we now believe that demand contracted. As a result of falls in both India and China, worldwide gross sales of platinum to jewellery fabricators dropped by 13% to 2.45 million oz, the lowest level since 2011.

In contrast to the jewellery sector, the other sectors saw rising demand last year. The use of platinum in autocatalysts rose 2% to 3.32 million oz in 2016. European demand surged by 7% to 1.78 million oz, the highest level since 2008, but

By the end of 2016, all new diesel cars sold in Europe were equipped with Euro 6b aftertreatment.

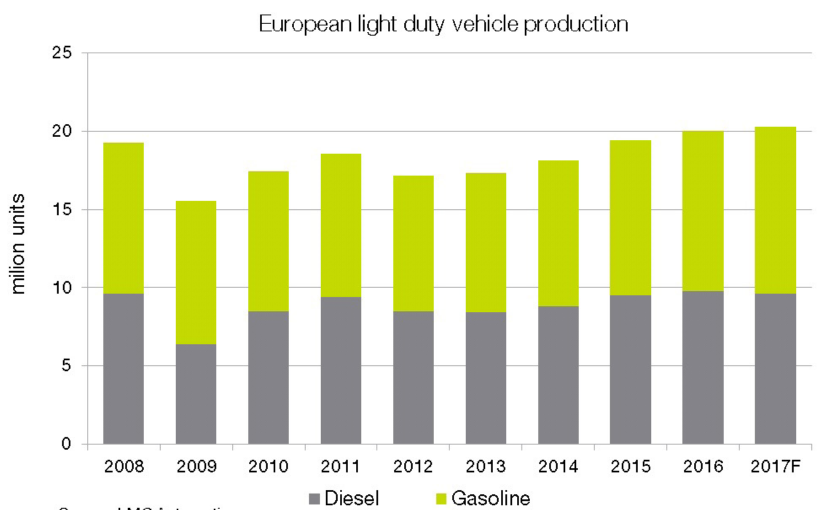
this was partly offset by a dip in demand in North America, where sales of heavy trucks declined sharply, and in India, where sales of diesel cars in the capital city were hit by legislative and tax measures.

Europe accounts for over half of all platinum usage on vehicles, because of its large diesel passenger car market and strict emissions legislation. Last year saw a third consecutive year of growth in light duty diesel (LDD) production, up 2.5% to a nine-year high of 9.76 million vehicles. This increase was recorded in spite of some loss of market share to gasoline engines. Erosion of diesel share has been most significant in those European markets such as France and Spain where diesel has, in recent years, dominated passenger car sales. Lower fuel prices have tended to reduce diesel's advantage in terms of reduced running costs, especially for smaller cars; at the same time, automakers are offering a wider range of new, downsized, fuel-efficient gasoline engines in smaller car segments. These small gasoline models have taken a disproportionate share of recent market growth.

The increase in diesel car output was accompanied by a rise of around 6% in the average platinum content of a European diesel catalyst system. The roll-out of Euro 6b standards is now complete: these limits were first applied to new models in September 2014 and have since been extended to all new passenger cars (September 2015) and all light commercial vehicles (September 2016). Thus, by the end of last year, all new light duty diesel vehicles sold in Europe were equipped with Euro 6b aftertreatment systems. We expect loadings in 2016 to represent the peak in this cycle of European emissions legislation.

Euro 6b legislation has compelled NOx aftertreatment on the vast majority of new European diesel cars.

Euro 6b legislation mandates a 56% reduction in NOx emissions versus the previous stage of legislation, and has compelled automakers to add NOx aftertreatment to the vast majority of European diesel cars. These aftertreatment systems fall into two broad categories depending on whether they achieve NOx control using a platinum-rich lean NOx trap (LNT), usually combined with a pgm-coated diesel particulate filter (DPF), or via non-pgm selective catalytic reduction (SCR) technology in conjunction with a pgm-rich diesel oxidation catalyst (DOC) and a DPF. Demand for both NOx treatment technologies increased during 2016 as automakers complied with Euro 6b. The main reason for higher platinum loadings in 2016 was this increased use of LNTs; these systems typically contain more pgm than Euro 5 systems and are also more highly loaded than Euro 6b systems based on SCR for NOx control. A detailed discussion of European diesel catalyst technology can be found on page 20 of our November 2016 report, which can be downloaded from www.platinum.matthey.com.



Source: LMC Automotive

North America also saw notable gains in the use of platinum on light duty diesel catalyst systems last year. Production rose by 7% to an all-time high of around 830,000 vehicles, while platinum demand increased by 8%. The catalyst systems used on US light diesel vehicles have an unusually high average pgm content, because diesel engines are favoured for the largest and heaviest passenger trucks and SUVs.

Johnson Matthey
Precious Metals Management

"The Indian diesel car market battled strong headwinds."

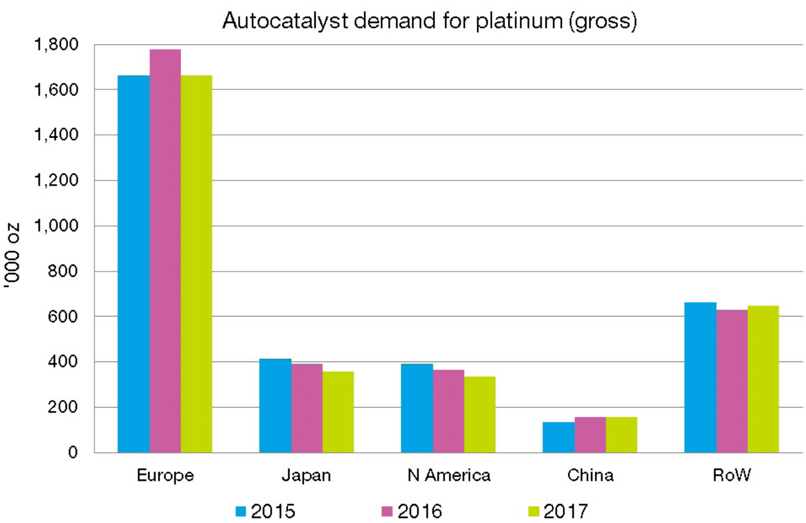
In contrast, there was a modest decline in platinum consumption on diesel cars in the Rest of World region. The Indian diesel market battled strong headwinds, as consumers responded to a narrowing of the price gap between gasoline and diesel fuel, and government measures to limit sales of diesel vehicles in the country's National Capital Region (NCR, covering Delhi and the surrounding area). A ban on sales of larger diesel cars and SUVs was enforced in the NCR throughout the first half of 2016, subsequently being replaced by a higher rate of sales tax. The registration of new diesel taxis in the NCR has also been prohibited. The result was a steep fall in sales of diesel cars, which in turn caused Indian automakers to slash their output of light duty diesel vehicles by 18.5% to 1.41 million units. However, with platinum loadings on Indian cars still relatively light (the current stage of legislation is equivalent to Euro 4), the impact on demand was rather limited.

Overall, demand from the light duty diesel sector rose by 5% to nearly 2.4 million oz. In contrast, other vehicle segments saw stable or reduced platinum consumption last year. Platinum usage on catalysts fitted to non-road mobile machinery saw strong growth in the 2010–2015 period, but was little changed in 2016. In the gasoline sector (including motorcycles), the use of platinum fell by 11% to under 300,000 oz, as Japanese car companies continued to thrift the pgm content of their catalyst systems and replaced some platinum with palladium. Demand for platinum in the heavy duty sector also dipped, due mainly to a steep drop in demand in North America. US haulage firms scaled back their vehicle purchasing plans in response to lacklustre demand for transporting freight, leaving dealers with high inventory levels, and causing truck manufacturers to cut output by 16%.

"Autocatalyst demand was at an eight-year high, while industrial consumption reached a five-year peak."

Nevertheless, autocatalyst demand was at an eight-year high last year, while industrial consumption also reached a five-year peak, on the back of strong demand from the chemicals and glass industries. Investment in certain sectors of the Chinese chemicals industry remains buoyant, supported by government policy aimed at developing self-sufficiency in key feedstocks such as paraxylene, the manufacture of which employs a platinum catalyst. Sales of platinum equipment to the glass industry rose significantly, reflecting heavy investment in new fibreglass production capacity in China, and also at Chinese-owned plants in North America and the Rest of World region. However, there was a decline in platinum requirements from manufacturers of LCD substrates: improvements in process efficiency have improved productivity and reduced the need for investment in new glass-manufacturing lines.

Net consumption of platinum by the petroleum refining industry was stable in 2016. Gasoline demand has been supported by low oil prices, improving margins at some older European and North American refineries which had been at risk of closure. Elsewhere, investment in new refining capacity in the Rest of World region remained strong, but Chinese demand edged lower, reflecting overcapacity at the country's domestic refineries.



Platinum Demand: Industrial '000 oz			
	2015	2016	2017
Chemical	539	545	550
Electrical	229	235	263
Glass	160	242	229
Medical & Biomedical	215	217	220
Petroleum	142	143	147
Other	447	461	472
Total	**1,732**	**1,843**	**1,881**

Sales of platinum to the electrical sector were up 3% in 2016. Hard disk drives (HDDs) are the largest single demand area for platinum in electronics applications: platinum-containing cobalt-chrome alloys are used in the disks' magnetic recording layer. While the use of HDDs in consumer electronics has been falling, due to a steep drop in personal computer sales and the adoption of solid state storage for laptops and handheld devices, HDDs remain the primary data storage technology used in the growth 'enterprise' sector. With data storage demand continuing to expand at annual rates exceeding 40%, the typical capacity of a HDD is rising. This in turn is having a positive impact on the number of disks installed in each drive unit, and hence on platinum demand.

Our estimate of electrical demand includes consumption of platinum in fuel cells, which rose by around 40% in 2016, following a similar rate of growth the previous year. Stationary power generation remains the largest segment, but purchases of platinum for fuel cell electric vehicles (FCEVs) are now expanding rapidly, albeit off a small base. We discuss the development of the fuel cell market in further detail on pages 17 and 18.

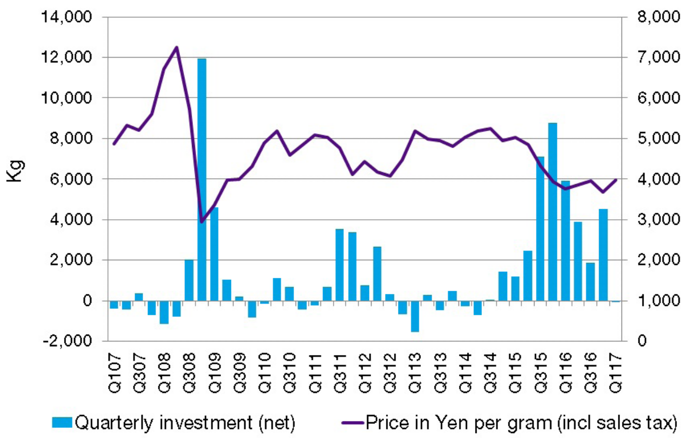
"During 2015 and 2016, we estimate that Japanese buyers purchased around 1.15 million oz of platinum bars."

Last year also saw exceptionally strong demand from the platinum investment sector, with buoyant demand for investment bars in Japan, a return of buying activity in European and US ETFs, the launch of a new platinum coin by the Austrian Mint, and further issues by other world mints. This greatly outweighed heavy liquidation by South African investors. Overall, we estimate that investment demand rose by 37% to 620,000 oz – the highest total for three years.

Japanese demand for platinum bars exceeded half a million ounces: we estimate that during 2015 and 2016, buyers in this region purchased around 1.15 million oz, in what we believe was the longest and heaviest episode of investor buying in this region since we began to measure demand in the 1980s. We attribute this to a conjunction of several factors that had a positive influence on buying behaviour, including low yen-denominated platinum prices, a wide discount to gold, and increased interest in precious metals among younger investors.

Price remains the primary stimulus for Japanese investment. While the absolute price level plays an important role, volatility is also a significant factor, with any sharp downward movement typically inciting new buying. The retail platinum price in Japan was below the important psychological price point of ¥4,000 per gram for most of 2016, only moving decisively above this level between mid-July and mid-August, when some profit-taking was seen. Net sales of platinum bars were positive in every month except July; purchasing activity peaked in January and October, as the retail price dipped below ¥3,500 per gram. In each of these months, Japanese investors acquired nearly 100,000 oz of platinum bars.

Platinum bar sales in Japan

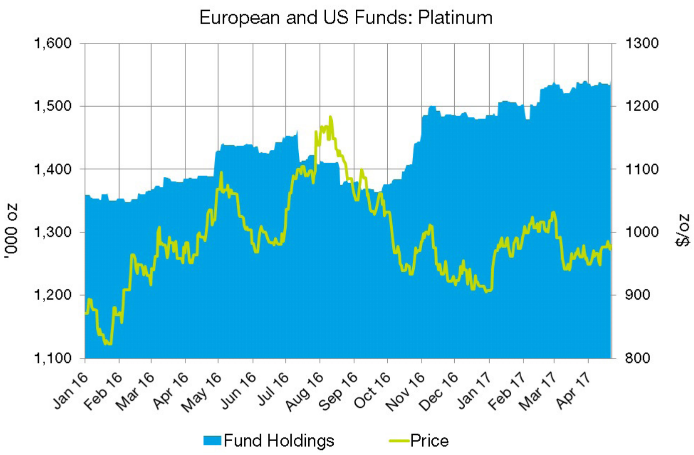


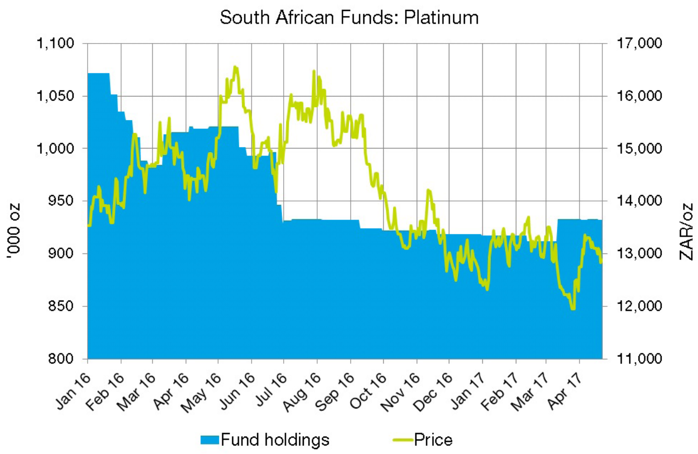
Platinum's price performance relative to gold was a subsidiary factor helping to explain historically-high levels of demand. The discount was unusually wide during 2016, exceeding ¥1,000 per gram for much of the first quarter, and remaining above ¥800 for most of the year. This tended to reinforce investors' perceptions that platinum represented unusually good value for money, in the context of historic prices and in comparison to gold.

"Following a bout of liquidation in 2015, platinum ETF holdings stabilised last year at just over 2.5 million oz."

Following a bout of liquidation in 2015, holdings of platinum ETFs stabilised last year at just over 2.5 million oz, with heavy selling in South Africa roughly balanced by a return to positive investment in the USA and Europe. South African investors were heavy sellers during the first nine months of 2016, redeeming about 150,000 oz of platinum. This selling occurred during a period of very strong gains in South African mining equity prices, suggesting that improved sentiment towards mining stocks encouraged institutional investors to rotate out of ETFs and into equities. Because rand-denominated platinum prices rose sharply between mid-2015 and mid-2016, it is likely that many investors were in a position to realise profits on their ETF holdings.

Elsewhere, there was some net buying in European and US ETFs in mid-year, as the platinum price rallied above $1,100/oz, but this was reversed by profit-taking during the third quarter. However, there was another uptick in investor interest during October, coinciding with an increase in market anxiety about the US elections, and a dip in the platinum price: between 1st October and 1st November, investors in Europe, the USA and Japan added around 135,000 oz of platinum to their holdings.





Johnson Matthey
Precious Metals Management

Forecast of Platinum SUPPLY & DEMAND IN 2017

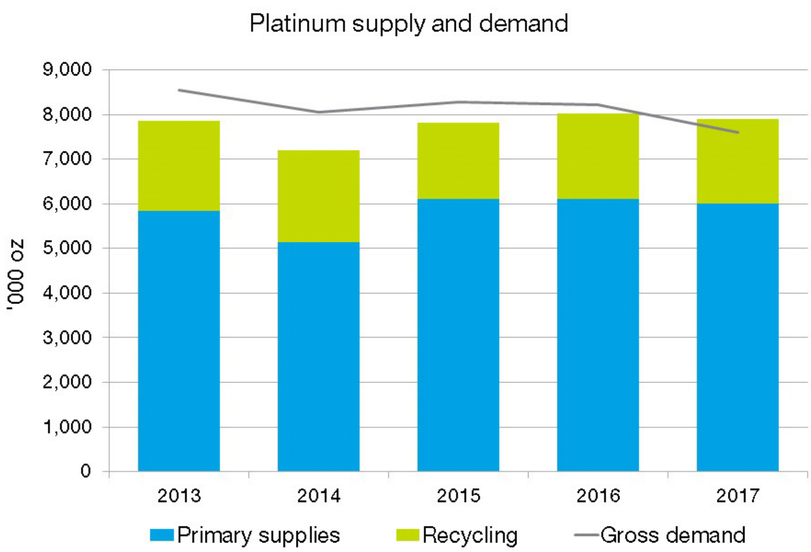
FORECAST: PLATINUM

- Lower auto, jewellery and investment demand will push the platinum market into surplus.
- Total supplies are likely to fall, with lower primary shipments and a drop in jewellery recycling.
- European diesel loadings will decline, as new catalyst strategies are adopted for RDE standards.
- Chinese jewellery demand will contract, as manufacturers turn to karat gold to improve margins.
- After two record years, Japanese investment bar sales are forecast to fall sharply.

With jewellery, autocatalyst and investment demand forecast to slow, the platinum market is predicted to move into surplus in 2017 for the first time in six years. Chinese jewellery fabrication is expected to contract again, while automotive demand will be hit by a fall in the platinum content of European diesel catalysts. After two record-breaking years of demand for platinum bars from Japanese investors, we expect investment demand to retreat sharply, but to remain positive. While industrial demand will be firm, and both primary supplies and recycling are expected to drop, this is unlikely to be enough to keep the market in balance.

Primary supplies of platinum are forecast to total just over 6 million oz in 2017, slightly down on last year. Shipments will once again depend partly on the extent to which South African and Russian producers can mobilise above-ground stocks, in the form of both semi-processed and refined materials, to supplement mine production.

We do not expect any significant change in South African mine output; whether production rises or falls will depend largely on the extent to which mining is disrupted by labour, safety or geological incidents. There is some growth potential at operations with shafts in the ramp-up phase, such as Royal Bafokeng Platinum's Styldrift project and Platinum Group Metals Limited's Maseve mine, while the Impala lease area will benefit from the return to full production of the fire-damaged 14 Shaft, as well as rising output at its new 16 and 20 Shafts. However, this will be partly offset by the impact of ongoing shaft closures at Lonmin.



This year should also see a modest increase in the recovery of pgm from the retreatment of surface materials derived from chrome and platinum mining. The Sylvania Dump Operations have been treating chrome tailings for several years, and pgm output is expected to peak at over 60,000 oz in 2017, before declining thereafter as the company's Steelpoort and Lannex operations reach the end of their lives. Jubilee Platinum will begin to extract pgm from chrome tailings this year: its new pgm processing plant was commissioned in the first quarter of 2017, and is expected to recover around 17,000 oz of platinum annually from chrome tailings. It has reached an agreement with Lonmin to toll refine this metal. The latter has its own Bulk Tailings Treatment (BTT) project under development, which enters production

"We do not expect any significant change in South African mine output in 2017."

during Lonmin's 2018 financial year starting in September 2017, and will deliver around 29,000 oz of platinum annually over a seven-year life.

There may be some further opportunity for mines to bolster sales by reducing pipeline stocks. Anglo American Platinum saw a 65,000 oz pipeline build in the final quarter of last year, following a furnace run-out at its Waterval smelter; this metal will be processed in 2017. At Lonmin, an ongoing clean-up of pgm-bearing materials in the smelter plant should add to refined production for a second consecutive year. However, it is likely that Northam will accumulate some unrefined pgm in concentrate ahead of the commissioning of its new smelter in December 2017. Overall, assuming that net destocking remains at similar levels to those seen in 2016, total shipments by South African producers are not likely to change much this year.

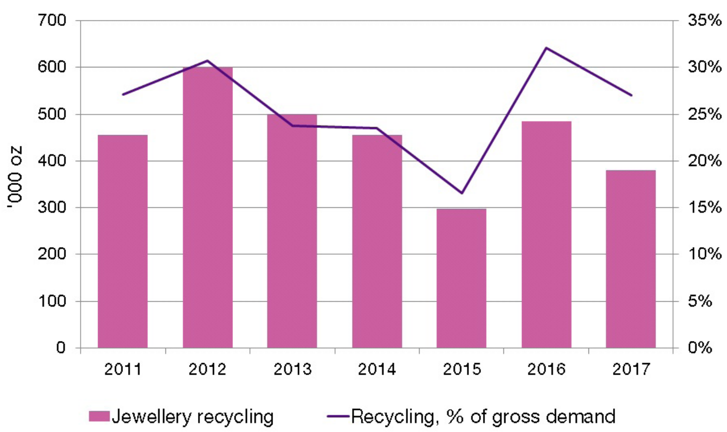
Output of platinum in Zimbabwe is likely to fall this year, because 2016's record total included a 20,000 oz contribution from the processing of inventory accumulated following a smelter outage the previous year. However, underlying mine production should be stable.

The Zimbabwean platinum mines have a track record that is unparalleled in the platinum mining industry, with production having grown incrementally almost every year for the last two decades. Although political risk remains high, the mines' consistent performance continues to drive investment in future mining and processing capacity. In November 2016, Zimplats confirmed its intention to develop a new shaft to replace output from the company's oldest mines, which are approaching depletion. The Mupani mine will cost around $264 million to develop and will enter production in 2021. At Anglo's Unki mine, a new smelter is under construction at an estimated cost of R664 million (around $50 million); it is due for completion in 2018.

"Russian supplies are more likely to fall than to rise."

Russian supplies are more likely to fall than to rise. Norilsk Nickel expects platinum production from its Russian operations to be in the range 581,000–645,000 oz: the wide range probably reflects uncertainty with regards to the pipeline impact of the ongoing transfer of pgm processing activities to the Kola Peninsula, and the pgm content of materials that may be recovered during the clean-up of closed facilities at the Norilsk mine site. These numbers may also include an allowance for the refining of some pgm from old copper concentrate, purchased by Norilsk Nickel from the state-controlled corporation Rostec in December 2016; this material originates from mining in the Norilsk area in the 1980s.

Chinese platinum jewellery recycling



Supplies of platinum from North America should be broadly stable. At the Stillwater Mining Company in Montana, USA (recently acquired by Sibanye Gold), new production from the Blitz expansion is not forecast to begin much before 2018; this project is eventually predicted to add up to 330,000 oz p.a. of combined platinum and palladium output. At Lundin's Eagle mine in Michigan, USA, output of pgm in concentrate is expected to be around 20,000 oz in both 2017 and 2018, but will fall thereafter as the richest ore reserves are mined out. The current project has only a five-year life, but it may be possible to extend this by mining the nearby Eagle East orebody.

"The autocatalyst scrap market is now showing definite signs of recovery."

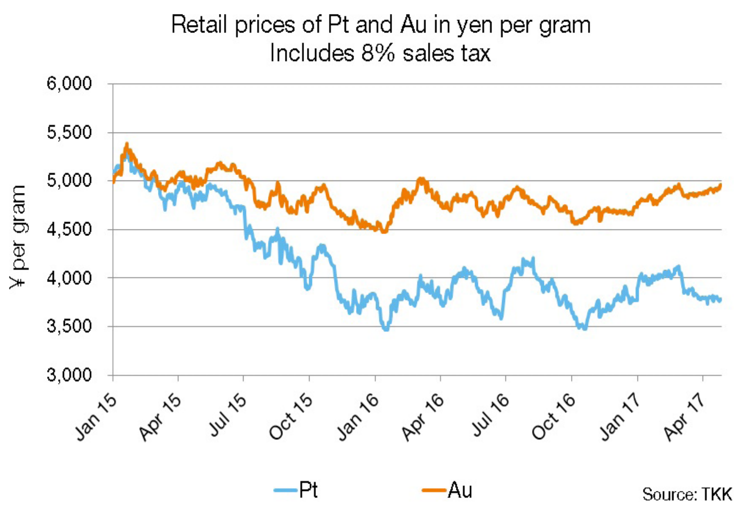
Canadian platinum production is largely determined by nickel mining activity, since the only primary pgm miner, North American Palladium, mines a palladium-rich orebody in which concentrations of the other pgm are low. Our forecast allows for a fall in the pgm content of ore mined at Glencore's Sudbury nickel operations, where the reported reserve grade has declined by around a quarter over the last three years. At Vale, closure of the Stobie mine was announced in March 2017, but is not likely to have a significant effect on pgm output this year. However, it is possible that pgm output will experience some temporary disruption during the transition to a single furnace operation at the Copper Cliff smelter, planned for implementation during the second half of 2017.

Overall, primary shipments are forecast to contract slightly this year, and secondary supplies may also fall: while the autocatalyst scrap market is now showing definite signs of recovery, we expect lower volumes of jewellery recycling.

"Chinese platinum jewellery recycling is forecast to return to more normal levels in 2017."

The recycling of platinum from spent autocatalyst is forecast to rise by around 8% in 2017, to 1.25 million oz, as scrap collection volumes recover following two years of unusually depressed conditions. However, we still expect the amount of platinum processed from end-of-life vehicles (ELVs) to be below the high of three years ago. North American recoveries in particular remain muted compared to the 2010–2014 period; this reflects the gradual decline in platinum usage (and corresponding increase in palladium consumption) on US gasoline vehicles that began in the late 1990s. This trend is now clearly reflected in the pgm content of US catalyst scrap, and it may be that platinum recoveries in this region have passed their peak. Elsewhere, autocatalyst recycling should show some growth this year, led by Europe, where increased availability of highly-loaded diesel scrap is expected to lift platinum recoveries by over 10%.

Chinese jewellery recycling is forecast to return to more normal levels in 2017, now that excess stock in the distribution network has worked its way through the supply chain. In China, most scrap jewellery is returned to manufacturers to be reworked into new jewellery items; on average, recycling supplies about a quarter of the metal used in Chinese jewellery fabrication. We would expect the decline in jewellery manufacturing activity over the last year to be reflected in lower scrap volumes in 2017.



Global demand for platinum has been at or above 8 million oz for the last four years, but is unlikely to remain at this level in 2017. While sales to some industrial consumers will remain strong – particularly in the chemicals and electrical sectors – we expect consumption of platinum in autocatalysts and jewellery to fall this year. We also consider it unlikely that investment purchasing will remain at the elevated levels seen in 2015–2016. Together, these factors are predicted to have a significant impact on world platinum demand, which is forecast to fall by 8% to 7.61 million oz.

Between January 2015 and December 2016, Japanese investors bought over 1.1 million oz of platinum in the form of over-the-counter bar purchases; during this period, new demand significantly outweighed liquidation in every

“Global demand for platinum is forecast to fall by 8% in 2017 to 7.61 million oz.”

quarter. However, in the first three months of 2017, net buying was close to zero. Steady gains in platinum's yen price during the first two months of 2017 resulted in a steep drop in new bar purchasing and a surge in profit-taking, but this was largely offset during the second half of March, when a new round of buying was triggered by a fall in the price and a widening of platinum's discount to gold.

Buying behaviour by Japanese investors is influenced not only by the absolute level of price, but also by its direction. Thus, demand in 2017 will depend not only upon the direction of dollar prices and the dollar-yen relationship, but also upon the degree of price volatility. The Japanese investment market tends to accumulate metal steadily over time; buying into falling prices tends to exceed profit-taking during periods of rising prices. Strong net demand is typically associated with large downwards price movements; at current price levels, it may be that there is limited scope for further large-scale buying into falling prices in the coming year.

“Euro 6d-TEMP, to be phased in from September 2017, will mandate Real Driving Emissions testing for the first time.”

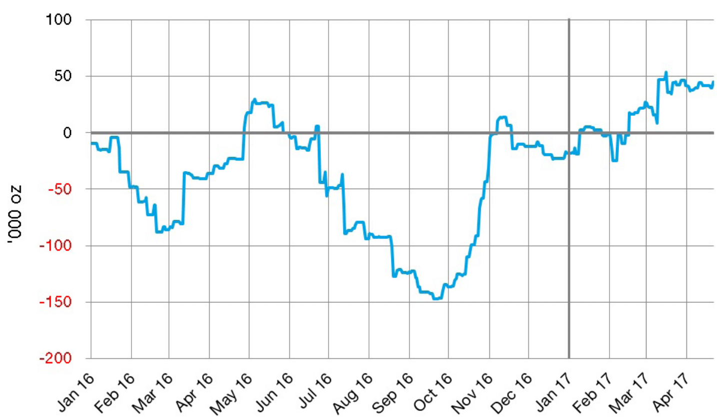
The first quarter of 2017 saw modest ETF buying in all regions except Japan. Buying activity was concentrated in the second half of February, when the price rose briefly over $1,020/oz, its highest level for six months. In contrast, the Japanese ETF saw some modest profit-taking over this period. Looking forward, our forecast for platinum investment – 220,000 oz in 2017 – assumes that there will be some further modest ETF buying during the remainder of the year, while sales of small investment products including coins and small bars will remain robust.

Global demand for platinum in autocatalysts is forecast to shrink by 5% to 3.16 million oz in 2017. Most of this decline will occur in the European light duty diesel sector, as vehicle manufacturers begin to introduce catalyst systems that meet the next stage of European legislation. Known as Euro 6d-TEMP, these new regulations will be phased in from September 2017, and will mandate Real Driving Emissions (RDE) testing for the first time: NOx emissions measured under real driving conditions must be less than 2.1 times those permitted during the laboratory test cycle used for type approval emissions testing. From January 2020, under the final phase of legislation, Euro 6d, this 'conformity factor' is due to be tightened from 2.1 to 1.5.

For Euro 6d-TEMP, we expect the European light duty market to see some shift away from LNTs and towards increased use of SCR (usually in conjunction with a DOC and particulate filter), because the latter technology offers more reliable NOx conversion at the higher driving speeds and more frequent accelerations experienced under RDE testing. Since SCR-based catalyst systems tend to have a lower pgm content than those that incorporate LNTs, we expect some short-term decline in pgm loadings on European diesels. This will be exacerbated by a trend towards combining the SCR and particulate filter on a single non-pgm brick. As a result, we expect average platinum loadings on European diesel cars to decline by around 4% this year.

The impact of falling loadings may be exacerbated by a slight decline in European diesel car production, the first since 2013. Diesel's share of passenger car sales in Europe was down

Net investment in platinum ETFs since January 2016



Johnson Matthey
Precious Metals Management

> **“Slower growth in vehicle production and declining diesel share may result in a fall in European diesel car output.”**

in the first quarter, with the German, French and Spanish markets reporting drops in the 4–7% range. However, other markets are less affected, and with overall European vehicle production still expected to grow this year, the fall in diesel car output is currently expected to be under 2%. It should be noted that this decline will be concentrated in the smaller car segments, where the use of LNTs has been most prevalent.

Looking forward, many car companies have yet to determine their final choice of catalyst systems for the final stage of Euro 6d. However, it is likely that the tighter NOx conformity factor will result in some additional use of NOx traps, in conjunction with SCR technology, as this combination provides effective NOx control across the full range of driving conditions. Additional use of NOx traps would be positive for pgm loadings, but would also add to aftertreatment system costs and may further damage diesel's competitiveness against gasoline, particularly for smaller vehicles.

The European heavy duty diesel sector is also experiencing some catalyst technology changes that will contribute to platinum thrifting this year. Since 2014, all heavy trucks sold in Europe have been equipped with pgm-containing aftertreatment systems to meet Euro VI emissions limits: typically, DOCs and DPFs are used to treat carbon monoxide, hydrocarbons and particulate matter, while NOx is treated using SCR technology. The pgm content of these systems is sensitive to the choice of base-metal catalyst used for SCR.

First-generation Euro VI systems mainly used Fe-SCR (based on iron), but as new truck models are introduced and next-generation catalyst systems adopted, some manufacturers are moving to V-SCR (based on vanadium). This is facilitating some thrifting of platinum loadings on diesel oxidation catalysts. In Fe-SCR systems, the efficiency of NOx conversion can be maximised by increasing the amount of NO_2 in the exhaust gas stream; this favours the use of platinum, which is a more effective catalyst than palladium for the oxidation of NO to NO_2. However, V-SCR technology does not require the NO to NO_2 ratio to be so tightly controlled, and platinum loadings therefore tend to be lower on these systems. It should be noted that V-SCR is not used in any mainstream light duty applications, and is not currently approved in North America (except in some non-road applications) or in Japan.

European emissions limits, compression ignition (diesel) vehicles

	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5a	Euro 5b/5+	Euro 6b	Euro 6c / 6d-TEMP	Euro 6d
	Jul 1992	Jan 1996	Jan 2000	Jan 2005	Sep 2009	Sep 2011	Sep 2014	Sep 2017	Jan 2020
Fuel sulphur limit (ppm)	(2000)	500	350	50	≤10	≤10	≤10	≤10	≤10
CO (mg/km)	2720	1000	640	500	500	500	500	500	500
HC + NOx (mg/km)	970	700	560	300	230	230	170	170	170
NOx (mg/km)			500	250	180	180	80	80	80
PM (mg/km)	140	80	50	25	5	4.5	4.5	4.5	4.5
PN # (Nb/km)						6*E11	6*E11	6*E11	6*E11
Durability ('000 km)	80	80	80 or 5 yrs	100 or 5 yrs	160	160	160	160	160
RDE conformity factor NOx								2.1	1.5
RDE conformity factor PN#								1.5	1.5

Dates and limits given are for Category M and N1 Class I vehicles; dates for N1 Class II & III and N2 vehicles are typically applied one year later in each case.
Dates given refer to new vehicle Type Approvals, all vehicle models must meet the limits generally one year later.

“Demand from the Indian light duty diesel sector should rebound as the market recovers from last year’s shocks.”

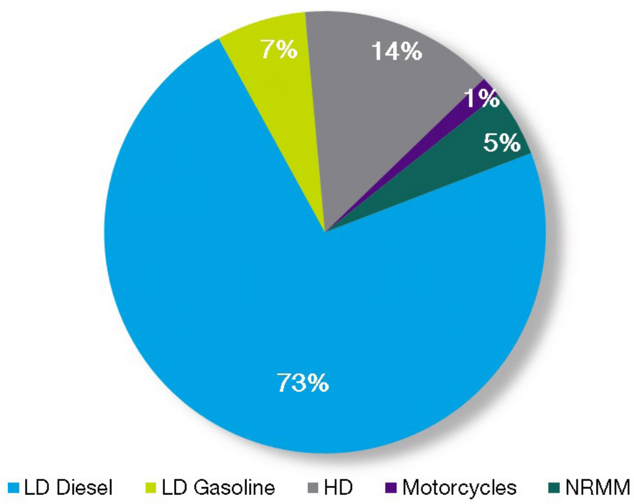
Demand from the US heavy duty market should stabilise in 2017 after last year’s steep fall in truck production, but consumption of platinum on US light duty diesels could decline, a consequence of increased palladium usage in this application. The diesel catalyst technology used on light vehicles sold into the US market differs somewhat from that used in other regions, partly because of vehicle size, but also due to differences in emissions legislation and test cycles. There is relatively little use of LNTs: the vast majority of US diesels are equipped with SCR technology for NOx control, along with pgm catalyst bricks in front of (and sometimes behind) the SCR to control other pollutants. These pgm bricks are usually heavily-loaded, but palladium takes a greater share of the pgm split than in other regions: the platinum:palladium ratio on US diesels will move close to 1:1 in 2017. This is because US emissions legislation restricts the extent to which automakers can boost the efficiency of the SCR reaction by using platinum to alter the NO to NO_2 ratio in the exhaust gas stream.

In contrast, demand for platinum from the Indian light duty diesel sector should rebound in 2017 as the market recovers from last year’s negative shocks. Total passenger car production is forecast to rise by 10%, while diesel’s share of this market is expected to recover to around 38%, leaving both diesel car output and platinum demand close to the record levels seen in 2014–2015. At the same time, we also expect to see a jump in heavy duty demand, albeit from a very low base. Bharat IV legislation will be enforced nationwide starting in April 2017; some heavy vehicles will require higher pgm loadings, though many trucks will be able to meet this legislation using SCR (non-pgm) technology alone. This will change with the introduction of Bharat VI (equivalent to Euro VI/ Euro 6) regulations, proposed for 2020, which will require the use of pgm catalysts on all Indian trucks, and will result in a significant increase in platinum demand.

“Chemical and glass demand are forecast to remain at historically elevated levels.”

As in India, the use of platinum on heavy duty diesels in China is currently modest. Legislation will tighten in July 2017, when China V standards will be implemented nationwide, but this will have only a small impact on loadings, and many vehicles will be able to meet the regulations without any pgm. However, the introduction of China VI limits, currently due to commence in 2020, is forecast to result in universal fitment of pgm catalysts and a very significant increase in average loadings.

Platinum demand by auto sector 2017



Industrial demand for platinum is forecast to remain strong in 2017, at 1.88 million oz, with chemical and glass demand remaining at historically elevated levels, and some gains in the electrical sector. Much of this increase will come from the fuel cell sector, where demand for platinum is expected to be up by more than a third on last year.

The most significant single source of fuel cell demand is currently the large stationary sector, where fuel cells are used for uninterruptible power supply and off-grid applications, including sewage farms, businesses, hospitals, and industrial facilities. Into this latter category falls Impala Platinum’s fuel cell installation at its Springs Refinery, which will eventually allow the company to take its plant off-grid; phase one of the project includes 20 fuel cells generating 8 MW of power and will become operational in mid-2017. Platinum demand in the

"Phase 1 of Impala Platinum's fuel cell installation will become operational in mid-2017."

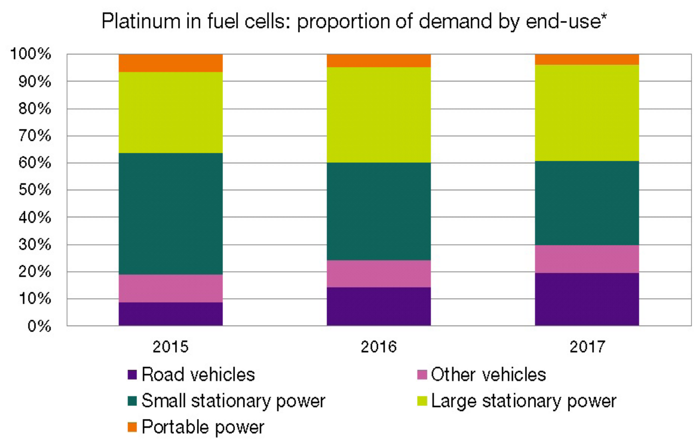
large stationary sector comes mainly from phosphoric acid fuel cells (PAFC), although there are a few megawatt-scale proton exchange membrane (PEMFC) systems in operation.

Smaller stationary FC plants for residential and telecoms applications are also expected to show continued growth. Japan already has close to 200,000 residential systems deployed; a European project known as ene.field is attempting to emulate this success, with the objective of deploying 1,000 small combined heat and power (CHP) units by the end of 2017. It will be followed by a new demonstration project, PACE, which will aim to install a further 2,500 systems, ahead of a move to a direct subsidy model similar to that used in Japan. Germany has already announced such a programme, known as KFW 433, which will make €500 million of subsidies available over an eight-year period and should lead to up to 70,000 deployments of FC CHP systems. However, it should be noted that a number of the fuel cell systems offered in Europe are based on solid oxide technology (SOFC), which does not use platinum.

Production of fuel cell electric vehicles (FCEV) remains small, probably amounting to fewer than 5,000 units this year. However, output is beginning to rise rapidly, and some automakers have ambitious near-term targets: for example, Toyota's sales target is 30,000 FCEVs annually by 2020. Refuelling remains a challenge, but there are a number of projects aimed at developing the hydrogen supply network, including Germany's H2 Mobility initiative which is a collaboration between fuel suppliers, car makers and government. This project is targeting 400 hydrogen refuelling stations (HRS) in Germany by 2023, and is currently adding around two new HRS a month.

"30 fuel cell buses are already in service in China, towards a total of 300 targeted for 2017."

In China, deployment of fuel cell buses is gathering pace, with over 30 such vehicles on the road by the end of 2016, towards a total of 300 targeted for 2017. Fuel cells in heavy duty vehicles have also made an appearance, with Scania testing fuel cells in Norway and Toyota unveiling a Class 8 fuel cell truck prototype at the Port of Los Angeles. In the non-road transport sector, two prototype fuel cell trains are being tested in Germany; homologation is underway and the first FC trains may enter service as early as 2018. In this application, the aim is for fuel cells to replace diesel in areas where electrification of lines is not planned or not possible.



*Small stationary <10 kW. Large stationary >10 kW, typically ≥100 kW. There is some overlap between portable and small stationary categories.

In contrast, the outlook for jewellery demand is rather muted. We expect gross sales to Chinese platinum jewellery manufacturers to contract again in 2017, although at the net level this should be offset by a fall in recycling. Elsewhere, we expect platinum demand in Europe, the USA, Japan and India will be broadly flat.

In addition to conducting a twice-yearly manufacturer survey, upon which we base our historic demand figures, we estimate monthly purchasing of platinum by the Chinese jewellery trade using data derived from the Shanghai Gold Exchange and trade statistics. Based on these figures, it appears that net new metal purchasing during the first quarter of 2017 fell to the lowest level since 2011. However, it should be noted that

"It is highly likely that Chinese platinum jewellery demand will fall again this year."

last year's purchasing figures were inflated by some speculative buying of platinum intended for future supply to the jewellery industry, so our year-to-date jewellery purchasing figures (shown in the graph on page 7) may overstate the decline in net fabrication demand in the early part of 2017.

Nevertheless, it is highly likely that demand will fall again this year, both at the retail and the manufacturing level. Jewellery makers and retailers are increasingly turning their attention to karat gold jewellery items, priced per piece rather than per gram, as a means of supporting margins. We note that at present this appears to be primarily an industry-led initiative, and it remains to be seen whether there will be any sustained impact on retail purchasing patterns. However, for the time being this may be limiting distributors' willingness to replenish stocks of platinum jewellery.

"Platinum is predicted to move into a moderate surplus for the first time in six years."

Not all manufacturers are focusing on karat gold jewellery as a means of improving margins: several platinum jewellery fabricators have recently introduced what they term 'value-add' platinum jewellery ranges. These consist of items with a greater design content, on which a higher profit margin can be charged. There are also some moves towards per-piece pricing of platinum pieces, but this is in its early stages.

Overall, with combined primary and secondary supplies down 1.5% at 7.91 million oz, and gross demand falling 8% to 7.61 million oz, platinum is predicted to move into a moderate surplus for the first time in six years. In view of the extent to which market stocks have been drawn down in recent years (see graph on page 2), we do not think that this year's moderate market surplus makes any material difference to underlying platinum availability.

Summary of Palladium SUPPLY & DEMAND IN 2016

SUMMARY: PALLADIUM

- Higher supplies and heavy disinvestment cut the palladium market deficit to 163,000 oz.
- Primary supplies grew by 5%, mainly due to destocking by Norilsk Nickel.
- Autocatalyst recycling rose modestly but remained depressed compared to the 2014 peak.
- Auto demand reached an all-time high as purchases by Chinese car companies surged by 23%.
- Total ETF holdings fell by 650,000 oz, with further heavy profit-taking by palladium investors.

The palladium market moved closer to balance in 2016, despite substantial growth in demand from the autocatalyst sector. This gain was more than offset by growth in both primary supplies and recycling, and a modest fall in industrial demand. In the investment sector, there was continued significant disinvestment by ETF holders at a rate similar to that seen in 2015.

The deficit fell to 163,000 oz, following four years of large shortfalls. The market was last in surplus in 2011, the final year of substantial stock sales by the Russian government (there were some sales from state inventories during 2012–2013, but at a much reduced rate). It should be noted that last year's deficit would have been much greater but for the liquidation of nearly 650,000 oz of ETF positions. By the end of 2016, ETF holdings totalled 1.65 million oz, down from nearly 3 million oz at their peak.

World primary supplies of palladium were remarkably strong in 2016, as sales by Russia rose sharply, greatly outstripping expectations. This more than compensated for a drop in shipments from South Africa, leaving total palladium supplies up 5% at 6.76 million oz.

Supplies of palladium from South Africa fell by 4% to 2.57 million oz, primarily due to a steep fall in refined output at Anglo American Platinum, where palladium production the previous year had been boosted by a significant release from in-process inventories.

Anglo is by far the country's largest producer of this metal, as a result of its portfolio of wholly-owned, joint venture and associate mines exploiting orebodies with a relatively high palladium content. These include the large open-cast Mogalakwena operation, the only mine currently exploiting the Platreef, as well as three eastern Bushveld mines at Bokoni, Modikwa and Mototolo, all of which extract UG2 which is richer in palladium than is typical for South African ore. Anglo's production typically has a 1.6:1 platinum-to-palladium ratio, compared with around 2:1 for the other South African refiners (this ratio excludes metal derived from the mines on Zimbabwe's Great Dyke).

Although refined production fell, underlying mine output of palladium rose by around 2%, mainly due to a strong performance at Mogalakwena, where refined palladium production exceeded 450,000 oz for the first time. There was also a notable increase in output at Northam's first eastern Bushveld operation, Booysendal North, where the UG2 mine has been ramping up towards steady-state production. Partly offsetting this, there was a fall in palladium shipments from the Nkomati Nickel mine; by-product pgm from this mine is included in our estimates of South African supplies even though the metal is processed in Russia and Europe.

In our previous report, we reported that Russian output of palladium was expected to fall sharply in 2016, as Norilsk Nickel implemented changes to the

Palladium Supply and Demand '000 oz			
Supply	**2015**	**2016**	**2017**
South Africa	2,684	2,574	2,581
Russia	2,434	2,773	2,684
Others	1,336	1,415	1,366
Total Supply	**6,454**	**6,762**	**6,631**
Gross Demand			
Autocatalyst	7,651	7,935	8,217
Jewellery	223	189	182
Industrial	2,007	1,938	2,028
Investment	-659	-646	-298
Total Gross Demand	**9,222**	**9,416**	**10,129**
Recycling	-2,412	-2,491	-2,706
Total Net Demand	**6,810**	**6,925**	**7,423**
Movements in Stocks	-356	-163	-792

“Primary palladium supplies were remarkably strong in 2016, as sales by Russia outstripped expectations.”

process flowsheet at its Polar and Kola sites, involving the closure of the old nickel smelter and pgm concentration plant at the Norilsk mine site, and the transfer of some nickel and pgm treatment activities to the Kola peninsula. However, in the event, palladium output from the company's Russian mining operations (excluding metal from external sources) declined by only 2% last year, to around 2.53 million oz, well above the company's target range of 2.30–2.39 million oz.

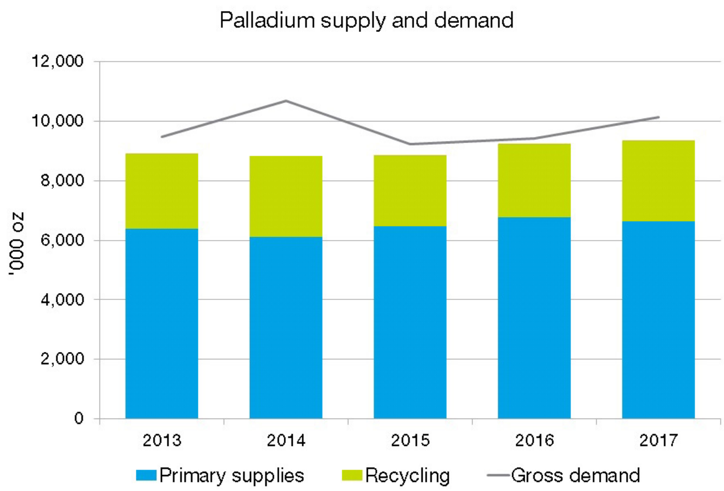
Norilsk had anticipated that the reconfiguration of its processing route would result in a significant increase in the amount of metal in its refining pipeline. While a sharp fall in the company's nickel output shows that in-process inventories have indeed risen, it appears that the impact on platinum and palladium output has been mitigated by the release of pgm from stocks of work-in-progress during the clean-up of decommissioned facilities.

In addition, new metal sales from Norilsk were significantly above the level of production, at 2.77 million oz, as the stock building that occurred in 2015 was reversed. This figure was 14% higher than the previous year, and represents the largest annual supply figure from Norilsk Nickel for nine years.

“Palladium output from Norilsk Nickel's Russian mining operations declined by only 2% last year.”

The above supply estimate does not include sales of metal from market activities: in order to meet strong demand from its customers, Norilsk also purchased some 300,000 oz of palladium from the market, generating onward sales revenue of $184 million. Around 160,000 oz of this metal was purchased on behalf of the Global Palladium Fund, which was created by Norilsk with the intention of reducing market volatility by acquiring stocks of metal held by the Russian Central Bank, hedge funds and other market participants. It should be noted that these market purchases by Norilsk Nickel are considered to represent a change in ownership of existing market stocks, and are therefore not included in our supply or demand figures.

Palladium supplies from North America rose by 2% to 894,000 oz last year, with a small increase in shipments of by-product palladium from nickel ores, and an 8% jump in shipments from Stillwater; the latter reported a modest gain in mined output and also sold some metal from stocks. However, the region's other primary pgm miner, North American Palladium, saw a 10% decline in payable palladium sales, to 150,000 oz, as its underground operation experienced a fall in volumes during a transition to a new mining method.



Supplies of palladium from other countries also improved last year, with record production levels at Boliden's Kevitsa mine in Finland.

Overall, shipments of primary metal rose by 5%, while secondary supplies also improved slightly: up 3% to 2.49 million oz, leaving total availability of primary and secondary palladium up 4% at 9.25 million oz. Returns of old palladium jewellery by Chinese consumers continued to decline, but this was offset by a modest rise in the recovery of palladium from scrapped catalytic converters. However, autocatalyst recycling remained depressed compared to 2014's peak level.

"Steel prices showed some recovery, leading to a modest improvement in scrap volumes."

Between January 2014 and the end of 2015, scrap steel prices fell by at least 50%, significantly altering the economics of vehicle recycling. With scrapyards prepared to pay only very low values for end-of-life vehicles (ELVs), it became less attractive for owners to scrap their cars, while there was increased competition for ELVs from exporters who purchase old vehicles and ship them to developing markets. The overall result was a rise in the average age of vehicles reaching scrapyards, and a concomitant reduction in the number of vehicles being scrapped. This in turn led to a decline in the volumes of spent catalytic converters being removed and processed. This situation was exacerbated by the decline in pgm prices after mid-2014, which motivated periodic – albeit usually short-term – hoarding of catalyst scrap at different points along the recycling circuit.

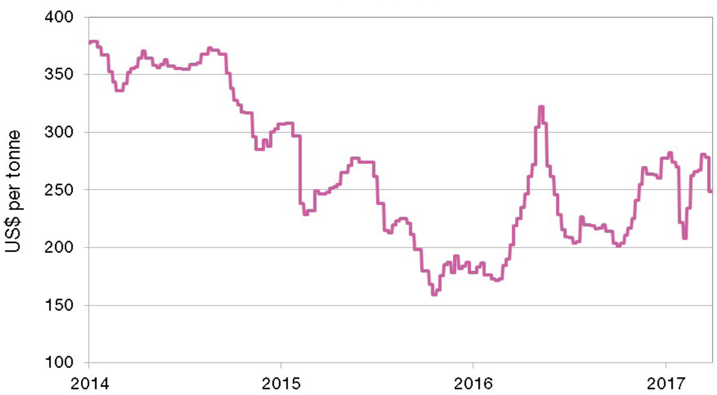
Steel prices were very volatile during 2016, but overall showed some recovery, leading to a modest improvement in catalyst scrap volumes during the second half of last year. The amount of metal recovered was also boosted by the increasing availability of palladium-rich scrap in the Rest of World region, where greater numbers of vehicles fitted with catalysts are entering the scrap collection circuit.

"Greater numbers of vehicles fitted with catalysts are entering scrap collection in the Rest of World region."

It should be noted that we have revised our estimates of Chinese recycling volumes for all pgm, in line with new information suggesting that the average pgm loading on spent catalyst is lower than we had previously assumed. We now believe that assay data obtained from recyclers was not representative of the pgm content of catalysts on end-of-life vehicles. because a large proportion of scrap collected is from repair shops, where catalysts are typically younger, and contain higher concentrations of pgm. There has been an increase in the number of ELVs reaching scrapyards, stimulated by government license plate restrictions which require vehicle owners to demonstrate that they have scrapped their existing car before they can register a new one. These older vehicles often carry catalysts with very low pgm loadings. Thus, while Chinese scrap volumes are rising, pgm recoveries are lower than we had previously estimated, and are also growing less rapidly than we had expected.

While China is only a relatively small player in the global autocatalyst recycling business, it is the source of the majority of palladium recycled from old jewellery – a hangover from the 2004–2009 period when the country had a thriving palladium jewellery sector. In China, recycled jewellery metal has traditionally returned to market via a 'closed loop' circuit in which old jewellery pieces are exchanged by consumers for new items, and then returned by retailers to jewellery fabricators, who use scrap metal to fulfil part of their manufacturing requirements. However, there is now very little palladium jewellery fabrication in China, and therefore very little demand for scrap metal from manufacturers.

Scrap steel shredded FOB Rotterdam
US$ per tonne



Source: Bloomberg

It should be noted that our figure for palladium jewellery recycling in China is based on information regarding scrap purchasing by jewellery makers. This 'closed' loop recycling number may underestimate the quantity of metal that is returned, because we are not able to quantify the amount of scrap jewellery purchased for cash by independent recycling and exchange businesses. The original selling price of palladium jewellery was typically substantially in

Palladium Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Europe	1,624	1,640	1,648	-396	-422	-443	1,228	1,218	1,205
Japan	768	799	767	-106	-110	-121	662	689	646
North America	2,035	1,948	1,984	-1,110	-1,152	-1,298	925	796	686
China	1,654	2,029	2,163	-68	-74	-83	1,586	1,955	2,080
Rest of World	1,570	1,519	1,655	-211	-232	-261	1,359	1,287	1,394
Total	**7,651**	**7,935**	**8,217**	**-1,891**	**-1,990**	**-2,206**	**5,760**	**5,945**	**6,011**

excess of its metal value, and in the past, consumers may have been discouraged from recycling their jewellery because they would receive only a fraction of its original purchase value. However, recent gains in the palladium price have improved the economic rationale for recycling. It is likely that metal which is recycled via this 'open loop' route is consumed in China's industrial and automotive sectors, both of which are enjoying a period of particularly strong demand.

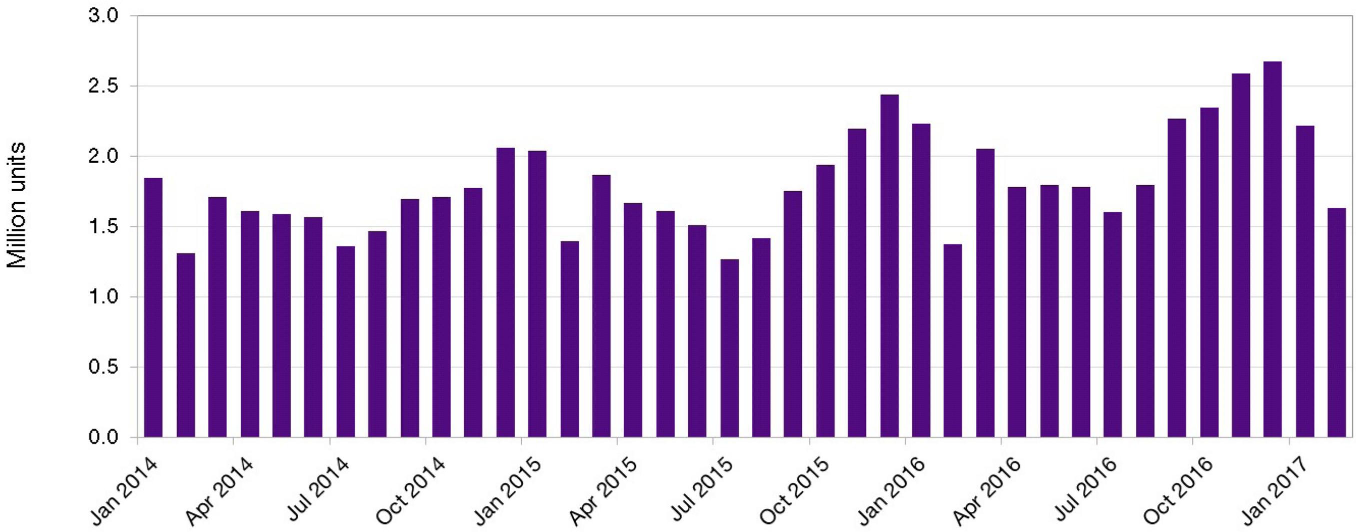
Global demand for palladium rose by 2% to 9.4 million oz, despite further heavy liquidation by ETF investors, and lower industrial and jewellery demand. In contrast, automotive demand recorded yet another year of significant growth, up 4% – or nearly 300,000 oz – to a new all-time high of 7.93 million oz.

"In China, light duty vehicle output reached a new record of 25.5 million units."

These gains came almost entirely from China, where purchases of palladium by the auto industry surged by 23% to over 2 million oz, as light duty vehicle output reached a new record of 25.5 million units. Of these, 97% had gasoline engines and were equipped with three-way catalysts, the great majority of which used palladium-rhodium technology (there is some very modest consumption of platinum, mainly on vehicles built at Chinese transplants operated by Japanese car makers).

Growth in the Chinese car market was supported by a reduction in the purchase tax on vehicles with engines smaller than 1.6 litres, introduced in October 2015 with the aim of boosting sales, improving average fuel economy, and supporting Chinese-owned automakers. This stimulus resulted in a dramatic expansion in sales of passenger cars, which rose by over 15% year-on-year to reach a record 24.4 million units. Chinese car companies significantly

Monthly passenger vehicle sales in China



Source: China Automotive Information Net (CAIN)

Palladium Demand: Industrial '000 oz			
	2015	2016	2017
Chemical	439	411	522
Dental	475	427	413
Electrical	960	953	945
Other	133	147	148
Total	**2,007**	**1,938**	**2,028**

increased their share, especially in the rapidly-growing compact sports utility vehicle (SUV) segment, where local brands are particularly strong. Output of SUVs in China expanded by nearly 3 million units last year.

The final quarter saw an extraordinary total of 7.6 million new passenger vehicles registered, ahead of the anticipated end of the tax break on 31st December 2016. During the final months of the year, dealers engaged in a variety of promotional activities aimed at encouraging consumers to take advantage of the tax incentive before it expired; some even displayed countdown timers on websites and in stores. The result was to pull forward some demand that would otherwise have occurred in 2017. (It should be noted that the tax break was eventually reduced rather than being completely removed, and should therefore continue to provide some support for sales this year.)

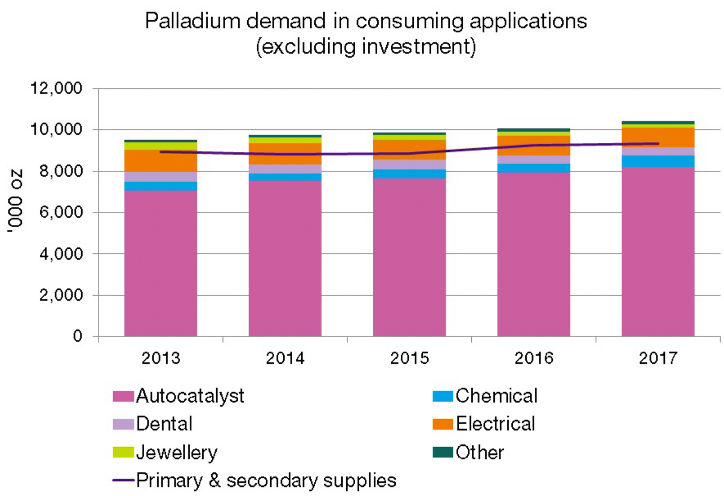
This boom in sales came at a time of rising palladium loadings on many Chinese cars, with China 5 emissions limits enforced in eleven provinces and eleven cities starting in April 2016. We estimate that the use of palladium on light duty gasoline vehicles in China rose by nearly a quarter last year.

"We estimate that the use of palladium on light duty gasoline vehicles in China rose by nearly a quarter last year."

Elsewhere, sales to European car companies rose modestly, in line with increased output of gasoline cars, while Japanese demand was supported by further substitution of palladium for platinum in gasoline catalysts. However, Rest of World demand was hit by falls in car output in some large markets, including Russia, South Korea and Brazil.

North American palladium usage also contracted, despite a small increase in production of light duty gasoline vehicles. Engine downsizing programmes at some US automakers have had an impact on palladium purchasing, as catalyst volumes and loadings are typically related to engine size. However, this dip in loadings is likely to be temporary, with Tier 3 Federal legislation beginning to take effect starting in 2017.

Global demand for palladium in industrial applications fell slightly in 2016, as consumption in the electrical and chemicals industries moderated slightly, and dental usage contracted. In recent years, sales of palladium catalysts to chemical companies have been exceptionally strong, especially in China, reflecting government policy to increase self-sufficiency in key chemical feedstocks. This has stimulated massive investment in new chemical plants, with rapid growth in domestic capacity for products such as purified terephthalic acid (used to make polyethylene terephthalate for plastic bottles and textiles) and hydrogen peroxide (used as a chemical feedstock as well as for bleaching wood pulp and textiles). However, there is now evidence of a modest slowdown in the pace of investment, leading to some projects being cancelled or postponed; we have therefore reduced our estimate of demand in 2016.



In the dental sector, demand from Japanese dentists – traditionally the mainstay of palladium usage in this application – has been trending downwards for some years. In 2016, the Japanese government increased its subsidy for palladium-rich 'Kinpala' alloys by nearly 10%, to offset recent increases

Johnson Matthey
Precious Metals Management

> **The Chinese palladium jewellery market has now all but disappeared.**

in materials prices, but this was not enough to prevent a further loss in market share to alternative materials such as hard resins and ceramics.

Consumption of palladium in the electronics sector declined marginally in 2016. The use of palladium in its traditional electronics applications – palladium pastes used in multi-layer ceramic capacitors (MLCC) and hybrid integrated circuits (HIC) – continues to edge lower, reflecting increased miniaturisation and the adoption of non-pgm materials outside of specialist applications in the auto, medical and defence sectors. However, this is being largely offset by modest growth in the use of palladium to plate connectors and printed circuit boards.

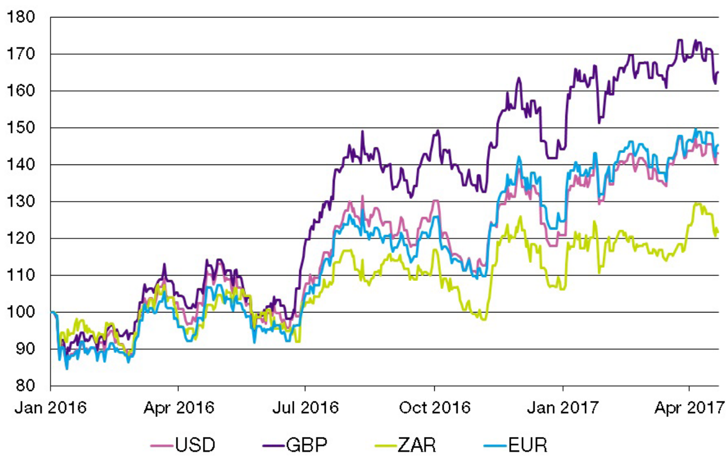
Demand for palladium in jewellery fell to its lowest level for nearly 30 years. The Chinese palladium jewellery market has now all but disappeared, with only one major manufacturer still using palladium as a jewellery metal (rather than as an alloying component). However, there is still some demand for palladium jewellery in Europe and North America, where it is used primarily in men's bridal rings.

> **Palladium use in consuming applications exceeded 10 million oz for the first time.**

Overall, the use of palladium in consuming applications in the automotive, industrial and jewellery sectors rose by 2% to exceed 10 million oz for the first time. However, investment demand remained deeply in negative territory, with heavy profit-taking by ETF holders occurring for a second consecutive year. At 645,000 oz, liquidation nearly matched the exceptionally high level of selling seen in 2015: this two-year period saw over 1.3 million oz of palladium disinvestment, almost reversing the increase in ETF holdings that occurred between 2012 and 2014. By the end of December 2016, total palladium ETF holdings had declined to 1.65 million oz, down from a peak of nearly 3 million oz less than eighteen months previously.

Selling activity was concentrated in the second half of the year, following a steep climb in the palladium price, from under $550/oz to over $700/oz, that occurred over a six-week period between mid-June and early August; this was followed in November by another rally that took palladium above $750/oz for the first time since June 2015. In some currencies, price rises during the June to December period were amplified by foreign exchange movements, with the dollar making significant gains against both the euro and sterling.

Palladium price indices, January 2016 to April 2017



European palladium holdings were broadly stable in the first half of 2016. However, as first the pound sterling and then the euro began to slide against the dollar, the European ETFs began to see profit-taking. In the second half, European investors liquidated more than 270,000 oz palladium, of which over 160,000 oz was sold in December alone.

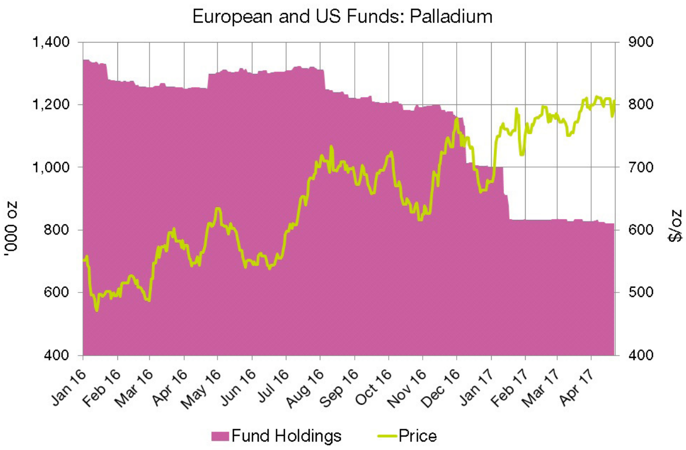
South African investors were also heavy sellers. During the first half, rand weakness enabled them to take advantage of a relatively high rand-denominated palladium price to rotate out of ETFs and into equities. From mid-year, a strengthening of the rand was more than offset by steady price gains, creating further opportunities for profit-taking, particularly in the final quarter, when the rand-denominated palladium price surged to all-time highs.

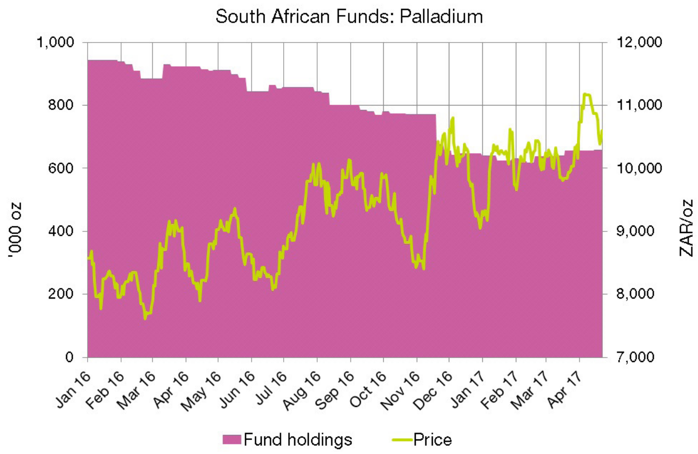
> **Availability of palladium deteriorated during 2016 and it appears there were periodic shortages of ingot.**

In contrast, profit-taking by US investors was more modest – around 70,000 oz in 2016, compared to 180,000 oz the previous year. It may be that investors in this region who have not taken advantage of selling opportunities over the last three years have different strategic investment priorities, or are simply looking for higher prices.

The steep fall in ETF positions over the last two years suggests that investors' enthusiasm for palladium has waned, perhaps because the existence of market stocks has dampened the impact of a long series of market shortfalls. Thus, ETF holders have taken the opportunities provided by recent price gains (and currency movements) to exit their palladium positions.

Nevertheless, availability of palladium deteriorated during 2016: during the final quarter, it appears that there were periodic shortages of loco Zurich ingot, while lease rates remain elevated, indicating tightness in the physical market. Over the last ten years, the market has been kept adequately supplied by a very large movement of palladium out of existing stocks, as is evidenced by trade statistics suggesting net withdrawals of around 10 million oz from Swiss and UK inventories between 2007 and 2016 (see graph on page 27). While we do not believe that above-ground stocks have been exhausted, no market can support large deficits indefinitely.





Forecast of Palladium
SUPPLY & DEMAND IN 2017

FORECAST: PALLADIUM

- A fall in primary palladium supplies should be offset by growth in recycling.
- Auto demand will set a new record, as gasoline car output expands and palladium loadings rise
- We expect ETF liquidation to continue, but at a slower rate, after two years of heavy selling.
- Higher auto demand and less disinvestment will push the market further into deficit.
- Availability of palladium ingot has deteriorated following five years of deficits.

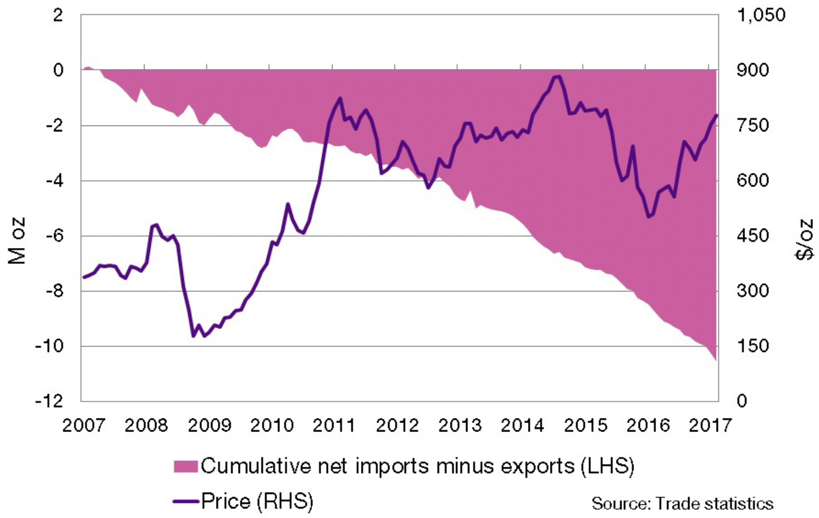
With combined primary and secondary supplies expected to grow only marginally this year, and firm prospects for growth in autocatalyst demand, the deficit in the palladium market seems set to widen significantly in 2017. The size of the deficit will depend primarily upon investor behaviour. Following price gains since the middle of last year, we believe there is potential for further profit-taking; however, it is likely that the rate of selling will slow, following two years of exceptionally heavy liquidation. We expect the market deficit to expand to nearly 800,000 oz, despite our forecast of just under 300,000 oz of disinvestment.

During the first four months of 2017 there have been further signs that availability of palladium is deteriorating, with traders reporting periodic difficulties in sourcing palladium ingot, and lease rates remaining elevated. Between 2012 and 2016 we estimate that at least 4 million oz of palladium were consumed from market stocks, and this is supported by evidence of heavy net withdrawals from Swiss and UK inventories. Another large deficit this year will further deplete remaining market stocks

Shipments of palladium from South Africa are expected to be stable or slightly up in 2017. While there is some modest growth potential from the ramp-up of new shafts, this will be partly offset by planned shaft closures at Lonmin. Our forecast also takes into account the risk of periodic production losses due to safety stoppages, labour unrest and technical incidents.

Beyond this year, there is some potential for modest near-term increases in palladium output from the ramp-up of new shafts at the Impala lease area, and of Styldrift and Maseve, while Northam has ambitious plans to raise production at its Booysendal mining complex, where a second UG2 mine is under construction.

Net UK and Swiss palladium trade



Source: Trade statistics

We expect shipments of palladium by Norilsk Nickel to fall this year, to just under 2.7 million oz, with lower sales from inventory outweighing gains in refined production. The company expects palladium output from its Polar and Kola sites to total between 2.64 and 2.73 million oz of palladium in 2017; this would represent an increase of up to 7% on last year's output, and may include some additional recovery of pgm from above-ground, semi-processed sources. In December 2016, Norilsk entered into a transaction to buy 1.5 million tonnes of copper concentrate from the Russian state-controlled corporation Rostec

Johnson Matthey
Precious Metals Management

Sibanye Gold's acquisition of Stillwater makes the company one of the world's top four primary palladium producers.

for approximately 67.5 billion roubles. This concentrate derives from mining activities at Norilsk during Soviet times, and is it likely that it contains some pgm. It will be fed into Norilsk's copper smelter when capacity is available.

Norilsk Nickel's Global Palladium Fund will again purchase metal from holders of market stocks: according to Russian press reports, the Fund intends to buy at least as much this year as in 2016 (around 150,000 oz). It appears that the Fund's strategy is not necessarily to stockpile this metal, but to supply it directly to Norilsk Nickel's industrial clients, bypassing the open market, with the intention of increasing security of supply for palladium users and decreasing price volatility.

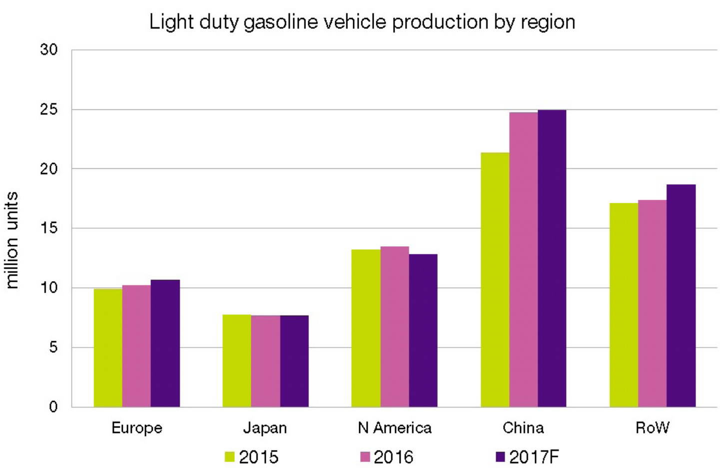
Supplies of palladium from North America are forecast to decline slightly. Having shipped some additional metal from stocks last year, sales by Stillwater could fall slightly in 2017; the company continues to develop its Blitz project, but this is not expected to contribute refined ounces until 2018. The acquisition of Stillwater by Sibanye Gold became effective in early May 2017, making the company one of the world's top four primary palladium producers on an attributable basis. It should be noted that we count palladium supply in the region where the metal was mined.

The recovery of palladium from spent autocatalysts is forecast to rise by over 10% this year.

In Canada, output from North American Palladium should rise in 2017, following the conversion of the underground mine to a new mining method, and an expansion of its tailings facility to facilitate a return to full-time milling operations (the plant is currently operating only two weeks a month). The company forecasts that output will total 180,000–190,000 oz of palladium in 2017.

Output of palladium from the Canadian nickel mines could decline slightly this year. While any impact from the closure of Vale's Stobie mine will be felt mainly in 2018, the company's planned move to single-furnace operation at its Copper Cliff smelter could have some short-term influence on the processing pipeline and hence on pgm output. Glencore's Sudbury operations have a limited mine-life and grades are falling, but output from the relatively palladium-rich Raglan mine (where the ore contains about 1.9 grams of palladium per tonne) should be stable.

The recovery of palladium from spent autocatalysts is forecast to rise by over 10% this year to 2.2 million oz, mainly due to a continued recovery in the number of vehicles being scrapped and processed in the North American market, where ELV catalysts contain relatively high concentrations of palladium. During the late 1990s and early 2000s, the US auto industry saw the rapid adoption of palladium in place of platinum on gasoline catalysts. Because palladium technology was less advanced and fuels less clean, total pgm loadings on palladium catalysts were typically much heavier than on the platinum-based ones they replaced, and even – in some cases – higher than on modern-day aftertreatment systems. These highly-loaded bricks are now reaching scrap yards in increasing numbers.



Source: LMC Automotive

Automotive demand for palladium is forecast to expand by 4% to reach 8.2 million oz in 2017, a new all-time record. Global

Johnson Matthey
Precious Metals Management

light duty gasoline output is expected to approach 75 million vehicles, the majority being equipped with pgm-containing catalysts, while average catalyst loadings are forecast to rise by around 2%, reflecting the implementation of stricter emissions legislation in North America, China and Europe.

The gasoline sector is entering a period of legislative change which will result in changes to catalyst fitment strategy on many vehicles, along with increases in average loadings. In North America, Tier 3 federal regulations will be phased in between 2017 and 2025, and we therefore expect the palladium content of a catalyst system to rise steadily over the next few years. In 2017, average palladium loadings are forecast to jump by 5%, offsetting an expected drop in output of gasoline vehicles. US demand will also benefit from a further shift towards the use of palladium in diesel catalysts, as discussed on page 17.

“Starting in September 2017, Euro 6c will impose a particle number limit for gasoline direct injection engines.”

European demand is also forecast to rise, as a fall in demand for palladium in diesel catalysts is offset by increased use on gasoline vehicles. In contrast to the diesel sector, the introduction of Euro 6b legislation starting in September 2014 did not result in any tightening of emissions limits for gasoline vehicles, and it therefore had no impact on catalyst loadings. However, going forward, the implementation of two new phases of Euro 6 legislation will lead to gasoline emissions control becoming significantly more challenging and aftertreatment systems more complex. This is likely to result in upwards pressure on loadings.

The most significant development for gasoline vehicles involves a change in how particulate emissions are regulated. Starting in September 2017, Euro 6c legislation will impose a mandatory particle number (PN) limit for gasoline direct injection (GDI) engines, in addition to existing particulate mass (PM) standards which are expressed in grams per kilometre. The PN standard effectively limits emissions of the finest soot particles, which are most harmful to the respiratory system.

In the same way as for NOx emissions (see page 15), this PN limit will be subject to measurement during real driving emissions (RDE) testing under Euro 6d. Conformity factors

European emissions limits, spark ignition (gasoline) vehicles

	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5a	Euro 5b/5+	Euro 6b	Euro 6c / 6d-TEMP	Euro 6d
	Jul 1992	Jan 1996	Jan 2000	Jan 2005	Sep 2009	Sep 2011	Sep 2014	Sep 2017	Jan 2020
Fuel sulphur limit (ppm)	(2000)	500	150	50	≤10	≤10	≤10	≤10	≤10
CO (mg/km)	2720	2200	2300	1000	1000	1000	1000	1000	1000
HC + NOx (mg/km)	970	500							
THC (mg/km)			200	100	100	100	100	100	100
NMHC (mg/km)					68	68	68	68	68
NOx (mg/km)			150	80	60	60	60	60	60
PM (mg/km)					5	4.5	4.5 (1)	4.5 (1)	4.5 (1)
PN # (Nb/km)							6*E11 (1,2)	6*E11 (1)	6*E11 (1)
Durability ('000 km)	80	80	80 or 5 yrs	100 or 5 yrs	160	160	160	160	160
RDE conformity factor NOx								2.1	1.5
RDE conformity factor PN#								1.5	1.5

Dates and limits given are for Category M and N1 Class I vehicles; dates for N1 Class II & III and N2 vehicles are typically applied one year later in each case.
Dates given refer to new vehicle Type Approvals, all vehicle models must meet the limits generally one year later.
(1) Applicable to gasoline direct injection (GDI) engines only.
(2) Until 3 years after the dates for Type Approval, a PN limit of 6 x 10^{12} may be applied upon request of manufacturer.

“Under RDE testing, vehicle emissions will be measured under a much wider range of conditions.”

(CFs) determine the multiple by which emissions may exceed the type-approval limits during RDE testing: for PN emissions, they have been confirmed as 1.5 at both Euro 6d-TEMP (from September 2017) and Euro 6d (from January 2020). The European Commission will review the CFs annually, with a view to tightening them further over time.

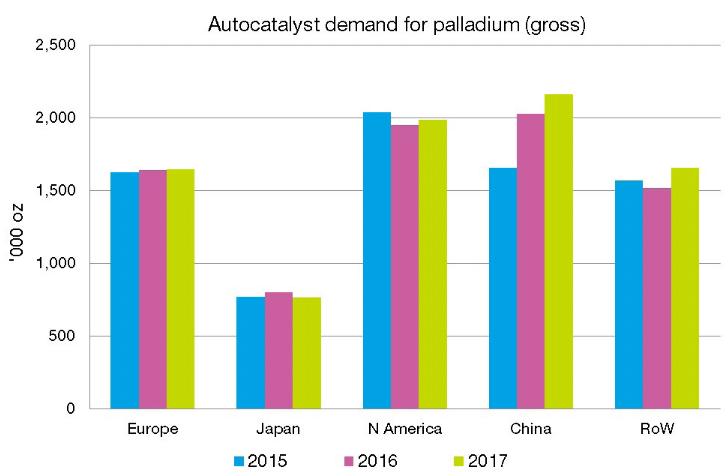
Compared to the current European test cycle, RDE testing will involve harsher and more frequent acceleration and higher maximum driving speeds, leading to higher PN emissions. In addition, emissions limits will need to be met over a much wider range of ambient temperatures (the current laboratory emissions testing conducted for type approval takes place at 23°C). PN emissions have been shown to increase significantly at lower ambient temperatures.PN emissions can be minimised via engine technology solutions, such as the use of fuel-injection strategies to regulate the combustion process, and can also be controlled by exhaust gas aftertreatment, in the form of a gasoline particulate filter (GPF). A GPF functions in much the same way as a diesel particulate filter (DPF), but because gasoline engines run at higher temperatures than diesel engines and produce lower levels of PM, ‘regeneration events’ to burn off the accumulated soot occur less frequently and at lower peak temperatures. This is one reason why GPFs, unlike DPFs, can be made from cordierite, the same substrate material that is used for the majority of three way catalysts.

“The number of European vehicles fitted with a GPF should grow rapidly from next year.”

Not all gasoline vehicles will require a GPF: in Europe, the legislated PN limits apply only to GDI engines, which typically emit more PM and larger numbers of very small particles than conventional ‘port fuel-injected’ (PFI) engines. However, it is possible that some PFI vehicles will also be fitted with a GPF.

The adoption of GDI technology, often in combination with downsizing and turbocharging, has been an important part of automakers’ strategies to improve engine performance and efficiency and thereby boost fuel economy and meet lower CO_2 emissions targets. Based on data from LMC Automotive, we estimate that over two-thirds of gasoline cars sold in Europe in 2016 were powered by GDI engines, and this proportion is likely to rise going forward. In 2017, the number of vehicles fitted with a GPF will be relatively small, but it should grow rapidly starting next year.

Car companies are considering a variety of aftertreatment configurations for GDI vehicles, including the use of three way catalysts and GPFs in series, as well as combining the two functions on a single brick known as a ‘four-way catalyst’. Some GPFs will be uncoated, but we expect a majority to contain palladium and rhodium, and this development will therefore be positive for pgm demand.



The new PN limits are not the only challenge ahead. NOx conversion during RDE testing is also a tough problem for vehicle manufacturers to overcome; for gasoline, the principal difficulty will be NOx control at high speeds, when the engine is working hardest. Higher levels of NOx conversion can be achieved by increasing the catalyst volume.

Finally, CO emissions may also be problematic for some engines. Under the current testing regime, gasoline vehicles may be calibrated to run ‘rich’ at high speed and high acceleration: this helps to cool the exhaust, and thereby protect the catalyst (which can be damaged if it is repeatedly

"It is likely that some gasoline vehicles will meet China 6a standards ahead of schedule."

exposed to very high temperatures). However, this also has the effect of increasing CO emissions outside the test window. Under RDE testing, vehicle emissions will be measured under a much wider range of conditions, giving automakers much less flexibility to calibrate the engine for optimum test performance. The aftertreatment system will therefore need to be more robust, to cope with a broad range of potential conditions; this may be achieved by using higher pgm loadings.

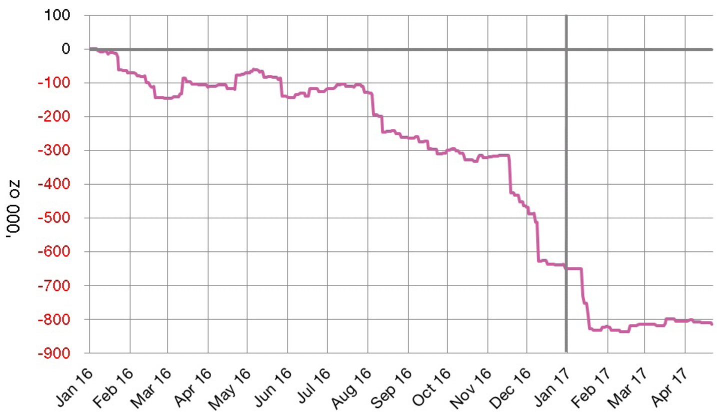
We also expect widespread use of GPFs in China going forward. A PN limit will be implemented in 2020 as part of China 6a standards, while mandatory RDE testing will be introduced under China 6b in 2023. It is likely that some gasoline vehicles will meet China 6a standards ahead of schedule, and that GPF fitment will grow steadily over the next three years.

"We expect a significant widening in this year's market deficit, to nearly 800,000 oz."

Industrial demand for palladium is expected to rise this year. Sales of palladium catalyst to the Chinese chemicals industry may return to growth in 2017, as the industry constructs new capacity for key chemical feedstocks such as monoethylene glycol (MEG), in order to increase domestic self-sufficiency. MEG is an important feedstock for polyethylene terephthalate (PET), widely used in packaging applications and textiles, and is usually manufactured from oil using a non-pgm process. However, because China is a net oil importer but has large domestic coal reserves, an increasing number of Chinese producers are using an alternative 'coal-to-MEG' (CTMEG) process, which involves a palladium catalyst.

Following two years of heavy liquidation, net ETF holdings began 2017 at little more than half their 2015 peak. During January, there was further heavy selling of European ETFs, as palladium surged above $750/oz, but holdings have since stabilised, despite further price gains. US ETF holdings were comparatively stable during the first quarter, while there was some modest buying in the South African funds. Although we believe that most palladium investment is 'in the money', it may be that remaining ETF holders have a longer-term investment horizon or a specific strategic objective: our forecast assumes that the extent of profit-taking will be significantly lower than in either of the last two years. However, we still expect investment to be in negative territory in 2017.

Net investment in palladium ETFs since January 2016



Assuming we are correct about a fall in the rate of ETF liquidation, 2017 should see gross demand for palladium regain the 10 million oz level last seen in 2014 (a year when demand was supported by ETF buying of nearly 950,000 oz). At the same time, combined primary and secondary supplies will rise only marginally, as higher autocatalyst recycling is offset by lower shipments from Russia, North America and Zimbabwe. The result will be a significant widening in this year's market deficit, to nearly 800,000 oz.

Summary of Rhodium SUPPLY & DEMAND IN 2016

SUMMARY: RHODIUM

- Strong purchases by auto and glass companies in China moved the rhodium market closer to balance.
- Significant growth in Chinese car sales pushed autocatalyst demand to a nine-year high.
- Industrial demand was supported by strong investment in the glass-fibre sector.
- Primary and secondary supplies rose slightly, but recycling volumes have yet to regain former peaks.

The rhodium market moved closer to balance in 2016, on the back of rising demand from Chinese automakers and glass manufacturers. Remarkable annual growth in Chinese passenger car sales helped lift global consumption of rhodium in autocatalysts by 4% to its highest level for nine years, while industrial demand was supported by strong investment in the glass-fibre sector. However, demand growth was partly offset by a modest increase in both primary and secondary supplies.

Primary supplies of rhodium rose by 3% to 774,000 oz. The largest gains came from Zimbabwe, with Zimplats reporting a 36% rise in production of rhodium in smelter matte. Part of this gain was derived from the processing of stockpiled material that accumulated during an interruption to smelter operations in 2015. South African supplies also rose modestly, as weakness in underlying mine output was offset by reductions in stocks.

As expected, production of rhodium from the South African mines fell by about 2%, reflecting weak output from the large western Bushveld complexes owned and operated by Impala Platinum and Lonmin, both of which mine large quantities of rhodium-rich UG2 reef. Combined output from the Impala lease area and Lonmin's Marikana mine fell by over 10%. However, this was partly offset by gains elsewhere, particularly from the eastern Bushveld UG2 mines, and from Anglo American's Amandelbult and Union operations.

In contrast, shipments of rhodium by South African producers were higher than expected. This was primarily because of a larger-than-anticipated contribution from pipeline stocks, as Lonmin conducted a clean-up of its smelter during which it recovered significant quantities of pgm from the reprocessing of refractory bricks, slag and other materials. In addition, a run-out at Anglo's Waterval smelter had less impact on rhodium output than we had predicted.

The recovery of rhodium from spent autocatalysts improved modestly to 273,000 oz in 2016, although it remained below the levels seen in the 2013–2014 period. An improvement in steel prices led to some improvement in volumes of scrapped vehicles, but rhodium recoveries rose less quickly than those of platinum or palladium; there has been an increase in the collection of platinum-only diesel catalysts in Europe, and highly loaded gasoline catalysts (including some palladium-only bricks) in the USA.

Rhodium Supply and Demand '000 oz			
Supply	**2015**	**2016**	**2017**
South Africa	611	615	600
Russia	80	85	85
Others	64	74	69
Total Supply	**755**	**774**	**754**
Gross Demand			
Autocatalyst	765	795	810
Other	163	195	181
Total Gross Demand	**928**	**990**	**991**
Recycling	-265	-273	-290
Total Net Demand	**663**	**717**	**701**
Movements in Stocks	92	57	53

Gross demand for rhodium rose by 7% to 990,000 oz in 2016, reflecting strong demand from the automotive and glass sectors. Automotive demand hit a nine-year high of 795,000 oz, as consumption by Chinese car companies surged in line with a 16% increase in domestic production of gasoline vehicles, while European consumption was lifted by the wider adoption of lean NOx traps (LNTs) on Euro 6b diesel cars. However, there was some further modest thrifting of rhodium loadings on Japanese gasoline models.

"Chinese fibreglass companies are adopting alloys with a higher rhodium content."

Industrial demand for rhodium was also strong: while purchases by chemical companies eased somewhat following two years of elevated demand, consumption by the glass sector more than doubled to 80,000 oz on the back of unusually strong buying in China. Demand for glass fibre is rising strongly, in line with increased use of fibreglass for applications in the automotive and wind turbine sectors. Vehicle manufacturers are making increasing use of fibre-reinforced engineering plastics, for example in engine parts, door modules and instrument panels; this enables them to reduce overall vehicle weight, improve fuel efficiency and reduce CO_2 emissions. Likewise, in the wind power industry, fibreglass is used to strengthen and reduce the weight of the sail arms of the turbine. At the same time, low rhodium prices have encouraged Chinese fibreglass companies to adopt platinum alloys with a higher rhodium content, to improve the technical performance and extend the life of their glass-making equipment.

"Demand for rhodium investment products returned to positive territory in 2016."

Demand for rhodium in investment products such as small bars and ETFs returned to positive territory in 2016, after modest disinvestment the previous year. This was the primary reason for the increase in our estimate of 'other demand'. We measure demand for rhodium both in ETFs and in the form of small investment bars; the latter are fabricated in small numbers, primarily in Europe, for sale to specialist collectors and investors. In the ETF sector, demand was positive in 2016 following modest redemptions in 2015. The launch of a new South African rhodium ETF in late 2015 did not have the immediate impact on demand that occurred when platinum and palladium products were introduced in previous years. However, it did result in the repatriation of some holdings formerly held in the European rhodium ETF, while the final quarter saw some fresh buying into rising prices.

Two consecutive years of fundamental surplus left the rhodium market particularly depressed for most of 2016, with the price falling below $650/oz in mid-year, its lowest level since early 2004. However, it staged a recovery from October onwards, ending the year at $770/oz, on the back of robust industrial purchasing, and some increased investor and speculator interest. While we estimate that demand for rhodium in ETFs and small investment products amounted to less than 10,000 oz in 2016, we believe that there was also some speculative buying, particularly in Asia. This latter purchasing is not included in our demand figures.

Forecast of Rhodium SUPPLY & DEMAND IN 2017

FORECAST: RHODIUM

- The rhodium market will remain in moderate surplus, despite firm demand.
- Autocatalyst consumption will be at a ten-year peak, but sales to glass makers will moderate.
- Shipments by primary producers may fall, but this should be matched by higher recycling volumes.
- Robust demand has encouraged some speculative buying, lifting prices above $1,000/oz.

Shipments of rhodium by primary producers are likely to retreat slightly in 2017, following unusually high shipments from South Africa and Zimbabwe last year. However, this will be balanced by anticipated growth in secondary supplies from the recycling of spent autocatalysts. With overall demand stable, the market is forecast to remain in moderate surplus.

Rhodium prices have, nevertheless, made some notable gains since the beginning of 2017, rising from $770/oz in January to over $1,000/oz by the end of March. While gross demand is not predicted to rise this year, at nearly 1 million oz it is robust by historical standards, and there are prospects of further growth in automotive demand. In contrast, there is very limited potential for expansion in supplies, and some risk of declines going forward, especially if UG2 miners in South Africa remain under financial pressure.

We believe that this picture of longer-term risks to availability may have encouraged some speculative purchasing, particularly in Asia. This investment takes place outside of conventional funds for which data is available, such as the rhodium ETFs offered by Deutsche Bank in Europe and Standard Bank in South Africa, holdings in which were broadly unchanged during the first quarter of 2017. As a result, we do not treat this type of speculative investment as demand, but instead classify such purchases as movements in stocks. It appears that despite recent increases in price, speculators have been reluctant to release their holdings to the market. For a time, during March 2017, this resulted in the development of 'backwardation', a situation in which rhodium for immediate delivery becomes more expensive than metal for future delivery.

On the supply side, we believe that South African shipments of rhodium may decline slightly this year, after a particularly strong showing in 2016. Underlying mine production of rhodium in South Africa should be broadly flat, in line with platinum output, but the industry remains vulnerable to disruption from safety stoppages and industrial and community unrest. In addition, shipments of metal recovered from in-process stocks were relatively high last year; we allow for stock sales to decline in 2017.

Supplies from Zimbabwe are also forecast to edge lower. Zimplats had a bumper year in 2016, due to the processing of a backlog of concentrate following the previous year's smelter shutdown, and pgm output should return to more normal levels

"South African rhodium shipments may decline slightly after a strong showing in 2016."

in 2017. Elsewhere, the rhodium content of ores tends to be much lower than in southern Africa. Supplies of rhodium from Russia, North America and other countries are forecast to be stable.

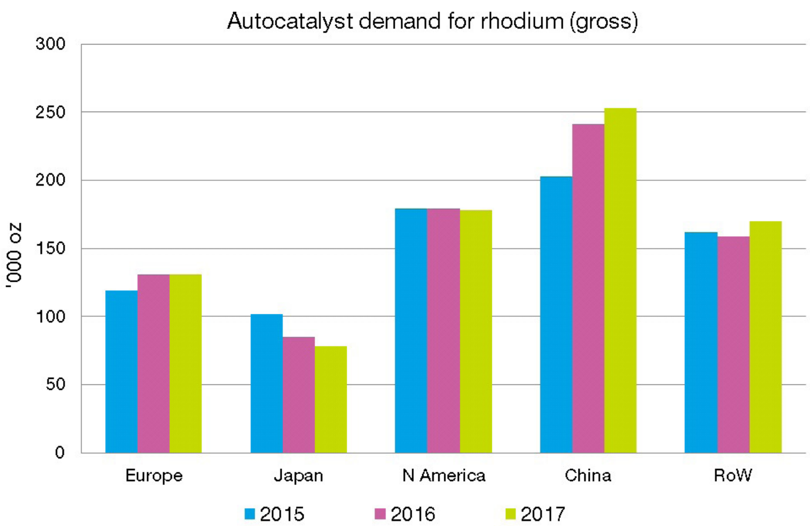
Recoveries of secondary metal from scrapped catalytic converters are forecast to rise by 6% to 290,000 oz. Collectors and refiners report that the amount of spent catalyst removed from end-of-live vehicles (ELVs) has begun to recover, after two years during which vehicle recycling volumes were weak compared to historical numbers. However, this year's gain in rhodium recycling will be slightly lower than for platinum, and significantly below that of palladium. This is explained by a number of factors, including the growth of diesel catalyst scrap in Europe (prior to Euro 6b, diesel catalysts did not contain any rhodium), increased availability of catalysts from the early 2000s including some palladium-only bricks with very high palladium loadings, and the general impact of rhodium thrifting over the last decade.

Demand from the automotive sector is forecast to see modest growth this year, up 2% to 810,000 oz, in line with tightening legislation in several major auto markets, and increases in global gasoline vehicle output. However, this will be partly offset by a fall in the use of rhodium on European diesel vehicles, reflecting a fall in the fitment of lean NOx traps (LNTs).

"2017 is expected to mark the start of a gradual increase in rhodium loadings on European gasoline cars."

In Europe, 2017 is expected to mark the start of a period of gradual increase in rhodium loadings on gasoline cars. The implementation of two new stages of European legislation will begin in September this year: Euro 6c mandates a particle number (PN) limit (in addition to existing particulate mass, PM, standards) for gasoline direct injection (GDI) vehicles, while Euro 6d-TEMP will introduce real driving emissions (RDE) standards for both PN and NOx (see pages 15 and 29 for further information).

Meeting NOx limits over the full range of driving conditions is technically challenging, and is expected to result in a rise in average catalyst volumes in order to optimise NOx control. Since rhodium is the best catalyst for NOx reduction, it is likely that its share of the gasoline pgm mix will increase. However, the potential gains that can be realised by adding more rhodium to catalyst systems will vary significantly between car companies and models: the benefits will be greatest where rhodium loadings have been most aggressively thrifted in the past.



The adoption of a mandatory PN limit for GDI vehicles under Euro 6c starting in September 2017 will result in the increasing use of gasoline particulate filters (GPFs). Only a minority of gasoline vehicles will be equipped with a filter in 2017, but fitment is expected to rise significantly starting next year. While some filters will be uncoated, many will use palladium-rhodium catalyst technology. Thus, we expect to see incremental gains in the overall pgm content of European gasoline catalyst systems over the next few years, with growth in rhodium loadings likely to be proportionally greater than for palladium.

Johnson Matthey
Precious Metals Management

"In North America, the implementation of Tier 3 federal regulations will begin this year."

In contrast, the outlook for rhodium usage in light duty diesel vehicles in Europe is weak. For Euro 6d-TEMP, a shift away from lean NOx traps in favour of SCR will result in a decline in rhodium loadings on diesel cars starting in 2017. This decline could be halted once final Euro 6d standards are enforced, at which point many automakers plan to equip vehicles with systems that combine NOx trap and SCR technology. However, catalyst systems and loadings for Euro 6d are still under development, and their rhodium content remains uncertain.

We also expect to see some increase in rhodium loadings in most other major gasoline markets, with the exception of Japan, where loadings have typically been relatively high and where there may be some limited potential for further thrifting. In North America, the implementation of Tier 3 Federal regulations will begin this year. This legislation is complex, allowing automakers to certify their vehicles to a range of different standards as long as fleet average emissions limits are met; the overall impact will be a progressive tightening of permissible emissions over the next eight years. By 2025, the combined limit for non-methane organic gases (NMOG) plus NOx will be considerably lower than under Euro 6b emissions standards. While we do not expect widespread GPF fitment, because there is no separate PN limit, tighter NMOG + NOx standards are likely to drive a modest increase in rhodium loadings on US gasoline cars over the next few years. However, in 2017 and 2018, any gains are likely to be offset by a fall in gasoline vehicle output, with both diesel and battery electric vehicles predicted to win US market share. It should be noted that NOx traps are rarely used on US vehicles and there is therefore very little rhodium usage in the North American diesel sector.

"Rhodium loadings on gasoline vehicles for the Chinese market are expected to rise."

Rhodium loadings on gasoline vehicles built for the Chinese market are also expected to rise this year, as China 5 legislation is extended to all vehicles sold nationally. Looking ahead, two new phases of legislation, China 6a and 6b, are due to be implemented in around 2020 and 2023 respectively. It is likely that these will lead to higher loadings of both palladium and rhodium, although engine design and exhaust treatment strategies have yet to be confirmed. We also expect some vehicles to be equipped with GPFs, in addition to three way catalysts, in order to meet China 6 limits. While it is not yet clear to what extent loadings will need to rise, it seems likely that overall growth in both the pgm content of catalysts and in vehicle production will be positive for Chinese rhodium demand in 2017 and beyond.

Industrial demand for rhodium is forecast to contract this year, primarily due to weakness in purchasing by the LCD glass sector, where a combination of productivity gains and the heavy investment seen over the last decade has resulted in some overcapacity. However, purchasing of platinum and rhodium for new fibreglass facilities remains robust, reflecting continuing growth in the use of fibre-reinforced plastics in the automotive and wind turbine industries.

PLATINUM '000 oz - Supply and Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	4,110	4,208	3,547	4,571	4,392	4,383
	Russia[2]	801	736	700	670	723	668
	North America	306	318	339	316	338	335
	Zimbabwe[3]	337	410	401	401	489	463
	Others[3]	126	163	156	151	161	162
	Total Supply	**5,680**	**5,835**	**5,143**	**6,109**	**6,103**	**6,011**
Demand[4]	Autocatalyst[4]	3,158	3,000	3,103	3,264	3,318	3,164
	Chemical	452	528	523	539	545	550
	Electrical[4]	176	218	225	229	235	263
	Glass	153	100	212	160	242	229
	Investment	450	871	277	451	620	220
	Jewellery[4]	2,783	3,028	2,897	2,824	2,446	2,341
	Medical and Biomedical[5]	223	214	214	215	217	220
	Petroleum	112	159	165	142	143	147
	Other	395	433	438	447	461	472
	Total Gross Demand	**7,902**	**8,551**	**8,054**	**8,271**	**8,227**	**7,606**
Recycling[6]	Autocatalyst	-1,120	-1,206	-1,272	-1,110	-1,152	-1,247
	Electrical	-22	-24	-27	-29	-32	-34
	Jewellery	-895	-790	-762	-574	-738	-616
	Total Recycling	**-2,037**	**-2,020**	**-2,061**	**-1,713**	**-1,922**	**-1,897**
	Total Net Demand[7]	**5,865**	**6,531**	**5,993**	**6,558**	**6,305**	**5,709**
	Movement in Stocks[8]	**-185**	**-696**	**-850**	**-449**	**-202**	**302**

Johnson Matthey
Precious Metals Management

PLATINUM '000 oz - Gross Demand by Region							
							Forecast
		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	1,323	1,281	1,475	1,662	1,778	1,664
	Chemical	110	98	103	120	122	122
	Electrical	17	15	14	12	13	16
	Glass	2	6	11	11	11	11
	Investment	135	-40	-73	-88	109	67
	Jewellery	179	219	204	203	177	177
	Medical and Biomedical	78	72	72	71	70	70
	Petroleum	-3	-12	22	-2	5	14
	Other	115	117	115	110	111	110
	Total	**1,956**	**1,756**	**1,943**	**2,099**	**2,396**	**2,251**
Japan	Autocatalyst	591	533	470	413	391	359
	Chemical	35	42	42	41	42	40
	Electrical	21	27	28	28	28	31
	Glass	-3	-20	-96	4	2	6
	Investment	98	-40	19	700	543	60
	Jewellery	312	309	313	314	306	300
	Medical and Biomedical	20	19	19	16	16	16
	Petroleum	3	-1	3	3	3	2
	Other	63	70	71	74	74	74
	Total	**1,140**	**939**	**869**	**1,593**	**1,405**	**888**
N. America	Autocatalyst	395	345	356	390	365	336
	Chemical	106	102	113	115	103	105
	Electrical	21	19	18	18	21	24
	Glass	7	7	12	10	29	33
	Investment	187	57	7	-32	109	108
	Jewellery	187	213	220	235	230	234
	Medical and Biomedical	89	85	83	85	86	87
	Petroleum	46	23	24	40	40	24
	Other	118	124	122	122	118	118
	Total	**1,156**	**975**	**955**	**983**	**1,101**	**1,069**
China	Autocatalyst	93	130	130	136	155	156
	Chemical	89	146	109	144	141	174
	Electrical	31	36	38	40	40	44
	Glass	53	92	211	111	130	100
	Investment	0	0	0	0	0	0
	Jewellery	1,950	2,100	1,935	1,796	1,510	1,405
	Medical and Biomedical	15	17	18	19	19	20
	Petroleum	21	56	30	32	26	25
	Other	40	49	52	58	73	81
	Total	**2,292**	**2,626**	**2,523**	**2,336**	**2,094**	**2,005**
RoW	Autocatalyst	756	711	672	663	629	649
	Chemical	112	140	156	119	137	109
	Electrical	86	121	127	131	133	148
	Glass	94	15	74	24	70	79
	Investment	30	894	324	-129	-141	-15
	Jewellery	155	187	225	276	223	225
	Medical and Biomedical	21	21	22	24	26	27
	Petroleum	45	93	86	69	69	82
	Other	59	73	78	83	85	89
	Total	**1,358**	**2,255**	**1,764**	**1,260**	**1,231**	**1,393**
	Grand total	**7,902**	**8,551**	**8,054**	**8,271**	**8,227**	**7,606**

PLATINUM Tonnes - Supply and Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	127.8	130.9	110.3	142.2	136.6	136.3
	Russia[2]	24.9	22.9	21.8	20.8	22.5	20.8
	North America	9.5	9.9	10.5	9.8	10.5	10.4
	Zimbabwe[3]	10.5	12.8	12.5	12.5	15.2	14.4
	Others[3]	3.9	5.1	4.9	4.7	5.0	5.0
	Total Supply	**176.6**	**181.6**	**160.0**	**190.0**	**189.8**	**186.9**
Demand[4]	Autocatalyst[4]	98.2	93.2	96.5	101.4	103.3	98.6
	Chemical	14.1	16.4	16.3	16.8	17.0	17.1
	Electrical[4]	5.5	6.8	7.1	7.2	7.3	8.2
	Glass	4.7	3.2	6.6	4.9	7.5	7.1
	Investment	13.9	27.2	8.6	14.1	19.3	6.9
	Jewellery[4]	86.6	94.1	90.0	87.9	76.1	72.8
	Medical and Biomedical[5]	7.0	6.6	6.7	6.6	6.8	6.8
	Petroleum	3.5	4.9	5.1	4.3	4.4	4.6
	Other	12.3	13.5	13.6	13.9	14.4	14.7
	Total Gross Demand	**245.8**	**265.9**	**250.5**	**257.1**	**256.1**	**236.8**
Recycling[6]	Autocatalyst	-34.9	-37.5	-39.6	-34.5	-35.8	-38.8
	Electrical	-0.7	-0.7	-0.8	-0.9	-1.0	-1.0
	Jewellery	-27.9	-24.6	-23.7	-17.9	-23.0	-19.2
	Total Recycling	**-63.5**	**-62.8**	**-64.1**	**-53.3**	**-59.8**	**-59.0**
	Total Net Demand[7]	**182.3**	**203.1**	**186.4**	**203.8**	**196.3**	**177.8**
	Movement in Stocks[8]	**-5.7**	**-21.5**	**-26.4**	**-13.8**	**-6.5**	**9.1**

PLATINUM Tonnes - Gross Demand by Region							
							Forecast
		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	41.1	39.8	45.9	51.7	55.3	51.8
	Chemical	3.4	3.0	3.2	3.7	3.8	3.8
	Electrical	0.5	0.5	0.4	0.4	0.4	0.5
	Glass	0.1	0.2	0.3	0.3	0.3	0.3
	Investment	4.2	-1.2	-2.3	-2.7	3.4	2.1
	Jewellery	5.6	6.8	6.3	6.3	5.5	5.5
	Medical and Biomedical	2.4	2.2	2.2	2.2	2.2	2.2
	Petroleum	-0.1	-0.4	0.7	-0.1	0.2	0.4
	Other	3.6	3.6	3.6	3.4	3.5	3.4
	Total	**60.8**	**54.5**	**60.3**	**65.2**	**74.6**	**70.0**
Japan	Autocatalyst	18.4	16.6	14.6	12.8	12.2	11.2
	Chemical	1.1	1.3	1.3	1.3	1.3	1.2
	Electrical	0.6	0.8	0.9	0.9	0.9	1.0
	Glass	-0.1	-0.6	-3.0	0.1	0.1	0.2
	Investment	3.0	-1.2	0.6	21.8	16.9	1.9
	Jewellery	9.7	9.6	9.7	9.8	9.5	9.3
	Medical and Biomedical	0.6	0.6	0.6	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	2.3	2.3	2.3
	Total	**35.4**	**29.3**	**27.0**	**49.6**	**43.8**	**27.7**
N. America	Autocatalyst	12.3	10.7	11.1	12.1	11.4	10.5
	Chemical	3.3	3.2	3.5	3.6	3.2	3.3
	Electrical	0.7	0.6	0.6	0.6	0.7	0.7
	Glass	0.2	0.2	0.4	0.3	0.9	1.0
	Investment	5.8	1.8	0.2	-1.0	3.4	3.4
	Jewellery	5.8	6.6	6.8	7.3	7.2	7.3
	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	0.7
	Other	3.7	3.9	3.8	3.8	3.7	3.7
	Total	**36.0**	**30.3**	**29.7**	**30.5**	**34.4**	**33.3**
China	Autocatalyst	2.9	4.0	4.0	4.2	4.8	4.9
	Chemical	2.8	4.5	3.4	4.5	4.4	5.4
	Electrical	1.0	1.1	1.2	1.2	1.2	1.4
	Glass	1.6	2.9	6.6	3.5	4.0	3.1
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	60.7	65.3	60.2	55.9	47.0	43.7
	Medical and Biomedical	0.5	0.5	0.6	0.6	0.6	0.6
	Petroleum	0.7	1.7	0.9	1.0	0.8	0.8
	Other	1.2	1.5	1.6	1.8	2.3	2.5
	Total	**71.4**	**81.5**	**78.5**	**72.7**	**65.1**	**62.4**
RoW	Autocatalyst	23.5	22.1	20.9	20.6	19.6	20.2
	Chemical	3.5	4.4	4.9	3.7	4.3	3.4
	Electrical	2.7	3.8	4.0	4.1	4.1	4.6
	Glass	2.9	0.5	2.3	0.7	2.2	2.5
	Investment	0.9	27.8	10.1	-4.0	-4.4	-0.5
	Jewellery	4.8	5.8	7.0	8.6	6.9	7.0
	Medical and Biomedical	0.7	0.7	0.7	0.7	0.8	0.8
	Petroleum	1.4	2.9	2.7	2.1	2.1	2.6
	Other	1.8	2.3	2.4	2.6	2.6	2.8
	Total	**42.2**	**70.3**	**55.0**	**39.1**	**38.2**	**43.4**
	Grand total	**245.8**	**265.9**	**250.5**	**257.1**	**256.1**	**236.8**

JM
Johnson Matthey
Precious Metals Management

PALLADIUM '000 oz - Supply and Demand							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	2,359	2,465	2,125	2,684	2,574	2,581
	Russia: Primary[2]	2,627	2,528	2,589	2,434	2,773	2,684
	Russia: State Stock Sales[2]	260	100	0	0	0	0
	North America	811	831	912	874	894	874
	Zimbabwe[3]	266	322	327	320	392	363
	Others[3]	162	152	150	142	129	129
	Total Supply	**6,485**	**6,398**	**6,103**	**6,454**	**6,762**	**6,631**
Demand[4]	Autocatalyst[4]	6,673	7,061	7,512	7,651	7,935	8,217
	Chemical	524	440	358	439	411	522
	Dental	510	457	468	475	427	413
	Electrical[4]	1,190	1,070	1,014	960	953	945
	Investment	467	-8	943	-659	-646	-298
	Jewellery[4]	442	354	272	223	189	182
	Other	104	109	111	133	147	148
	Total Gross Demand	**9,910**	**9,483**	**10,678**	**9,222**	**9,416**	**10,129**
Recycling[6]	Autocatalyst	-1,675	-1,905	-2,158	-1,891	-1,990	-2,206
	Electrical	-443	-463	-474	-475	-481	-482
	Jewellery	-194	-157	-89	-46	-20	-18
	Total Recycling	**-2,312**	**-2,525**	**-2,721**	**-2,412**	**-2,491**	**-2,706**
	Total Net Demand[7]	**7,598**	**6,958**	**7,957**	**6,810**	**6,925**	**7,423**
	Movement in Stocks[8]	**-1,113**	**-560**	**-1,854**	**-356**	**-163**	**-792**

Johnson Matthey
Precious Metals Management

PALLADIUM '000 oz - Gross Demand by Region

		2012	2013	2014	2015	2016	Forecast 2017
Europe	Autocatalyst	1,427	1,493	1,583	1,624	1,640	1,648
	Chemical	79	76	-19	77	81	82
	Dental	81	80	77	70	65	61
	Electrical	151	119	105	102	101	100
	Investment	163	-14	-74	-200	-269	-183
	Jewellery	64	61	60	59	58	59
	Other	24	24	25	27	30	28
	Total	**1,989**	**1,839**	**1,757**	**1,759**	**1,706**	**1,795**
Japan	Autocatalyst	799	782	795	768	799	767
	Chemical	17	18	18	17	15	15
	Dental	220	184	205	227	198	192
	Electrical	320	245	236	214	210	207
	Investment	0	-4	-2	4	-3	0
	Jewellery	70	70	67	66	62	60
	Other	9	9	9	9	9	9
	Total	**1,435**	**1,304**	**1,328**	**1,305**	**1,290**	**1,250**
N. America	Autocatalyst	1,803	1,771	1,961	2,035	1,948	1,984
	Chemical	87	70	74	79	81	86
	Dental	190	168	160	152	138	133
	Electrical	163	159	153	147	146	144
	Investment	304	10	-205	-181	-71	-15
	Jewellery	44	43	44	42	38	35
	Other	39	43	43	59	52	53
	Total	**2,630**	**2,264**	**2,230**	**2,333**	**2,332**	**2,420**
China	Autocatalyst	1,325	1,499	1,608	1,654	2,029	2,163
	Chemical	213	180	200	194	165	265
	Dental	3	8	8	8	7	7
	Electrical	176	168	170	168	170	172
	Investment	0	0	0	0	0	0
	Jewellery	238	155	78	34	10	8
	Other	14	15	16	17	31	35
	Total	**1,969**	**2,025**	**2,080**	**2,075**	**2,412**	**2,650**
RoW	Autocatalyst	1,319	1,516	1,565	1,570	1,519	1,655
	Chemical	128	96	85	72	69	74
	Dental	16	17	18	18	19	20
	Electrical	380	379	350	329	326	322
	Investment	0	0	1,224	-282	-303	-100
	Jewellery	26	25	23	22	21	20
	Other	18	18	18	21	25	23
	Total	**1,887**	**2,051**	**3,283**	**1,750**	**1,676**	**2,014**
	Grand total	**9,910**	**9,483**	**10,678**	**9,222**	**9,416**	**10,129**

PALLADIUM Tonnes - Supply and Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	73.4	76.7	66.1	83.5	80.1	80.3
	Russia: Primary[2]	81.7	78.6	80.5	75.7	86.3	83.5
	Russia: State Stock Sales[2]	8.1	3.1	0.0	0.0	0.0	0.0
	North America	25.2	25.8	28.4	27.2	27.8	27.2
	Zimbabwe[3]	8.3	10.0	10.2	10.0	12.2	11.3
	Others[3]	5.0	4.7	4.7	4.4	4.0	4.0
	Total Supply	**201.7**	**198.9**	**189.9**	**200.8**	**210.4**	**206.3**
Demand[4]	Autocatalyst[4]	207.5	219.6	233.6	237.9	246.8	255.7
	Chemical	16.3	13.8	11.1	13.6	12.7	16.3
	Dental	15.8	14.1	14.6	14.8	13.3	12.8
	Electrical[4]	37.1	33.2	31.6	29.9	29.5	29.3
	Investment	14.6	-0.2	29.3	-20.5	-20.1	-9.3
	Jewellery[4]	13.8	11.0	8.5	7.0	5.9	5.6
	Other	3.2	3.4	3.5	4.1	4.6	4.6
	Total Gross Demand	**308.3**	**294.9**	**332.2**	**286.8**	**292.7**	**315.0**
Recycling[6]	Autocatalyst	-52.2	-59.2	-67.1	-58.8	-61.8	-68.7
	Electrical	-13.7	-14.4	-14.8	-14.8	-15.0	-15.0
	Jewellery	-6.0	-4.9	-2.7	-1.4	-0.6	-0.6
	Total Recycling	**-71.9**	**-78.5**	**-84.6**	**-75.0**	**-77.4**	**-84.3**
	Total Net Demand[7]	**236.4**	**216.4**	**247.6**	**211.8**	**215.3**	**230.7**
	Movement in Stocks[8]	**-34.7**	**-17.5**	**-57.7**	**-11.0**	**-4.9**	**-24.4**

PALLADIUM Tonnes - Gross Demand by Region							
							Forecast
		2012	2013	2014	2015	2016	2017
Europe	Autocatalyst	44.4	46.4	49.2	50.5	51.0	51.3
	Chemical	2.5	2.4	-0.6	2.4	2.5	2.6
	Dental	2.5	2.5	2.4	2.2	2.0	1.9
	Electrical	4.7	3.7	3.3	3.2	3.1	3.1
	Investment	5.1	-0.4	-2.3	-6.2	-8.4	-5.7
	Jewellery	2.0	1.9	1.9	1.8	1.8	1.8
	Other	0.7	0.7	0.8	0.8	0.9	0.9
	Total	**61.9**	**57.2**	**54.7**	**54.7**	**52.9**	**55.9**
Japan	Autocatalyst	24.8	24.3	24.7	23.9	24.9	23.9
	Chemical	0.5	0.6	0.6	0.5	0.5	0.5
	Dental	6.8	5.7	6.4	7.1	6.2	6.0
	Electrical	10.0	7.6	7.3	6.7	6.5	6.4
	Investment	0.0	-0.1	-0.1	0.1	-0.1	0.0
	Jewellery	2.2	2.2	2.1	2.1	1.9	1.9
	Other	0.3	0.3	0.3	0.3	0.3	0.3
	Total	**44.6**	**40.6**	**41.3**	**40.7**	**40.2**	**39.0**
N. America	Autocatalyst	56.1	55.1	61.0	63.3	60.6	61.7
	Chemical	2.7	2.2	2.3	2.5	2.5	2.7
	Dental	5.9	5.2	5.0	4.7	4.3	4.1
	Electrical	5.1	4.9	4.8	4.6	4.5	4.5
	Investment	9.5	0.3	-6.4	-5.6	-2.2	-0.5
	Jewellery	1.4	1.3	1.4	1.3	1.2	1.1
	Other	1.2	1.3	1.3	1.8	1.6	1.6
	Total	**81.9**	**70.3**	**69.4**	**72.6**	**72.5**	**75.2**
China	Autocatalyst	41.2	46.6	50.0	51.4	63.1	67.3
	Chemical	6.6	5.6	6.2	6.0	5.1	8.2
	Dental	0.1	0.2	0.2	0.2	0.2	0.2
	Electrical	5.5	5.2	5.3	5.2	5.3	5.3
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	7.4	4.8	2.4	1.1	0.3	0.2
	Other	0.4	0.5	0.5	0.5	1.0	1.1
	Total	**61.2**	**62.9**	**64.6**	**64.4**	**75.0**	**82.3**
RoW	Autocatalyst	41.0	47.2	48.7	48.8	47.2	51.5
	Chemical	4.0	3.0	2.6	2.2	2.1	2.3
	Dental	0.5	0.5	0.6	0.6	0.6	0.6
	Electrical	11.8	11.8	10.9	10.2	10.1	10.0
	Investment	0.0	0.0	38.1	-8.8	-9.4	-3.1
	Jewellery	0.8	0.8	0.7	0.7	0.7	0.6
	Other	0.6	0.6	0.6	0.7	0.8	0.7
	Total	**58.7**	**63.9**	**102.2**	**54.4**	**52.1**	**62.6**
	Grand total	**308.3**	**294.9**	**332.2**	**286.8**	**292.7**	**315.0**

RHODIUM '000 oz - Supply and Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	577	554	469	611	615	600
	Russia[2]	90	80	80	80	85	85
	North America	22	23	24	23	24	24
	Zimbabwe[3]	28	36	36	35	43	38
	Others[3]	3	8	7	6	7	7
	Total Supply	**720**	**701**	**616**	**755**	**774**	**754**
Demand[4]	Autocatalyst[4]	775	770	786	765	795	810
	Chemical	80	82	91	93	70	84
	Electrical	6	5	3	3	5	5
	Glass	35	47	57	37	80	50
	Other	63	87	38	30	40	42
	Total Gross Demand	**959**	**991**	**975**	**928**	**990**	**991**
Recycling[6]	Autocatalyst	-252	-278	-305	-265	-273	-290
	Total Recycling	**-252**	**-278**	**-305**	**-265**	**-273**	**-290**
	Total Net Demand[7]	**707**	**713**	**670**	**663**	**717**	**701**
	Movement in Stocks[8]	**13**	**-12**	**-54**	**92**	**57**	**53**

RHODIUM Tonnes - Supply and Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Supply[1]	South Africa	17.9	17.2	14.6	19.0	19.1	18.6
	Russia[2]	2.8	2.5	2.5	2.5	2.6	2.6
	North America	0.7	0.7	0.7	0.7	0.8	0.8
	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**	**24.0**	**23.4**
Demand[4]	Autocatalyst[4]	24.1	24.0	24.5	23.8	24.7	25.2
	Chemical	2.5	2.5	2.8	2.8	2.2	2.6
	Electrical	0.2	0.1	0.1	0.1	0.2	0.2
	Glass	1.0	1.4	1.8	1.2	2.4	1.5
	Other	2.0	2.8	1.2	1.0	1.3	1.3
	Total Gross Demand	**29.8**	**30.8**	**30.4**	**28.9**	**30.8**	**30.8**
Recycling[6]	Autocatalyst	-7.8	-8.6	-9.5	-8.2	-8.5	-9.0
	Total Recycling	**-7.8**	**-8.6**	**-9.5**	**-8.2**	**-8.5**	**-9.0**
	Total Net Demand[7]	**22.0**	**22.2**	**20.9**	**20.7**	**22.3**	**21.8**
	Movement in Stocks[8]	**0.4**	**-0.5**	**-1.8**	**2.8**	**1.7**	**1.6**

Johnson Matthey
Precious Metals Management

IRIDIUM '000 oz - Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Demand	Chemical	19	20	20	20	23	23
	Electrical	28	35	44	80	100	83
	Electrochemical	73	50	55	57	46	46
	Other	75	81	89	94	80	85
	Total Demand	**195**	**186**	**208**	**251**	**248**	**237**

IRIDIUM Tonnes - Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Demand	Chemical	0.6	0.6	0.6	0.6	0.7	0.7
	Electrical	0.9	1.1	1.4	2.5	3.1	2.6
	Electrochemical	2.3	1.6	1.7	1.8	1.4	1.4
	Other	2.3	2.5	2.8	2.9	2.5	2.6
	Total Demand	**6.1**	**5.8**	**6.5**	**7.8**	**7.7**	**7.3**

RUTHENIUM '000 oz - Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Demand	Chemical	134	312	332	402	248	291
	Electrical	247	337	360	458	444	455
	Electrochemical	172	146	154	140	149	149
	Other	79	106	108	149	154	162
	Total Demand	**632**	**901**	**954**	**1,149**	**996**	**1,057**

RUTHENIUM Tonnes - Demand							
							Forecast
		2012	2013	2014	2015	2016	2017
Demand	Chemical	4.2	9.7	10.3	12.5	7.7	9.0
	Electrical	7.7	10.5	11.2	14.3	13.8	14.2
	Electrochemical	5.3	4.5	4.8	4.3	4.6	4.6
	Other	2.5	3.3	3.4	4.6	4.8	5.0
	Total Demand	**19.7**	**28.0**	**29.7**	**35.7**	**30.9**	**32.8**

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.

[2]Our **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.

[3]Supplies 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.

[5]Our **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.

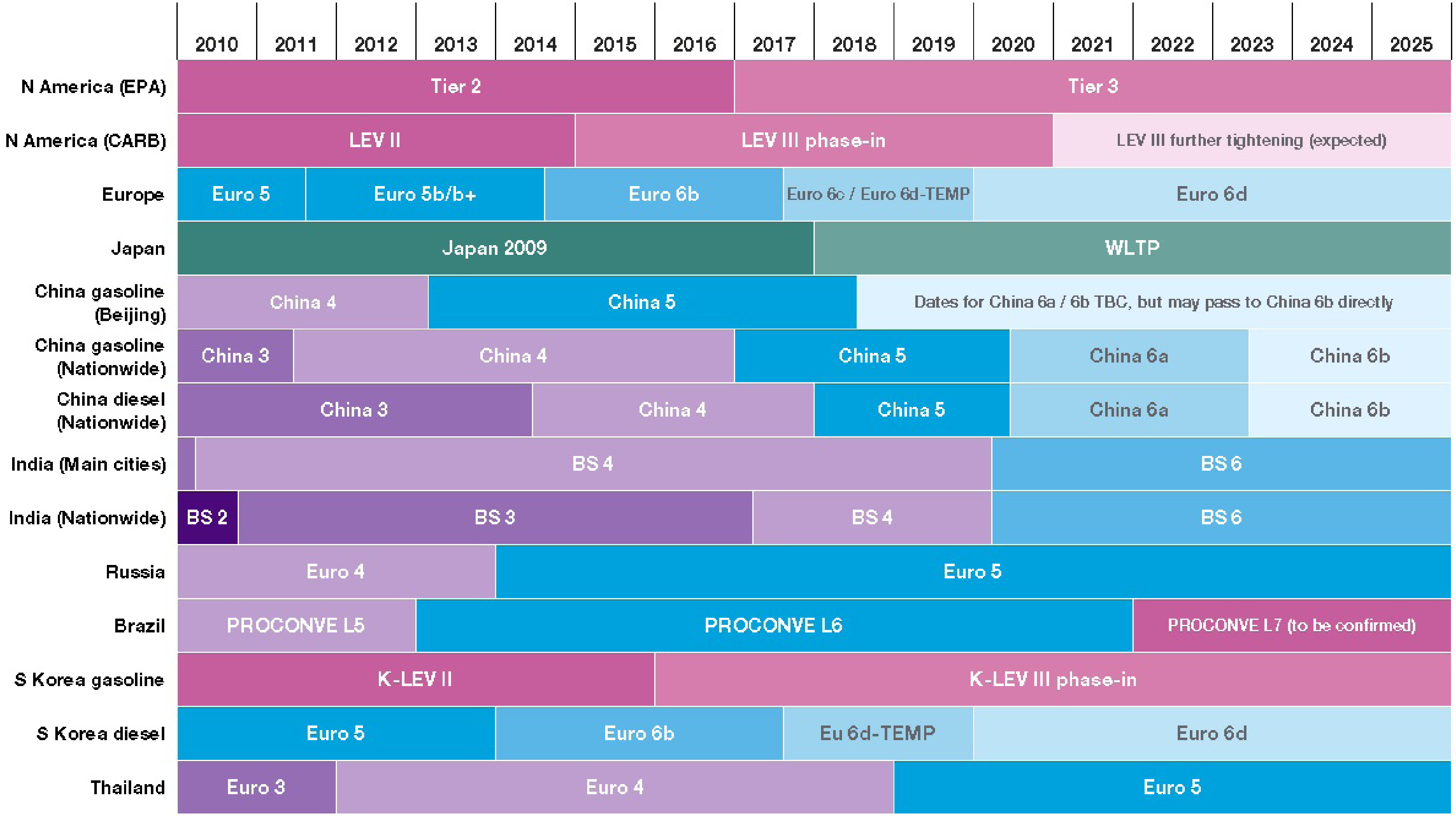
[7]**Net demand** figures are equivalent to the sum of gross demand in an application less any metal recovery from open loop scrap in that application, whether the recycled metal is reused in that industry or sold into another application. Where no recycling figure is given for an application, gross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

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

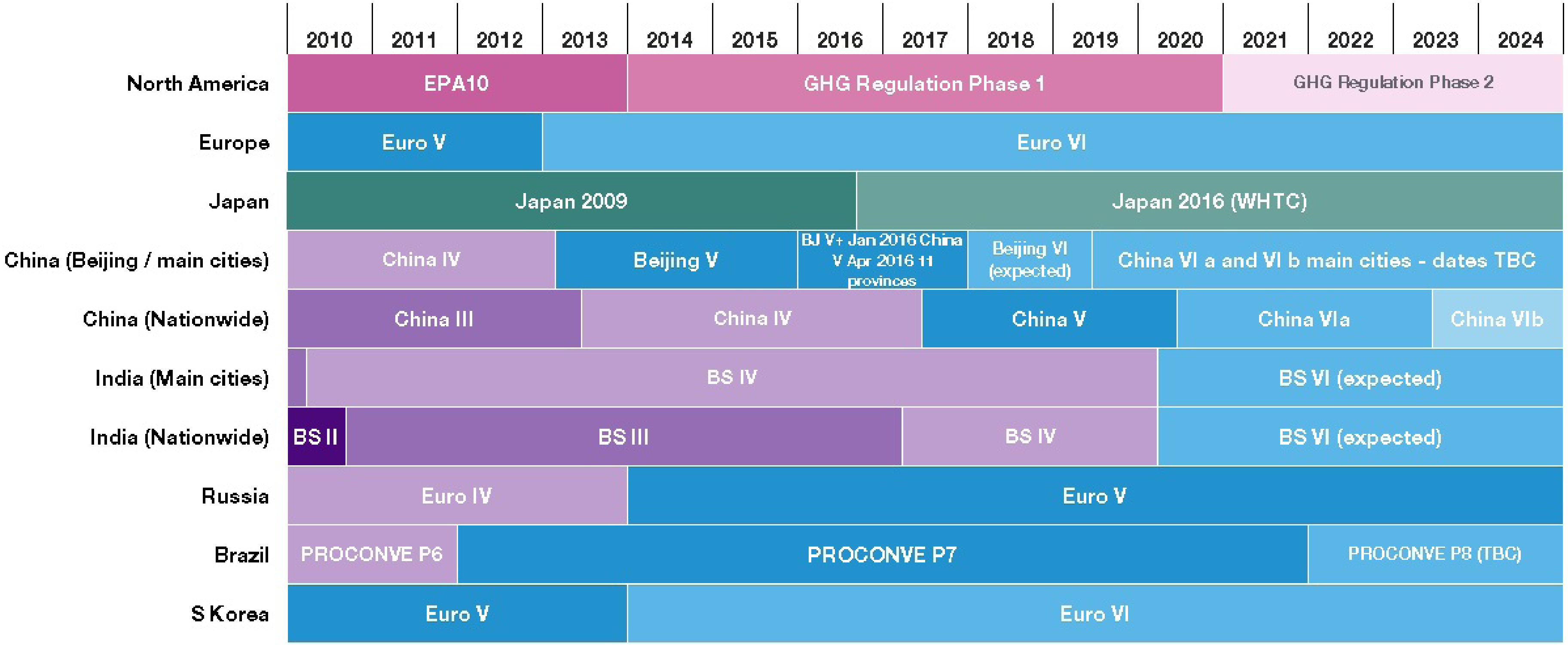
EMISSIONS LEGISLATION: LIGHT DUTY



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.

Johnson Matthey
Precious Metals Management

EMISSIONS LEGISLATION: HEAVY DUTY DIESEL



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

Johnson Matthey
Precious Metals Management

DISCLAIMER

Johnson Matthey PLC endeavours to ensure the accuracy of the information and materials contained within this report, but makes no warranty as to accuracy, completeness or suitability for any particular purpose. Johnson Matthey PLC accepts no liability whatsoever in respect of reliance placed by the user on information and materials contained in this report, which are utilised expressly at the user's own risk.

In particular, this report and the information and materials in this report are not, and should not be construed as, an offer to buy or sell, or solicitation of an offer to buy or sell, any regulated precious metal related products or any other regulated products, securities or investments, or making any recommendation or providing any investment or other advice with respect to the purchase, sale or other disposition of, any regulated precious metal related products or any other regulated products, securities or investments including, without limitation, any advice to the effect that any precious metal related transaction is appropriate or suitable for any investment objective or financial situation of a prospective investor.

A decision to invest in any regulated precious metal related products or any other regulated products, securities or investments should not be made in reliance on any of the information or materials in this report. Before making any investment decision, prospective investors should seek advice from their financial, legal, tax and accounting advisers, take into account their individual financial needs and circumstances and carefully consider the risks associated with such investment decisions. This report does not, and should not be construed as acting to, sponsor, advocate, endorse or promote any regulated precious metal related products or any other regulated products, securities or investments.