

Summary of Platinum SUPPLY & DEMAND IN 2015

SUMMARY: PLATINUM

- Growth in auto and investment demand helped keep the platinum market in significant deficit in 2015.
- South African shipments reached a four-year high, with a strong recovery in mine production and further destocking by producers.
- Recycling fell by 17%, as low prices hit scrap volumes in the autocatalyst and jewellery sectors.
- Autocatalyst demand rose by 6%, as Euro 6b legislation was phased in and global diesel car output hit record highs.
- 2015 saw exceptional levels of physical investment in Japan, while Chinese jewellery demand proved more resilient than expected.

The platinum market suffered from negative sentiment and falling prices in 2015, but demand trends were broadly positive. Expectations of weakness in the Chinese jewellery market proved overstated, while net selling of platinum by ETF investors in Europe, the USA and South Africa was outweighed by a surge of physical investment demand in Japan. Consumption of platinum in autocatalysts was strong, while industrial offtake was stable, leaving total demand for platinum up 4%. On the supply side, a recovery in sales by South African producers was partly offset by a steep fall in recoveries from scrapped cars and old jewellery, leaving the market in significant deficit.

Primary supplies of platinum rose by 19% to 6.08 million oz in 2015, the highest level in four years. This gain was entirely due to higher shipments from South Africa, where platinum production recovered strongly from 2014's damaging strike; sales by producers in other regions were flat or down.

Stock movements once again played an important role in the supply story: South African producers released significant quantities of platinum from refined and in-process inventories, in order to maintain cash flow during a period of weak prices and unprecedented financial pressure. In contrast, some producers in other regions added modestly to stocks in 2015, either in response to low prices, or to provide a buffer against future operational disruption.

Shipments of platinum from South Africa rose by over 1 million oz to 4.57 million oz, the highest level since 2011. This was 274,000 oz higher than we forecast in our November 2015 report; most of this change is attributable to stock movements. We previously assumed that producers were unlikely to supplement their sales with shipments of platinum from inventory, following heavy depletion of reserves during the 2014 strike. However, the need to generate revenue led all three major producers to make further sales from stocks last year. We estimate that nearly 150,000 oz of platinum were refined from pipeline inventories (including 130,000 oz following a stocktake at Anglo Platinum's refinery), while some 70,000 oz were shipped from pre-existing refined stocks.

During the past two years, around 650,000 oz of platinum have been supplied from inventories held by South African producers. This focus on revenue generation can be explained by the unprecedented financial stress under which the industry has been operating, due to a combination of strike losses, productivity issues, continuing mining cost inflation (albeit down from its double-digit peak), and declines in the values of both pgm and base metals to multi-year lows.

Rand depreciation protected producers from the full impact of last year's collapse in dollar-denominated pgm prices, but platinum's rand price

Platinum Supply and Demand '000 oz			
Supply	2014	2015	2016
South Africa	3,537	4,569	4,288
Russia	700	670	679
Others	871	837	932
Total Supply	5,108	6,076	5,899
Gross Demand			
Autocatalyst	3,241	3,433	3,497
Jewellery	2,897	2,827	2,929
Industrial	1,755	1,749	1,919
Investment	277	451	332
Total Gross Demand	8,170	8,460	8,677
Recycling	-2,071	-1,725	-1,917
Total Net Demand	6,099	6,735	6,760
Movements in Stocks	-991	-659	-861



“ South African producers sold significant quantities of pgm from stocks in order to generate much-needed revenue. ”

nevertheless dropped by about 9% from its January 2015 peak of nearly R15,000 per oz, to just over R13,500 per oz at the year end (this compares to a fall of over 30% in dollar platinum prices over the same period). Other metal prices were also weak: in rand terms, palladium also lost 9% of its value, while rhodium suffered a decline of nearly 30%, and nickel (which accounts for a significant proportion of by-product revenue at some platinum mines) fell by over 20%.

While shipments of platinum were at a four-year high last year, underlying production was almost identical to 2013's figure, at 4.35 million oz. Nevertheless, compared to 2014's strike-hit total, there was a significant improvement in output: overall, the operations that had been affected by the AMCU stoppage reported a near-doubling in production.

At these older western Bushveld mines – the traditional ‘backbone’ of the South African platinum industry – years of underinvestment, shaft closures and rationalisations have taken their toll. As recently as 2007, these operations collectively produced 3.5 million oz per annum; last year, output from the same mines totalled less than 2.4 million oz. Restructuring and rationalisation continued during 2015, and will extend into 2016 and beyond.

“ During 2015, platinum's rand price dropped 9%, versus a 30% drop in the dollar price. ”

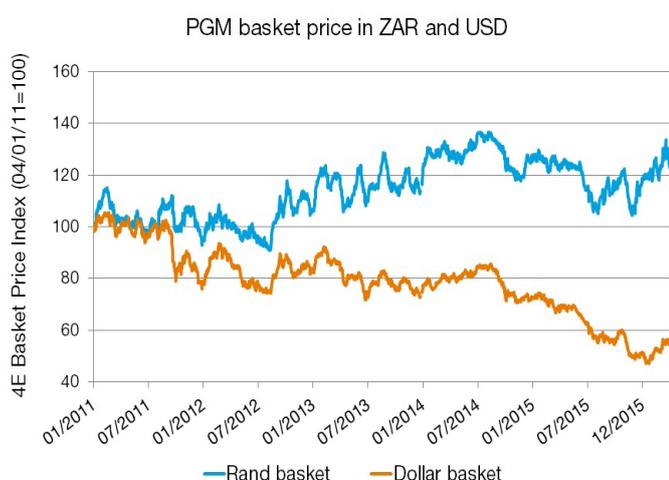
In the past two years, Anglo American Platinum's Rustenburg Section has undergone a series of shaft closures and reorganisations, and last September the company agreed to sell its Rustenburg assets to Sibanye Gold. Anglo also intends to sell the Union mine but, if a buyer cannot be found, it will consider placing the operation on care-and-maintenance. Following the closure of its decline sections, production at Union totalled 141,000 oz last year, compared with a previous baseline of 220,000 oz. The group's interests in the Pandora joint venture and the Bokoni mine are also up for sale.

Impala Platinum is undertaking rationalisation at its Rustenburg lease area. The mechanised sections at 8 and 12 shafts were closed in December 2015 (removing about 45,000 oz of annual platinum production), while the 17 shaft replacement project has been placed on care-and-maintenance pending higher pgm prices.

Of the major mining houses, it is Lonmin that has come under the greatest financial pressure. In November 2015, the company announced a rights issue in order to strengthen its balance sheet: this was completed in December, raising \$373 million in net proceeds.

A rationalisation programme is underway, involving several shaft closures that will eventually reduce Lonmin's annual platinum output by around 100,000 oz. At the large Hossy and Newman shafts, mining operations will continue in the immediate future in order to extract available ore reserves, but development work will cease. The 1B shaft was mothballed in October 2015, while two other small, older shafts are also slated for closure.

Production from mines not directly affected by the strike rose more modestly, from 1.86 million oz in 2014 to 1.95 million oz last year. Over half this increase came not from traditional Merensky or UG2 mining, but from sources rich in palladium, nickel or chrome, such as Anglo's Mogalakwena mine, the Tharisa chrome mine, and the Nkomati Nickel mine, all of which achieved record pgm production levels. (It should be noted that



“ Sales by Norilsk Nickel fell, due to stock-building ahead of a planned reconfiguration of its processing facilities. ”

we count Nkomati’s pgm in our South African figures, even though this metal is processed outside South Africa.) It was also a good year for Aquarius Platinum’s Kroondal mine, which matched its 2010 peak, while Northam Platinum’s Zondereinde and Booyendal operations both reported higher output.

Two mines commenced operations last year, while one closed. The Smokey Hills mine, formerly owned by Platinum Australia and mothballed in 2012, was temporarily restarted by its new owner, African Thunder Platinum (operations were once again suspended in April 2016 due to low prices). In 2015, its plant processed 234,000 tonnes of ore yielding just over 16,000 oz of pgm and gold; this metal was treated by Impala Refining Services. At Platinum Group Metals Limited’s Maseve mine, which has been under development for several years, concentrator commissioning commenced in late 2015, although the first shipment of pgm concentrate to Anglo American Platinum’s smelter was delayed until early 2016. However, Glencore’s Eland mine, which also had a concentrate offtake agreement with Anglo, was placed on care-and-maintenance in October 2015.

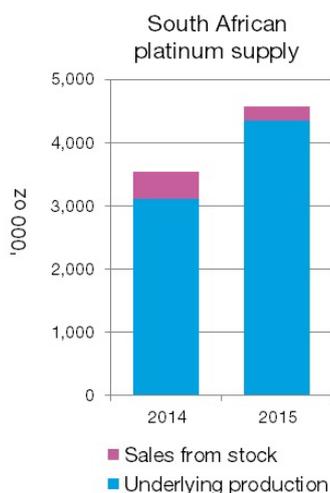
Supplies of pgm from Zimbabwe were stable in 2015. (It should be noted that we measure Zimbabwe supplies at the point of shipment to South Africa, either in the form of concentrate or matte.) Zimplats undertook a number of initiatives in order to mitigate production losses at Bimha mine, where an underground collapse in July 2014 resulted in its temporary closure. It has restarted open-cast mining, and has redeployed mining teams from Bimha to other shafts. Redevelopment at Bimha is in progress, and full production will be restored by April 2018. Elsewhere, both Mimosa and Unki reported incremental improvements and set new production records.

At Norilsk Nickel, production of platinum from the company’s Russian operations was up 2% to 610,000 oz in 2015, following the refining of some in-process stocks in the first half. However, sales of platinum fell by 3%, as Norilsk added an estimated 32,000 oz of platinum to its refined inventories ahead of a reconfiguration of its nickel and pgm processing facilities that will take place during 2016. This is discussed in more detail on pages 26 and 27.

We estimate that output from alluvial platinum mines in the Khabarovsk region and the Urals fell to around 90,000 oz in 2015, half the level of a decade ago. At the major alluvial operations, grades have been falling in recent years, and it has become impossible to compensate by increasing the volume of sands processed.

Supplies of platinum from North America fell by 6% in 2015, to 319,000 oz, due to lower output of by-product pgm from Canadian nickel producers, combined with some stock building by Stillwater Mining Company in the USA.

At Vale’s Sudbury operations, production of nickel–copper ore fell by 6%, following seismic events at the company’s Stobie mine. However, this decline was largely offset by an increase in average nickel and copper grades across Vale’s seven Sudbury mines. We think it likely that average pgm grades also increased, in line with the ramp-up of the Totten mine, where the pgm content is unusually high for Sudbury ores. However, total refined platinum production at Vale, including metal from other sources, fell by 16% to 154,000 oz; this may reflect an increase in pipeline stocks following planned maintenance at the Sudbury smelter in August 2015.



“ Low recycling rates removed at least 200,000 oz of potential secondary supply from the market. ”

Glencore also reported a fall in combined pgm production from its Sudbury and Raglan mines and its Nikkelverk refinery: platinum output totalled 76,000 oz, down 7%. Meanwhile, weak base metal prices forced some smaller nickel miners in the Sudbury basin to curtail output. KGHM closed its McCreedy mine, although its Morrison shaft remains in production, while the Lockerby mine closed in August 2015 after its owner, First Nickel, went into receivership.

Canada's only primary pgm producer, North American Palladium, reported a slight fall in platinum output due to a seven-week mill shutdown in May–June 2015 following flooding at the concentrator. In the USA, America's largest pgm miner, Stillwater, saw a small increase in platinum production, to 118,000 oz. However, sales declined by 9% as the company opted to stockpile modest quantities of metal in anticipation of higher prices in future. Last year also saw the first full year of operations at Lundin Mining's Eagle mine in Michigan, USA, which produced over 27,000 tonnes of nickel and 24,000 tonnes of copper in concentrate, plus by-product pgm.

“ Hoarding by autocatalyst scrap collectors intensified as pgm prices declined to multi-year lows. ”

While primary supplies of platinum overall grew strongly, there was a sharp decline in recoveries from secondary materials last year: lower vehicle scrappage rates and hoarding by autocatalyst collectors resulted in at least 200,000 oz of potential platinum supply being removed from the market. It is interesting to note that this broadly offset the impact of destocking by South African producers.

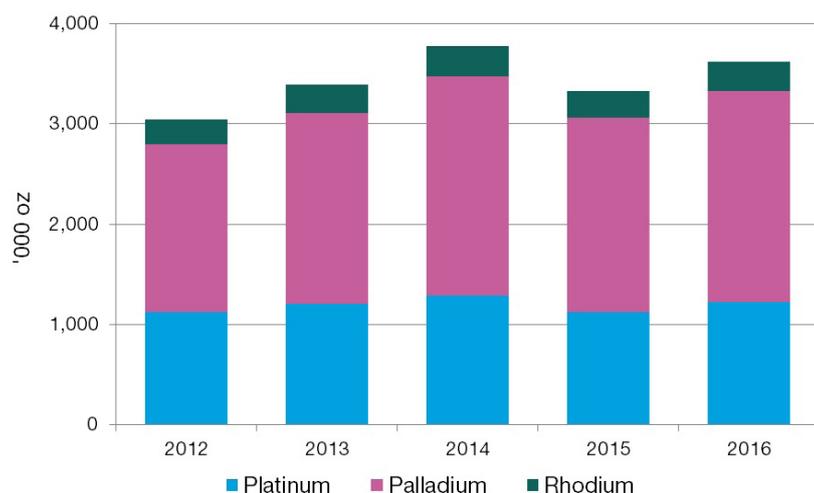
Autocatalyst recycling has now fallen short of expectations for two consecutive years. Growth was unexpectedly lacklustre in 2014, with the platinum content of scrap failing to rise in line with expectations, and some scrap collectors adding to inventories in response to falling pgm prices. In the past, stock-building has generally been a short-lived phenomenon; however, in 2015, hoarding intensified in the face of declines in pgm prices to multi-year lows. This trend was reinforced by a collapse in scrap steel prices, which rendered the recycling of end-of-life vehicles (ELVs) marginal in some cases. The result has been a significant and prolonged slowdown in the volume of catalytic converters being collected, processed and refined.

The withholding of scrap appears to have occurred at several points along the collection and

recovery pathway. Firstly, it appears that there may have been a fundamental reduction in the number of cars reaching scrap yards, for two reasons. A fall in exchange values for ELVs has led to consumers holding onto vehicles longer (often as a second or third family car), and a corresponding rise in the average age of vehicles being retired. Even when cars are retired, they do not necessarily enter the scrap collection system: recyclers face competition from exporters, who purchase old vehicles at auction for resale in less developed markets, in some cases pushing ELV prices above their inherent scrap value.

In addition, some autocatalyst collectors began to stockpile catalytic converters in early 2015, in the face of persistent price weakness. This hoarding

Autocatalyst recovery by metal



PGM MARKET REPORT MAY 2016

Platinum Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Europe	1,487	1,657	1,726	-530	-470	-522	957	1,187	1,204
Japan	500	471	461	-62	-62	-64	438	409	397
North America	356	383	376	-571	-460	-494	-215	-77	-118
China	140	141	148	-25	-30	-33	115	111	115
Rest of World	758	781	786	-94	-100	-106	664	681	680
Total	3,241	3,433	3,497	-1,282	-1,122	-1,219	1,959	2,311	2,278

was unusual, both in its duration and in its magnitude: as the scrap industry matures, it is clear that collectors increasingly have the financial wherewithal to hold onto catalyst scrap for a significant length of time, should they believe that it is in their interests to do so. In some cases, recyclers are holding not only unprocessed scrap, but also refined metal, with the intention

of selling at a more opportune moment once prices improve. It should be noted that we do not include metal in our recycling numbers until it has been returned to the market.

Based on historic trends in catalyst fitment, we had expected to see platinum recycling outperform that of palladium and rhodium in 2015, reflecting growth in platinum usage on European diesels between 2000 and 2005. However, in the event, recoveries of all three ppgm fell by around 12% last year. While there is now some evidence of increasing platinum loadings on ELVs in Europe, growth in the platinum content of autocatalyst scrap continues to lag expectations, perhaps because the fall in scrappage rates has resulted in a rise in the average age of vehicles reaching collectors' yards.

Other recycling sources also supplied less platinum in 2015. The recovery of platinum from old jewellery in China fell by over a third, as low prices discouraged consumers from exchanging jewellery items for new pieces. In addition, there is some evidence that a move towards higher purity alloys is making jewellery makers more reluctant to source platinum via scrap purchasing.

Gross demand for platinum rose by nearly 300,000 oz to 8.46 million oz in 2015, as gains in the automotive and investment sectors offset a modest decline in jewellery demand. While strength in the auto sector came as no surprise, in view of tightening European emissions legislation, both the jewellery and investment sectors finished the year on an unexpectedly strong note: our new estimate for combined demand in these two sectors is more than 250,000 oz higher than in our November 2015 report.

“ Global diesel car production set a new all-time record. ”

Global automotive demand for platinum reached 3.43 million oz in 2015, a gain of 6% on the previous year. This was almost entirely due to growth in the light duty diesel (LDD) sector, where consumption rose by 11%. In contrast, the use of platinum on motorcycles, gasoline cars and heavy duty vehicles declined, although there was a modest increase in consumption on non-road diesel engines.

It was an exceptionally positive year for LDD production globally, with output rising to 16.3 million units, surpassing the previous record set in 2011 by more than half a million vehicles. The vast majority of these were equipped with some form of catalytic emissions control: we estimate that more than 98% of diesel cars built in 2015 carried at least one platinum-containing catalyst brick.

Europe is by far the world's largest LDD market, accounting for two-thirds of global car production in this segment. Diesel's share of European car output peaked at over 50% in 2011, but has been on the wane in the last four years, slipping marginally to 48% in 2015.



Johnson Matthey
Precious Metals Management

“ Over half the light duty diesel vehicles made in Europe in 2015 carried Euro 6b compliant catalyst systems. ”

“ Between 2013 and 2015, the average platinum content of European diesel catalyst systems rose by 13%. ”

Nevertheless, in the context of a strongly recovering total market, output of LDD vehicles still recorded a healthy increase: up 6% to 9.4 million units. This was a million units below the 2007 peak, but represented the highest figure for four years.

Elsewhere, other regional diesel markets also registered healthy growth. Diesel car output grew by 11% in Japan, as one major manufacturer introduced a range of diesel-powered compact cars for the domestic market, competing primarily against gasoline hybrids. In North America, light duty diesel production was up 9%: sales of diesel-powered light trucks continued to forge ahead, outweighing a fall in diesel car sales following the withdrawal from sale of some Volkswagen models.

In the Rest of World region, total LDD output rose by 2%, with a subdued performance in India (the world's second largest diesel car market) being outweighed by primarily export-driven gains in Korea and Thailand (respectively, the third and fourth largest manufacturers of LDD vehicles globally).

The phase-in of Euro 6b emissions standards began in September 2014, and the regulations applied to all new passenger cars registered in Europe starting in September 2015. (For a more detailed discussion of the implementation of the different stages of Euro 6 emissions legislation, see page 47.) As a result, we estimate that over half of LDD vehicles produced in Europe in 2015 were fitted with Euro 6b compliant catalyst systems, up from around a quarter the previous year.

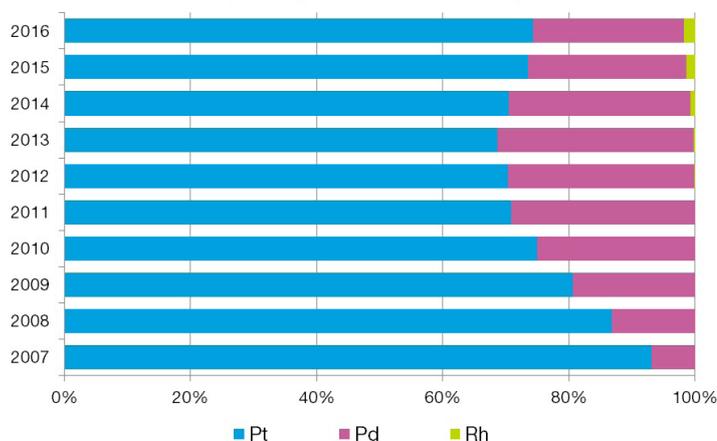
Euro 6b focuses primarily upon diesel NOx emissions, with limits more than halved compared to Euro 5. As a result, nearly all Euro 6b diesels require the addition of NOx aftertreatment: most smaller cars are fitted with a platinum-rich lean NOx trap (LNT), in addition to a diesel particulate filter (DPF), while larger vehicles typically use non-pgm selective catalytic reduction (SCR) technology downstream of a pgm-containing oxidation catalyst and DPF. A small number of vehicles use a combination of LNT and SCR technology.

The move to Euro 6b catalyst technology has had an important impact on average platinum loadings: between 2013 and 2015, we estimate that the average platinum content of a European diesel catalyst system rose by 13%. This gain reflects the addition of platinum-rich LNT bricks to some catalyst systems, combined with higher platinum loadings on oxidation

catalysts and particulate filters, partly at the expense of palladium. In vehicles fitted with SCR technology, platinum plays an important role in controlling the ratio of NO to NO₂ in the exhaust gas stream, which is necessary in order to optimise NOx conversion. As a result, the average platinum to palladium ratio in Euro 6b catalyst systems has increased compared to Euro 5.

Elsewhere, changes to diesel catalyst loadings were comparatively minor. US emissions legislation is gradually tightening, as first California LEV III and subsequently Federal Tier 3 standards are phased in, but to date the impact on platinum demand has been very limited, due to the long phase-in period and the relatively small number of diesel vehicles affected.

European light duty diesel: PGM split



“ Platinum use in gasoline catalysts remains much higher in Japan than elsewhere, despite further thrifting in 2015. ”

In stark contrast to rising global diesel demand, the use of platinum in gasoline catalysts fell by a further 17% in 2015, to little more than 360,000 oz worldwide. Since 2007, platinum usage in this segment has more than halved, despite an increase of around 40% in world light duty gasoline vehicle output over the same period. Most car makers use palladium-rich technology in gasoline emissions catalysis, but there is still some use of platinum by Japanese auto companies, and in lean-burn gasoline vehicles in Europe.

Last year saw further thrifting of platinum by Japanese car makers. In recent years, auto companies in this region have made concerted efforts to reduce and even eliminate platinum from their gasoline vehicles. Nevertheless, usage of platinum in gasoline applications remains significantly higher in Japan than elsewhere, reflecting the traditionally conservative approach to catalyst loadings and the pgm mix adopted by some automakers based in this region. In contrast, where platinum is used by European automakers, it is primarily in response to technical and legislative imperatives, and is largely confined to diesel and a small number of lean-burn gasoline engines.

The heavy duty sector has been a source of significant platinum demand growth in recent years, most recently due to the introduction of Euro VI legislation in 2013–2014. However, growth stalled in 2015, with platinum demand affected both by general thrifting of catalyst pgm content, and by greater use of palladium in heavy duty catalysis.

“ Sales of platinum to the chemicals industry remained at historically high levels. ”

Industrial demand for platinum was stable in 2015, as a fall in demand from petroleum refiners offset modest growth in the glass and chemical sectors. Purchases of platinum by the chemicals industry remained at historically high levels, with further investment in on-purpose propane and isobutane dehydrogenation adding to strong demand from traditional platinum-using sectors such as paraxylene and silicones. There was also a sharp improvement in demand from display glass manufacturers, following two years of sales of metal back to the market in the wake of plant closures in 2013 and 2014.

Platinum usage in hard disks declined modestly. While total demand for data storage capacity continues to rise, disk drive manufacturers reported double-digit declines in shipments of hard drive units last year, as sales of personal computers fell to eight-year lows. However, this fall was partly offset by an increase in the average storage capacity of a hard disk drive unit: between the start of 2014 and the end of 2015, it is estimated that the capacity of a typical drive rose from around 900 gigabytes to over 1.3 terabytes. One way of expanding storage capacity is to increase the number of disks per drive, and this provided some support for platinum demand last year.

Our estimate of electrical demand includes platinum for fuel cell applications. Fuel cell demand rose by 10,000 oz in 2015, with several large phosphoric acid fuel cells being purchased for stationary power generation, and increased use in the transportation sector. After launching in Japan, Toyota's Mirai fuel cell car went on sale in California last August, and in Germany, the UK and Denmark a month later, and early demand was reported to be very positive. In China, a government drive to reduce urban air pollution led to a significant order for fuel cell buses and stimulated the development of fuel cell trams.

“ Demand for large phosphoric acid fuel cells for power generation helped lift platinum demand for fuel cells by 10,000 oz. ”

There was a dip in demand for platinum from petroleum refiners, due in part to the timing of several capacity expansions and some renewed return of platinum back to the market following refinery closures in Europe and elsewhere.



PGM MARKET REPORT MAY 2016

Platinum Demand: Jewellery '000 oz									
	Gross			Recycling			Net		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Europe	204	203	200	-5	-5	-5	199	198	195
Japan	313	314	313	-275	-256	-252	38	58	61
North America	220	240	244	-23	-11	-5	197	229	239
China	1,935	1,796	1,850	-455	-298	-400	1,480	1,498	1,450
Rest of World	225	274	322	-4	-4	-4	221	270	318
Total	2,897	2,827	2,929	-762	-574	-666	2,135	2,253	2,263

Chinese platinum jewellery demand faced significant headwinds in 2015, but ultimately proved more robust than we had anticipated. We now estimate that gross purchases of platinum by jewellery makers in China fell by 7% last year to 1.80 million oz, a much smaller decline than the 16% fall we predicted in our November 2015 report.

“After a weak first half, jewellery manufacturing demand in China staged a significant recovery in the second half.”

The first half of 2015 was a period of unusual weakness in platinum sales to the Chinese jewellery industry, despite significant declines in international market prices which would in the past have stimulated jewellery makers to increase their stocks. Buying into price dips makes sense in a generally rising market, but is less rational during periods of prolonged price weakness; indeed, there is some evidence that manufacturers actively reduced inventories during early 2015. As a result, we estimate that first-half sales of platinum to Chinese jewellery makers fell by over 25% compared with the same period of 2014.

Manufacturing demand staged a significant recovery in the second half. Evidence from the Platinum Guild International’s (PGI’s) Retail Barometer suggests that retail sales of platinum jewellery picked up strongly in mid-year, following a weak first half, leaving sales down only 4% for the year as a whole. This translated into an improvement in purchasing by jewellery makers, who needed to meet rising retail demand as well as rebuild depleted stock levels.

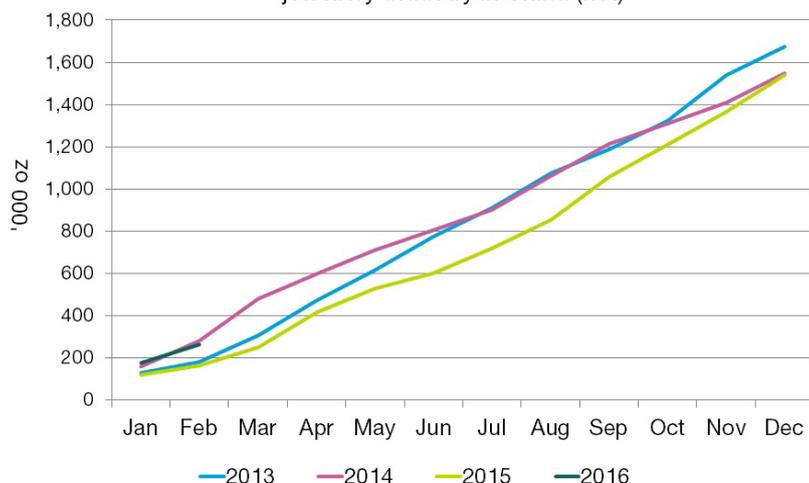
This surge in buying was particularly evident from September onwards: in the final four months of last year, we estimate that net purchases of metal by the jewellery industry were over 40% higher than in the equivalent period of 2014. This is supported by our survey of Chinese platinum jewellery factories, conducted in January 2016, which shows a significant improvement in manufacturing activity in the second half of last year.

Low platinum prices have also had an impact on recycling behaviour in China, where exchanges of old jewellery items form an important part of the retail market. Historically, there

has been a good correlation between price and the volume of recycling as a percentage of gross demand, and 2015 was no exception. Sustained low prices have been reflected in a much lower level of consumer exchanges, with the result that net demand for platinum in jewellery actually grew slightly last year.

Elsewhere, changes in jewellery demand in 2015 were modest, with the notable exception of the rapidly developing Indian market (included in our Rest of World figure), where sales to jewellers rose by 25% to exceed 220,000 oz. While platinum rings, mainly diamond-studded, account for the majority of Indian platinum demand, last year saw particularly strong growth in plain jewellery, including heavier items such as men’s bracelets

Estimated cumulative annual purchasing by the platinum jewellery industry in China (net)



“ Sales to jewellers in India rose by 25% and might have been even higher if not for the catastrophic Chennai floods. ”

and neck chains. Sales of these products have been boosted by the ‘Evara Platinum Blessings’ promotional campaign, which is based on the concept of parents giving their blessings to newly married couples in the form of a platinum jewellery set including men’s and women’s items.

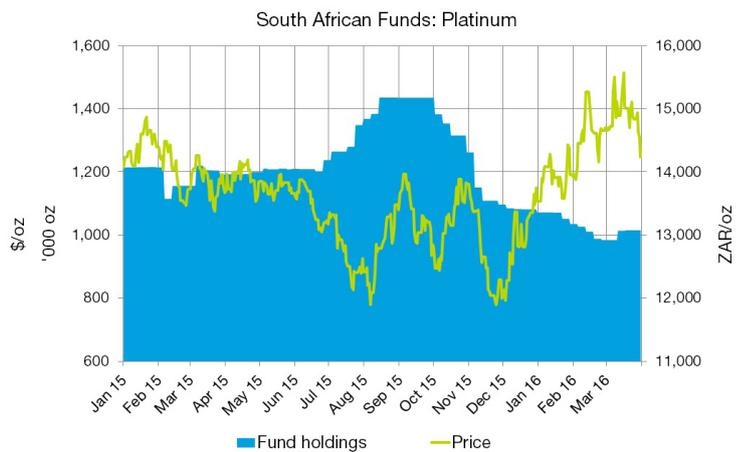
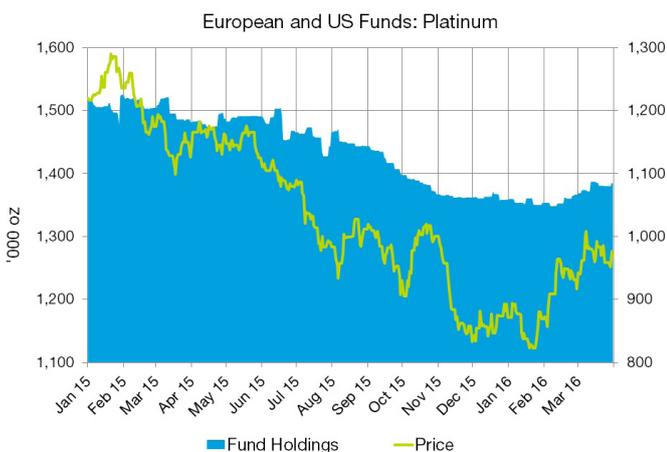
Growth in the Indian market might have been even higher, had it not been for the catastrophic flooding that hit the Chennai region in November and December. This resulted in six weeks of disruption to the jewellery industry during the key wedding season, which ran from the third week of October 2015 to mid-March 2016.

In Japan, steep falls in the yen platinum price caused a surge of interest in platinum bars, but this was not mirrored in the jewellery sector. Unlike their Chinese counterparts, Japanese retailers do not change retail prices frequently: they absorb cost increases when metal prices rise, and enjoy higher margins when prices fall. This means that prices have a very muted impact on consumer demand. However, jewellery makers did report some additional orders in the final quarter of 2015, from wholesalers and retailers seeking to take advantage of low yen-denominated platinum prices. Overall, we think that platinum sales to the Japanese jewellery industry were little changed last year, with lower bridal demand (a consequence of a falling marriage rate) offset by some gains in the fashion jewellery sector.

“ Uncertainty over the outlook for the diesel vehicle and platinum jewellery markets led to selling by US and European investors. ”

European demand was also flat. In the UK, retail sales of platinum jewellery remain robust, and there was another rise in the hallmarking of platinum items. However, in continental Europe, platinum is now largely confined to the ‘high-value’ end of the market, and to the gem-set segment where it remains the preferred metal for the most valuable stones; in lower priced segments, white and rose gold are more popular. In contrast, there was continued growth in the North American market, in line with a recovering economy. US retail sales of platinum jewellery are estimated to have risen by 10%, although part of this demand was met by imports.

During 2015, economic conditions and price movements were generally unfavourable for platinum investment in Europe and North America. Prices moved steadily lower, from over \$1,200 in January to a seven-year low of under \$900 in December: this reflected intensifying negativity in investor sentiment towards commodities in general and pgm in



“ South African ETF holdings were down 140,000 oz for the full year following heavy selling in the final quarter. ”

particular. Investors were discouraged by a combination of uncertainty over the outlook for the diesel vehicle and jewellery markets, while a rapid return to full production in South Africa dampened any expectations of short-term cuts in supply. The prospect of a rise in US interest rates also acted as a drag on precious metals investment generally.

Combined ETF holdings in Europe and North America peaked at close to 1.7 million oz in mid-2013 and again in mid-2014, but have been on a declining trend since the AMCU strike ended. By the end of last year, holdings in these funds had fallen below 1.4 million oz. Investors in these two regions sold over 150,000 oz of platinum during 2015, with disinvestment beginning in mid-year and intensifying in September, especially in Europe.

Because most of the European and US funds have been in existence since before 2011, and there have been significant inflows and outflows during that time, it is difficult to assess the price at which metal was purchased. However, platinum prices have been on a downward trend since 2011, and it is reasonable to assume that most platinum ETF investors were ‘out of the money’ last year. This may explain why selling of platinum has been much more subdued than that of palladium.

“ In contrast to Europe and North America, Japanese investors have a long history of buying into dips in the market. ”

The South African funds also saw some net disinvestment during 2015, but the pattern of investor behaviour differed from that seen elsewhere. Following the inception of the first rand-denominated ETF in April 2013, South African funds rapidly accumulated 1.2 million oz of platinum over a fourteen-month period, most of it at prices of around R14,000 to R15,000 per oz. Thereafter, total investment remained broadly unchanged until mid-2015.

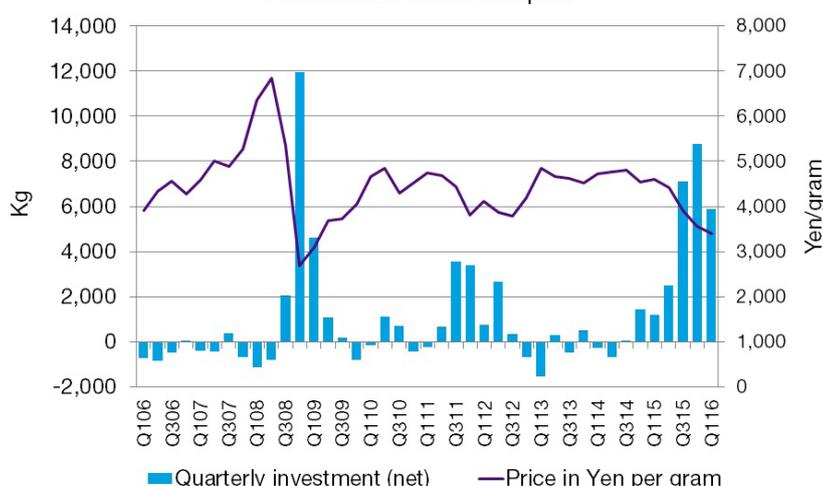
In July 2015, a collapse in the dollar price pushed the rand price below R13,000 per oz, stimulating further investment and lifting total investment in South African ETFs to a peak of around 1.4 million oz in August. However, in the final quarter – despite prices remaining below R13,000 per oz for the most part – investor sentiment appeared to change abruptly. This three-month period saw investors reduce their platinum positions by over 350,000 oz, leaving South African holdings down 140,000 oz for the full year.

Japanese investor behaviour frequently differs from that seen in other regions, and 2015

provided a convincing demonstration of this. Typically, European and North American markets experience a lack of buying interest, or even disinvestment, during periods of low prices; in contrast, Japanese buyers have a long history of buying into dips in the market. Japanese investors generally purchase physical platinum in the form of investment bars which are sold ‘over the counter’ by bullion houses. However, in 2015, there was also significant buying in Mitsubishi’s yen-denominated ETF, with investors adding around 70,000 oz to their holdings.

The Japanese investment bar market was relatively subdued in the first five months of 2015. However, demand began to pick up in mid-year, as the platinum price sank towards and then through the

Platinum bar sales in Japan



“ Platinum investment demand in Japan reached 700,000 oz for the year and led to shortages of investment-grade bars. ”

important psychological barrier of ¥4,000 per gram for the first time since September 2012. Sales reached record levels in November, when the price fell below ¥3,500 per gram, and remained exceptionally strong in December; in these two months alone, we estimate that Japanese investors purchased well in excess of 200,000 oz of platinum. These peak levels of bar demand coincided with the year-end bonus season in Japan: it appears that platinum investment is gaining appeal among younger, salaried Japanese workers.

While this buying was clearly related to a fall in the platinum price to multi-year lows, other factors also played an important role. Probably the most important of these was platinum's move to a significant discount to gold. Indeed, the initial surge in buying in June 2015 was probably largely stimulated by the opening of a price differential of more than ¥400 per gram between the two metals (from close to parity at the start of the year). This discount widened to more than ¥800 per gram in November, when demand for platinum bars reached its peak. The bullion houses report that many investors visiting their retail outlets opted to purchase platinum as well as, or instead of, gold because – at the relative prices seen in the second half of 2015 – platinum was perceived to offer better value for money.

In addition, sales in 2015 may have been influenced by a reduction in the inheritance tax threshold, which came into force in January. It is possible that some investors were attracted to precious metals as a means of storing wealth in a portable form. The value of smaller bars in the 50 to 200 gram range falls well below that which would trigger a reporting requirement.

This has resulted in a change in buying patterns: historically, Japanese bar investment was primarily in the form of half-kilogram bars, but more recently, smaller bars weighing 200 grams and below have increased in popularity. There were significant shortages of bars in 2015, and fabricators responded by converting large quantities of platinum ingot into investment-grade bars mostly weighing between 50 and 500 grams.

In total, we estimate that platinum investment in Japan amounted to 700,000 oz last year, lifting net global investment demand to 450,000 oz. This played a significant role in keeping the market in deficit, in a year when primary supplies increased by nearly 1 million oz. However, while investment flows remain an important factor in determining platinum's supply–demand balance, it is worth noting that the market would have been in deficit in 2015 even if investment demand had been zero. This contrasts with the 2008–2013 period, when the market would have been in continuous surplus had it not been for investment purchasing.

“ The platinum market would have posted a deficit in 2015, even before net global investment of 450,000 oz. ”



Forecast of Platinum **SUPPLY & DEMAND IN 2016**

FORECAST: PLATINUM

- A fourth year of significant deficit is expected in 2016, as a fall in South African shipments offsets a recovery in secondary supplies.
- Euro 6b legislation will apply to all diesel cars sold in Europe this year, lifting platinum use in autocatalysts.
- Sales to jewellery makers are forecast to recover, while industrial consumption will be boosted by record chemical demand.
- Buying by Japanese investors should keep investment demand in positive territory this year.

Our forecast for platinum supply and demand in 2016 envisages a fourth year of significant market deficit. We see little prospect of any increase in shipments of newly mined metal, although combined primary and secondary supplies could rise marginally, assuming some recovery in autocatalyst recycling. On the demand side, this should be the peak year for platinum use on Euro 6 diesel cars, while there are good prospects for further moderate growth in jewellery demand. Industrial consumption is expected to be unusually strong, while continued Japanese buying should keep investment demand in positive territory.

Successive fundamental deficits have as yet failed to have any noticeable impact on market liquidity, confirming the existence of substantial market stocks prior to 2012. During the last three months of 2015, over half a million ounces of platinum flowed into Japan, as Japanese bullion houses imported large quantities of ingot for conversion to investment-grade bars. These usually high physical metal flows – at least double the normal quarterly rate – appeared to have little or no price impact.

Over the last year, sentiment towards platinum has been negatively affected by a slowdown in world economic growth, increased uncertainty in the key Chinese market, and a recovery in South African supplies. This has led to ‘investor fatigue’, evident in a decline in the net long speculative position on the futures markets, as well as in ETF holdings, since mid-2014.

This year, platinum has recovered from lows of below \$820 per oz in January to trade at over \$1,000 per oz during the second half of April. There has been a corresponding increase in the net long futures position, and this may indicate that market sentiment has started to turn more positive. However, uncertainty over the outlook for economic growth in general, and for platinum jewellery and diesel vehicle markets in particular, may continue to act as a drag on investor activity.

Global platinum supplies are expected to fall by 3% this year, to 5.90 million oz. After two years of inventory reductions, South African producers now have less flexibility to supplement supplies with metal from stocks; we predict that shipments from this region will fall by 6% in 2016. Russian sales are forecast to be little changed, although production may undergo some temporary disruption due to processing changes at Norilsk Nickel. In contrast, we expect a modest increase in supplies from Zimbabwe and North America.

The immediate outlook for production at South Africa’s three major refiners is subdued. Anglo expects to treat between 2.3 and 2.4 million oz of platinum this year, compared to refined production of 2.46 million oz in 2015. Output from Impala Platinum’s western Bushveld lease area will be reduced by around 50,000 oz of platinum in the first half, following a serious fire at 14 shaft in January. This means that lease area production is unlikely to grow significantly in 2016. The effects of rationalisation will constrain pgm output

“ South African supplies are unlikely to be supplemented by significant withdrawals from producer stocks in 2016. ”

at Lonmin, although the company expects to maintain platinum sales at around 700,000 oz in the financial year to September.

While there are expansion projects in the ramp-up phase at some smaller producers, including Platinum Group Metals Ltd, Royal Bafokeng Platinum and Northam, these will be balanced by closures and restructuring elsewhere. Thus, underlying platinum output is predicted to be stable at best, even if the industry is able to avoid any major disruptions due to strike action. The current three-year wage agreement at Anglo, Impala and Lonmin expires in June 2016, and talks between the platinum producers and AMCU were due to begin in April.

On the basis that producer stock levels are now at their lowest level for many years, it is unlikely that supplies can be supplemented by significant stock withdrawals for a third consecutive year. Our forecast of 4.29 million oz represents a decrease in shipments of around 280,000 oz compared with 2015; our figure incorporates an allowance of 130,000 oz for losses due to labour, safety or technical disruptions.

The industry will undergo further reshaping in 2016 and beyond. This year will see the entry of a significant new player, Sibanye, whose acquisition of Aquarius Platinum and of Anglo American's Rustenburg operations was approved by competition authorities in March. Anglo is still seeking buyers for other mines, including Union, and its shares of Pandora, Kroondal and Bokoni.

Other producers are lining up to fill anticipated supply deficits going forward. Royal Bafokeng Platinum has delayed the start-up of its Styldrift expansion, but the first metal from this project should be refined during 2016. Northam and its German partner, Heraeus, announced in October 2015 that they would invest in a new smelter, which will give Northam the processing capacity needed to develop and expand its eastern limb projects.

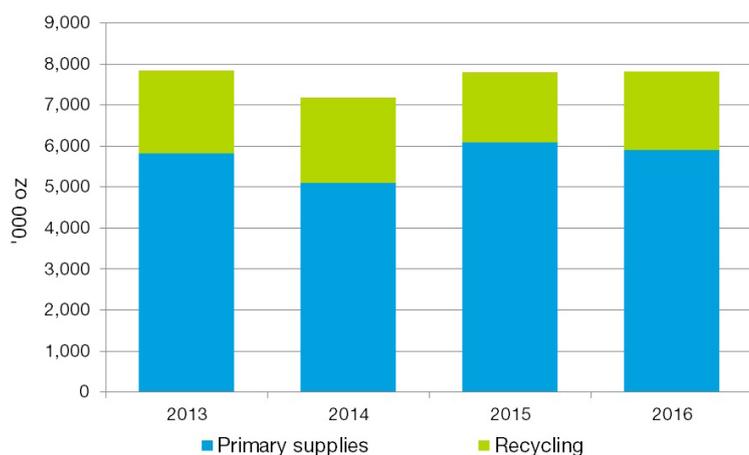
On the northern limb, Ivanhoe Mines is working on a bankable feasibility study for its Platreef Project, and has already begun shaft sinking activities. A pre-feasibility study was based on an initial four-million-tonne-per-year operation yielding 430,000 oz of platinum, palladium, rhodium and gold annually. Platinum Group Metals Ltd also has a northern limb project, Waterberg, which is at the pre-feasibility stage, as well as its new Maseve

mine on the western Bushveld which delivered its first concentrate in February 2016 and is currently in the ramp-up phase.

This year is likely to see a muted production profile in Russia, with the shutdown of Norilsk's ageing nickel plant due to take place during 2016. The transfer of some nickel- and pgm-processing activities to the company's Kola operations is expected to result in a one-time pipeline build, reducing output of all metals this year. However, the stock-building that took place in 2015 should give Norilsk the flexibility to maintain shipments at or slightly above last year's level.

We expect some growth in Zimbabwean supplies this year. Zimplats has now restored production levels following the Bimha shaft collapse, and output in 2016

Platinum: primary supplies plus recycling



“ Global platinum supplies are likely to fall by 3% in 2016, to 5.9 million oz. ”

“ On current evidence, a full recovery in the autocatalyst recycling market may be delayed until 2017 or beyond. ”

will be supplemented by the refining of around 20,000 oz of platinum in matte that was awaiting treatment at the end of 2015. However, the industry is under pressure from low prices and the risks associated with the Zimbabwe government’s indigenisation and local beneficiation programme. Impala Platinum has already committed to the refurbishment of the existing Selous Base Metals Refinery (BMR), and is evaluating increases in furnace capacity. In December 2015, the company received notice of the government’s intent to acquire part of the Zimplats lease area, despite an agreement in 2006 under which the company obtained indigenisation credits in return for the release of approximately 36% of its ground.

Overall, we expect primary supplies to contract by 3% to 5.90 million oz in 2016, representing a drop of 177,000 oz in platinum shipments compared with last year. In contrast, our forecast allows for some improvement in the recovery of platinum from auto and jewellery scrap, following a prolonged period of slower collection rates and active stock-building during 2015.

The quantity of platinum recovered from end-of-life vehicles (ELVs) is forecast to rise by 9% to 1.22 million oz in 2016. The significant level of hoarding seen last year, coupled with an underlying growth in autocatalyst recycling volumes, might have been expected to result in a large increase in recoveries this year. However, during in the first quarter, there was no evidence of such an upturn, despite an improvement in pgm prices since the beginning of the year; this may reflect the fact that steel prices have remained close to multi-year lows. We have therefore taken a cautious view of the potential for improvements in recycling volumes in 2016. It is possible that a full recovery in the autocatalyst recovery market will be delayed until next year or beyond.

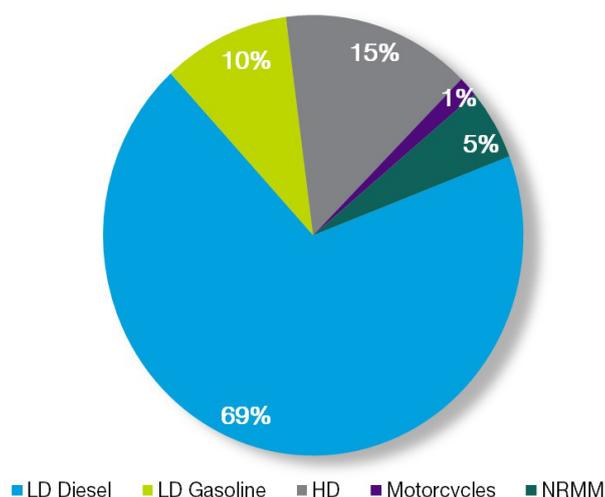
We continue to anticipate an underlying increase in the platinum content of catalyst scrap, especially in Europe, where diesel cars from the early and mid-2000s are now entering the recycling circuit in significant numbers. These vehicles typically carry platinum autocatalysts with relatively high loadings – in some cases higher than on modern diesel cars.

It should be noted that there remains considerable uncertainty about the future trajectory of pgm recoveries from ELVs. Forecasting the pgm content and split of metals in scrapped catalytic converters is particularly challenging at present, due to the dramatic changes in catalyst fitment that took place in the late 1990s and early 2000s: during this period, platinum’s share of the mainly gasoline US market faltered and then collapsed, while platinum usage on European diesels saw unprecedented expansion.

In the last two to three years, predicted increases in the platinum content of scrap have failed to materialise, but we are now starting to see evidence of higher platinum assays in material collected in Europe. In North America, platinum recoveries should be supported in the short-term by increased recycling of heavy duty catalysts, but are expected to decline going forward, reflecting the fall in platinum loadings on light duty vehicles sold in the region after 2003.

European emissions legislation will once again be the key driver of automotive demand growth in 2016: all new diesel cars sold in this region will be equipped with Euro 6b catalyst systems this year. As a result, average loadings on European diesels will rise for a third

Platinum demand by auto sector 2016



“European emissions legislation will again be the key driver of automotive demand growth for platinum in 2016.”

“Going forward, legislation is set to tighten further in Europe, with the introduction of Real Driving Emissions testing.”

consecutive year, and total consumption of platinum in this sector is forecast to increase by 5%. In contrast, demand will be flat or down in most other automotive segments, with the notable exception of the Chinese diesel market where growth is forecast to be significant in percentage terms, but off a very low base. Total automotive demand for platinum is forecast to rise 2% to reach 3.50 million oz in 2016.

We expect some further modest growth in light duty diesel output in Europe this year, as slight diesel share erosion is offset by overall growth in car production. The Volkswagen scandal does not appear to have had any significant effect on consumer attitudes towards diesel engines. In 2016, diesel cars are projected to account for around 47% of total light duty output in Europe, down slightly from 48% last year, and from a peak of 51% in 2011. While diesel's share of the European light duty market is expected to slip further over the next few years, we expect any losses to be modest and gradual.

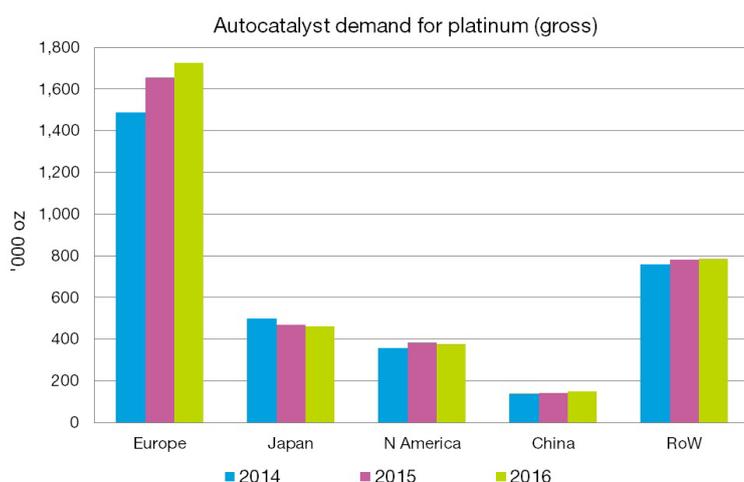
Euro 6b regulations have applied to all new passenger car registrations in Europe since September 2015. Normally, once the implementation of a new phase of European emissions legislation is complete, this is followed by a period of consolidation, during which automakers focus primarily on thrifting. This cycle of European emissions legislation is different, however. Over the next five years there will be further legislative tightening, in the form of stricter particulate emissions limits for gasoline vehicles under Euro 6c, followed by the introduction of Real Driving Emissions (RDE) testing under Euro 6d regulations (see page 47 for a more detailed explanation of the stages of Euro 6 emissions legislation).

For diesel vehicles, Euro 6d is likely to trigger some changes in the mix of catalyst bricks, loadings and pgm splits used on European light duty vehicles, as manufacturers seek to optimise NOx control over a broader range of driving conditions. We expect to see greater use of selective catalytic reduction (SCR), including catalyst bricks known as SCRf that combine the functionality of the SCR and the particulate filter. In some cases, this will be at the expense of lean NOx traps (LNTs), although the impact on platinum use will be mitigated by increased platinum loadings elsewhere in the aftertreatment system, particularly on oxidation catalysts.

Once Euro 6d legislation is fully implemented, we expect many vehicles to use both LNT and SCR technology, due to the need for NOx control during both city driving (where lower engine temperatures favour the use of LNTs) and highway driving (where SCR has the advantage, due to higher engine temperatures).

Nevertheless, the overall impact on platinum consumption is likely to be negative. We believe that European diesel platinum loadings will peak in 2016, after which there will be some gradual erosion of demand as car companies begin to roll out Euro 6d-compliant emissions systems and look to thrift overall pgm content.

In contrast, both China and India are entering a period of increasing platinum consumption, due to a combination of rising diesel vehicle production (both light and heavy duty), and tightening legislation. In 2016, both countries are expected to report higher output of diesel cars and trucks along with increases in both catalyst fitment



“ The Indian government has announced its intention to accelerate the roll-out of tighter emissions legislation. ”

rates and average loadings. At present, diesel cars in both countries are fitted with oxidation catalysts, but particulate filters are not yet in widespread use, while many heavy vehicles can meet existing limits without using any pgm at all. This is set to change over the next few years.

The Indian government has announced its intention to accelerate the roll-out of tighter emissions legislation, skipping Bharat Stage (BS) 5/BS V (equivalent to Euro 5/Euro V) and passing directly to BS 6/BS VI (similar to Euro 6/Euro VI) in 2020. For light duty vehicles, the use of additional platinum-rich bricks (particulate filters and in some cases LNTs) will be strongly positive for platinum loadings, but the cost of BS 6 emissions control systems may have a negative impact on diesel share in the price-sensitive Indian car market. In the heavy duty sector, BS VI introduction will result in the use of pgm-containing catalysts on all trucks, compared with a minority at present.

Chinese emissions legislation is also set to tighten further. Starting in April 2016, eleven Chinese provinces (including the Beijing and Shanghai areas) implemented China 5 regulations for light and heavy duty gasoline vehicles, along with diesel cars. These regulations will be extended nationwide over the next two years. The application of China V to heavy duty vehicles also commenced in April this year, initially affecting only public vehicles in Beijing, Shanghai and nine other provinces; it will be enforced nationwide on all trucks from July 2017.

“ 2016 should be a very strong year for industrial demand. ”

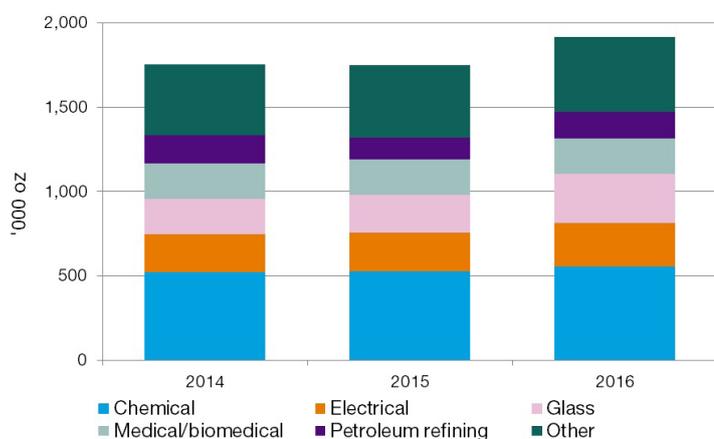
We expect this to be a very strong year for industrial demand. Chemical demand is forecast to remain at unusually high levels, with new paraxylene capacity coming on-stream in the Rest of World region, and sales to the Chinese chemical industry remaining strong. In China, the petrochemical industry is benefiting from strategic projects such as ‘Made in China 2025’, a ten-year programme that focuses on strengthening China’s position as a leading manufacturer.

The outlook for glass demand is positive, with further growth in display glass capacity in China, and an upturn in fibreglass investment in the Rest of World region. Sales to petroleum refiners should also rise, particularly now that the risk of further refinery closures in Europe has been reduced by an improvement in margins in this region. We expect healthy growth in fuel cell demand (included in our electronics number), with another good performance in

the stationary power category, along with an increase in the number of fuel cell vehicles deployed on the road.

The Honda Clarity fuel cell car went on sale in Japan in March 2016, although the company is limiting sales to 200 vehicles in the first year. The Clarity will be introduced in the USA and Europe by the end of 2016, and there are plans to expand production. This vehicle is a notable step in the evolution of fuel cell vehicles, because for the first time the fuel cell fits under the hood of a regular family car. Toyota will also ramp up production of the Mirai, to around 2,000 units in 2016. The world’s first car sharing programme exclusively for fuel cell vehicles will start in Munich this summer, using Hyundai ix35 Fuel Cell cars. In China, further progress in deploying fuel cells in trams and buses is expected.

Gross industrial demand for platinum



“ The momentum in sales to Chinese jewellery makers has continued into the early part of 2016. ”

In the jewellery sector, we expect modest growth in purchasing by Chinese and Indian jewellery makers to lift total gross jewellery demand by around 100,000 oz to 2.93 million oz, the highest level for three years.

Sales to Chinese jewellery makers were very strong in the final four months of 2015, and the momentum continued into the early part of this year. As discussed on page 8, we believe that there may have been some restocking by Chinese jewellery manufacturers and distributors, following inventory reductions in the first half of 2015. However, it is likely that the recovery in demand also reflects a fundamental improvement in retail sales and fabrication levels since the middle of last year. This is supported by evidence from Johnson Matthey’s biannual factory survey, which tracks manufacturing demand, and by the PGI Retail Barometer.

Purchasing by Chinese jewellery makers was unusually strong in January 2016, and remained above year-ago levels in February (it is normal for buying to fall away during this month, because the number of working days is reduced due to Chinese New Year celebrations). The graph below shows our estimate of net purchasing by the Chinese jewellery industry, along with the twelve-month moving average, which has been on a consistent upward trend since mid-2015.

In recent years, the trajectory of platinum demand has been heavily influenced by developments in the gold jewellery market, and this is likely to remain the case in 2016. Three years ago, a correction in the gold price led to increased retail footfall by bargain-hunting consumers, and thus indirectly to higher sales of platinum jewellery, as the retail network expanded and retailers took opportunities to ‘upsell’ platinum items to customers purchasing gold. However, since 2014, a fall in consumer demand for gold jewellery has led to slower retail expansion and reduced footfall, with knock-on impacts in the platinum jewellery sector.

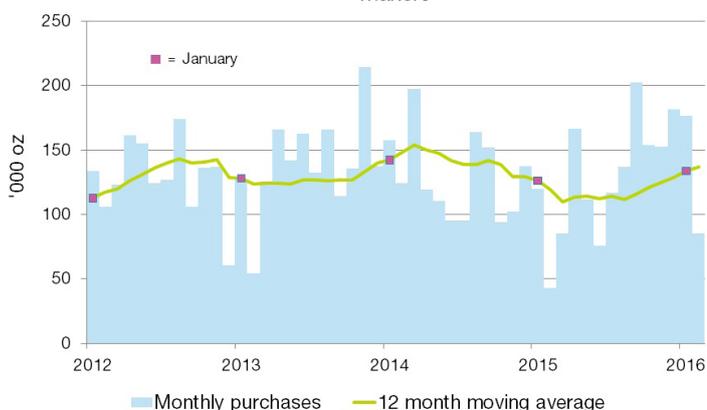
While Chinese jewellery manufacturers always state that platinum jewellery does not compete directly with gold (other than when opportunities to ‘upsell’ occur as described above), changes in the relative prices of the two metals may have an impact this year. Historically, the retail price of platinum has rarely been below that of gold, even during

periods when platinum has traded at a discount on world markets. This has changed recently, with retailers in most areas now posting a higher price per gram for gold than for platinum.

What remains unclear is whether, and how, a sustained discount to gold will affect platinum demand. While Chinese consumers are attracted to products that appreciate in price, and lower platinum prices have therefore had a negative impact on perceptions of value, it is possible that the current price differential will provide additional opportunities for retailers to ‘upsell’ platinum items.

Overall, we believe that the modest recovery in retail sales seen since mid-2015 should help sustain recent improvements in net purchasing by jewellery manufacturers, leading to a small

Estimated net platinum purchases by Chinese jewellery makers



“ Indian platinum jewellery demand will grow by 20%, and prospects for further expansion remain excellent. ”

increase in gross Chinese jewellery demand this year. However, if jewellery recycling also increases, as we predict, net demand may decline slightly.

We continue to expect strong growth in Indian jewellery demand. Promotional campaigns have been effective in raising consumer awareness of platinum and in establishing new market segments in which it can compete alongside, rather than directly against, gold. Market penetration of platinum jewellery in India remains very low, and the target market – young, urban, wealthy individuals – is large and growing rapidly. This means that there is very substantial potential for further expansion of this market.

However, our forecast allows for the rate of expansion in this market to slow slightly to 20% in 2016. We expect growth to be dampened by the knock-on effects of severe flooding in the Chennai region last year: although jewellers were quick to reopen their businesses following the floods, some weddings that would have taken place during the October 2015 to March 2016 period were called off or postponed. Demand has also been affected by industrial action in response to a proposed 1% increase in excise duty on non-silver jewellery, which caused widespread disruption to the jewellery industry during March and early April 2016.

“ The price environment remains conducive to another year of positive investment in Japan. ”

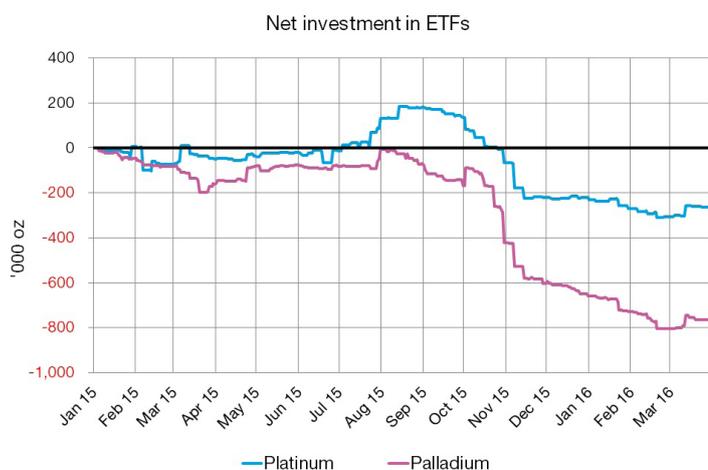
We expect investment to remain in positive territory in 2016, albeit at lower levels than last year. In the first quarter of 2016, there was little discernable trend in total ETF holdings in Europe and North America, despite the platinum price recovering from a low of under \$820 in January to around \$950 at the end of March. There was some ebb and flow of investment during this period, leaving total holdings up about 25,000 oz. South African holdings moved in the opposite direction, with about 55,000 oz of net liquidation during the first quarter. There was a spell of heavy selling between mid-January and mid-February, but some of these losses were recouped the following month. Overall, movements in ETF holdings have been comparatively subdued so far this year, and with many investors out of the money at current prices, we think that – in the absence of large price movements – ETF demand may be close to neutral in 2016.

Sales of platinum bars to Japanese investors are unlikely to reach the exceptional heights achieved in 2015. However, the price environment remains conducive to another year of positive investment. January was another exceptional month for platinum bar sales, as the price dipped towards ¥3,000 per gram, while net sales during February and March remained

well above long-term averages, despite a modest recovery in the yen platinum price.

Japanese investors traditionally hold back once prices start to increase. However, the discount to gold remained consistently over ¥900 per gram throughout the first quarter, and rose as high as ¥1,100 per gram in early March; it is likely that this helped maintain strongly positive sentiment towards platinum among Japanese retail investors. We estimate that net bar investment in the first quarter exceeded 170,000 oz – four times the level seen in the first three months of 2015.

At the time of writing, the yen platinum price remained well below the key ¥4,000 per gram level, with a discount to gold of over ¥700 per gram. Thus, there is reason to be optimistic



“ The deficit in the platinum market is forecast to widen to around 860,000 oz in 2016. ”

about short-term Japanese bar demand. However, if platinum prices rise significantly in yen terms, and particularly if the discount to gold begins to narrow, we would expect to see some slackening of demand, and perhaps some profit-taking.

Analysis of trends in Japanese bar sales over the last eight years suggests that it is very unlikely that net demand in the first quarter will be reversed over the rest of the year. We therefore allow for Japanese investment demand to total a little over 200,000 oz in 2016.

Platinum's move to a significant discount to gold in mid-2015 also appears to have had a positive impact on the coin market. We expect platinum consumption in this sector to rise significantly in 2016, as mints increase production in order to satisfy pent-up consumer demand. The US Mint expects to strike both bullion and numismatic platinum coins this year, while the Austrian Mint intends to launch a one-ounce platinum version of their Vienna Philharmonic bullion coin, and the Perth Mint will offer a 2016 version of its Platypus one-ounce coin.

Overall, assuming positive investment demand as discussed above, we believe that the market is likely to remain in significant deficit in 2016. We currently project that the shortfall of supply over demand will widen to around 860,000 oz. It should be noted that this figure is based on the assumption that there will be some recovery in the collection and processing of scrapped autocatalysts during the second half.

Summary of Palladium SUPPLY & DEMAND IN 2015

SUMMARY: PALLADIUM

- A recovery in production and further sales from stocks in South Africa lifted primary palladium supplies by 6% to 6.43 million oz.
- A steep decline in autocatalyst recovery and weak jewellery recycling led to an 11% fall in secondary supplies.
- Gross demand plunged by 13% due to a 1.6 million oz reversal in ETF purchasing between 2014 and 2015.
- Sales to automakers rose to a record 7.63 million oz, as gasoline vehicle production outperformed expectations in China and Europe.
- Despite negative investment demand, the palladium market remained in a fundamental deficit of 447,000 oz.

The palladium market moved closer to balance last year, due to a strong recovery in South African supplies during a year in which investment demand moved abruptly into negative territory. Global primary supplies of palladium rose by 6%, while gross demand plunged by 13%, almost entirely due to a dramatic reversal in ETF purchasing: investors, who had acquired over 940,000 oz of palladium the previous year, sold around 660,000 oz of their holdings in 2015. This greatly offset overall improvements in automotive and industrial demand, and a steep fall in the recovery of palladium from scrapped catalytic converters: the market deficit shrank from nearly 2 million oz in 2014 to under 500,000 oz last year.

Since 2010, ETF demand has seen enormous annual variations, with very large positive investment in 2010 and 2014, and substantial liquidation in 2011 and 2015. This has tended to mask underlying trends in gross demand. Excluding investment, demand in 'consuming applications' (automotive, industrial and jewellery) has risen steadily from 8.6 million oz in 2010 to just under 10 million oz in 2015. Since 2012, this has been significantly in excess of the level of supply from primary and secondary sources; last year, before accounting for ETF liquidation, the supply shortfall exceeded 1.1 million.

This fundamental shortage occurred despite a significant rise in South African supplies. Gains here were mainly due to the restoration of production to more normal levels following the AMCU stoppage of 2014: palladium output from the strike-affected mines rose by 550,000 oz, representing a near-doubling compared with the previous year. Elsewhere in South Africa, Anglo's Mogalakwena mine – the single largest palladium producing operation in South Africa – reported a 23% gain in refined output, to 467,000 oz (this figure includes some metal derived from in-process stocks). There was also an increase in pgm production at the Nkomati Nickel mine, which delivered some 108,000 oz of by-product palladium for refining.

Shipments from South Africa were also boosted by further sales of producer stocks. Producers' strategic reserves of refined metal were heavily depleted by the AMCU strike, but they ended 2014 with surplus pgm in their processing pipelines, and much of this metal was released last year. In total, we estimate that around 130,000 oz of the South African palladium supplied in 2015 was derived from in-process inventories.

A combination of improved production and continued stock sales pushed South African palladium supplies to their highest level since the peak years of 2006–2007 – a time when the large western Bushveld mines operated by Anglo American, Impala Platinum and Lonmin were collectively producing around 50% more pgm than they do today. In the last eight years, there has been significant rationalisation at these operations, historically the 'backbone' of South African

Palladium Supply and Demand '000 oz			
Supply	2014	2015	2016
South Africa	2,125	2,683	2,521
Russia	2,589	2,434	2,487
Others	1,374	1,309	1,382
Total Supply	6,088	6,426	6,390
Gross Demand			
Autocatalyst	7,462	7,629	7,757
Jewellery	272	225	215
Industrial	2,076	2,138	2,185
Investment	943	-659	-295
Total Gross Demand	10,753	9,333	9,862
Recycling	-2,752	-2,460	-2,629
Total Net demand	8,001	6,873	7,233
Movements in Stocks	-1,913	-447	-843



PGM MARKET REPORT MAY 2016

Palladium Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
Europe	1,583	1,625	1,658	-469	-397	-424	1,114	1,228	1,234
Japan	769	722	741	-119	-106	-114	650	616	627
North America	1,961	2,063	1,937	-1,335	-1,110	-1,196	626	953	741
China	1,623	1,680	1,913	-82	-116	-140	1,541	1,564	1,773
Rest of World	1,526	1,539	1,508	-184	-210	-238	1,342	1,329	1,270
Total	7,462	7,629	7,757	-2,189	-1,939	-2,112	5,273	5,690	5,645

pgm production. This has contributed to a sharp drop in overall mine production of platinum since 2007; in contrast, palladium output has fallen only slightly over this period. This reflects the opening or expansion of several mines extracting relatively palladium-rich ores from the northern and eastern limbs. These include Anglo's Mogalakwena mine, the only operation currently

extracting ore from the Platreef, and eastern Bushveld UG2 mines such as the Impala-ARM joint venture at Two Rivers, and Northam's Booyendal mine. Eastern limb UG2 ores are relatively rich in palladium compared to UG2 elsewhere on the Bushveld complex.

At Norilsk Nickel, output of palladium from Russian ores totalled 2.58 million oz in 2015, almost unchanged compared with the previous year. However, there was a decline in sales as a result of the company's decision to allocate 142,000 oz of palladium to strategic stocks, ahead of changes to its processing flowsheet that will be implemented during 2016. This will involve the closure of the nickel smelter and refinery at the company's Polar site, and the transfer of some nickel processing operations to the Kola Peninsula. In the second half of 2015, Norilsk Nickel reported that reconfiguration of the processing facilities ahead of the transfer was beginning to have some effect on production. However, most of the impact will occur in 2016, when there will be a one-off increase in the processing pipeline for all metals.

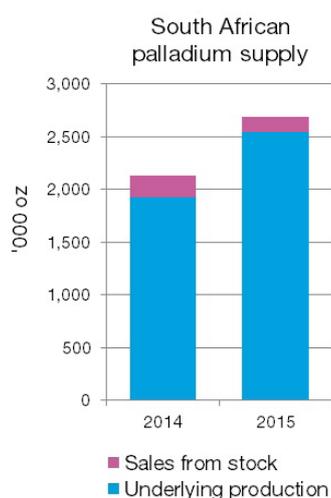
North American supplies of palladium declined by 5% to 867,000 oz last year, due to lower refinery output at Vale, the cessation of low-grade ore treatment at North American Palladium, and a slight fall in sales by Stillwater Mining (following some shipments from stocks during 2014).

Low pgm prices typically have a muted impact on supplies outside southern Africa, since much pgm output in these regions is a by-product of nickel-copper mining. However, weak palladium prices did result in some cuts to North American primary output in 2015. At North American Palladium's Lac des Iles mine, the processing of stockpiled low-grade ore is marginal at current prices, and the company ceased treating this material in the final quarter of last year. This contributed in a 4% decline in palladium production in 2015.

At the USA's only primary pgm producer, Stillwater Mining Company, low prices resulted in a fall in palladium output from the Stillwater mine, following a decision to cease mining in some higher-cost stopes. However, the company's total production rose marginally, due to improved productivity at its lower-cost East Boulder operation, and the ramp-up of the recently-developed Graham Creek area.

Vale reported a 15% decline in nickel production from its Sudbury mines, following seismic events which disrupted production from the Stobie mine, and a maintenance shutdown at the smelter in August. Reported palladium output fell 14% to 341,000 oz; this figure includes metal refined from other sources.

At Glencore's Integrated Nickel Operations (INO: comprises the company's Sudbury nickel mines, the Raglan operation in northern Quebec, and the Nikkelverk refinery in



“ Combined primary and secondary supplies of palladium rose by less than 1% in 2015. ”

Norway), palladium production was up 5%, at 157,000 oz. This may reflect a movement in pipeline stocks, since nickel output from INO sources fell by 4%, platinum by 7%, and copper by 15%. The decline in base metal production was attributed to a planned six-week shutdown at the Sudbury smelter, along with a fall in copper grades at Glencore’s Sudbury mines. In the Sudbury area, the highest pgm grades are typically associated with copper-rich ores.

In total, global primary supplies of palladium rose by 6% in 2015 to reach 6.43 million oz, but this gain was almost entirely offset by a fall in the processing of recycled materials: shipments of secondary palladium fell by 11% to 2.46 million oz. Combined primary and secondary supplies rose by less than 1% to 8.89 million oz.

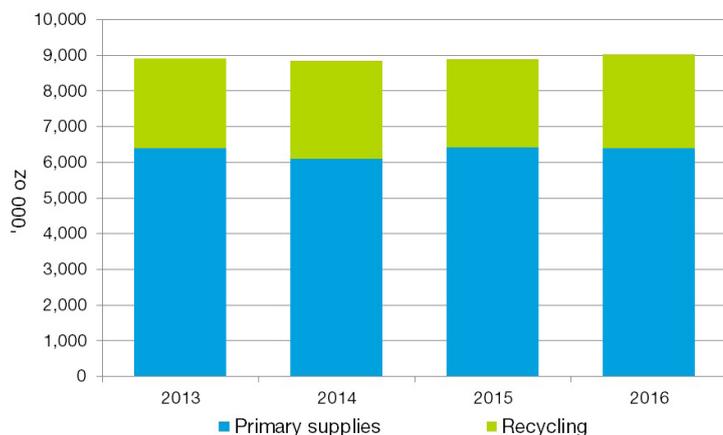
The main reason for weakness in secondary supplies was a steep fall in the recovery of palladium from spent catalytic converters. Last year, only 1.94 million oz of palladium were supplied by the autocatalyst recycling sector, a decline of 250,000 oz on the previous year, as weak steel and pgm prices prompted a sharp slowdown in the scrapping and reprocessing of end-of-life vehicles (ELVs) and their catalyts. This is discussed in more detail on page 4 and 5.

“ Only 1.94 million oz of palladium were supplied by autocatalyst recycling, a decline of 250,000 oz on 2014. ”

This contraction in the auto recycling sector occurred at a time when, in theory, pgm recoveries should have been rising rapidly. The late 1990s and early 2000s saw dramatic growth in the use of palladium on catalytic converters fitted to gasoline vehicles, initially in North America and subsequently in Europe. At the time, fuel was less clean and catalyst technology less advanced, so palladium loadings tended to be high by present-day standards. Cars built during this period are now reaching retirement age, and should have contributed to a significant increase in average palladium loadings on scrap. However, any gains have been more than offset by a reduction in the number of vehicles reaching scrap yards, and by hoarding at various points in the collection and processing circuit.

Jewellery recycling was also weak, reflecting the collapse of palladium jewellery manufacturing in China over the last seven years. Only small quantities of palladium jewellery were recovered in China last year. The only other region where measurable amounts of palladium are recovered from scrapped jewellery is Japan, where platinum jewellery alloys typically contain 5–10% palladium.

Palladium: primary supplies plus recycling



While overall supply of palladium from primary and secondary sources was little changed in 2015, gross demand contracted by 13%, or 1.42 million oz. Purchasing by automotive and industrial consumers rose by 230,000 oz, but this modest growth was overshadowed by a dramatic reversal in ETF demand, which saw investment decline by 1.6 million oz compared to the previous year.

Much of this huge swing in investment demand occurred in South Africa, where ETF investors had purchased over 1.2 million oz of palladium in 2014. There was further modest purchasing of rand-denominated palladium ETFs during the first nine months of 2015, with total holdings peaking at nearly 1.4 million oz in early October. However, heavy selling occurred in the second half of that month, and continued

“ Much of the huge swing in investment demand was in South Africa but other regions also saw net liquidation in 2015. ”

into November; by the year end, holdings were down by over 400,000 oz from their peak. For the full year, net redemptions totalled 280,000 oz.

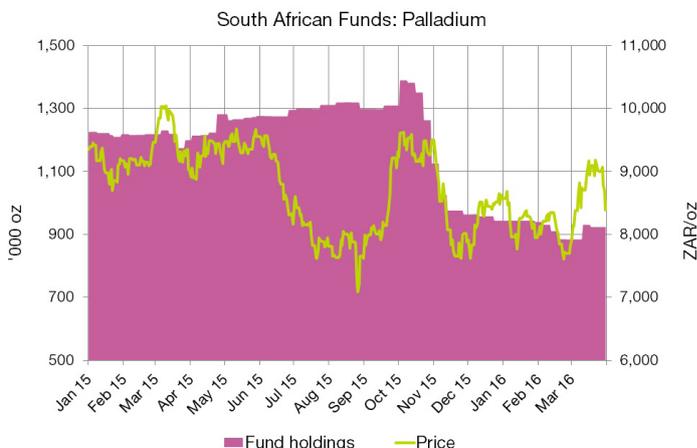
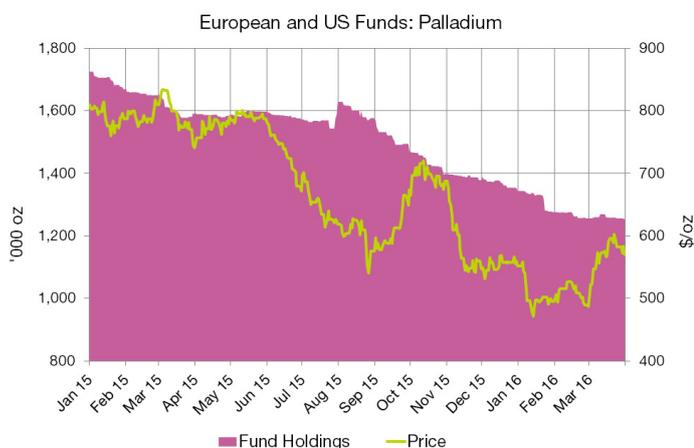
Other regions also recorded net liquidation in 2015. In Europe, despite some ebb and flow of investment, total ETF holdings were broadly unchanged over the first eight months of the year. Subsequently, there was a surge of redemptions, as investors appeared to take advantage of a spike in the palladium price from below \$600 in September to over \$700 in mid-October. This selling continued during November and December, even though the price slumped back below \$600. Over the calendar year, European ETF investors liquidated around 200,000 oz of palladium holdings, over twice as much as they had sold in 2014.

Redemptions in the US fund were slightly lower than the previous year, at around 180,000 oz. In sharp contrast to the European and South African funds, selling was largely concentrated in the first nine months of year, with a peak of activity during August and September, when prices were unusually volatile. Holdings stabilised as the palladium price weakened during the final quarter.

The ETF selling seen during 2015 appears to reflect negative investor sentiment towards commodities, and specific concerns about the prospects for palladium demand in China, given the sharp slowdown in vehicle sales that occurred during the first nine months of last year. The sell-off was particularly sharp in Europe and South Africa, perhaps because funds in these regions had not previously seen any large-scale liquidation of ETF positions since their inception. In contrast, US investors had already sold significant quantities of palladium in both 2011 and 2014.

Unlike platinum, palladium does not enjoy a high profile among Japanese retail investors, and the market for palladium bars in Japan is negligible. As a result, there was little scope for the palladium investment market to benefit from lower yen prices, and Japanese investors added just 4,000 oz to their palladium ETF holdings in 2015.

While swings in investment demand tend to determine the trajectory of total gross demand for palladium, the autocatalyst sector continues to underpin consumption. Sales to automakers set a new record of 7.63 million oz in 2015, a rise of 2%. Automotive consumption of palladium is now so large that, in the last two years, gross demand has exceeded global primary supplies by more than 1 million oz each year.



“ Global production of light duty gasoline vehicles reached an all-time record of almost 70 million units in 2015. ”

“ The phase-in of California LEV III standards helped increase palladium usage on US gasoline cars by 5% in 2015. ”

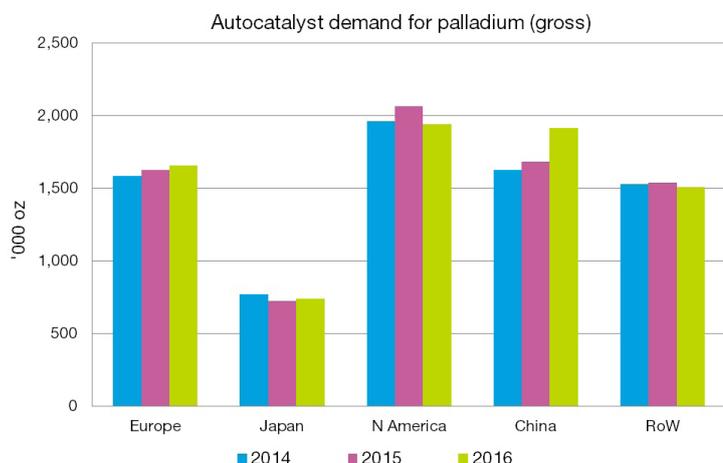
Global production of light duty gasoline vehicles reached an all-time record last year, just short of 70 million units. This represented a 1% increase from 69.3 million in 2014, mainly due to growth in Europe and China, both of which outperformed expectations. These gains offset a sharp contraction in demand for ‘Kei’ (micro) cars in Japan, following a reduction in government tax incentives, and steep falls in gasoline car production in some large Rest of World markets such as Russia and Brazil.

The European market has seen a steady recovery from the low point reached in 2012, when gasoline car production fell to just 8.7 million vehicles, down nearly 15% from its pre-financial-crisis peak. Since then, a recovery has gradually picked up pace and in 2015, output rose by 8% to nearly 10 million vehicles, the highest level since 2007.

After six years of dramatic expansion in the Chinese market, during which the country’s light duty vehicle production more than trebled and it overtook Europe to become the world’s largest car maker, it was widely expected that growth would come to an abrupt halt in 2015. Domestic car sales were hit by licence plate restrictions, aimed at reducing congestion and pollution in large cities, and by the diversion of disposable income into the stock market as Chinese equity values reached new peaks in the first half of 2015. By the time stock prices collapsed in June, year-to-date domestic car sales were down by more than 3%.

However, the final months of 2015 saw a dramatic reversal of the downward trend. In October, the government halved taxes for vehicles with engines smaller than 1.6 litres, releasing pent-up demand for new cars, and stimulating double-digit growth in sales in November and December. As a result, full-year sales rose by 6%, and production increased by 5% for the year as a whole.

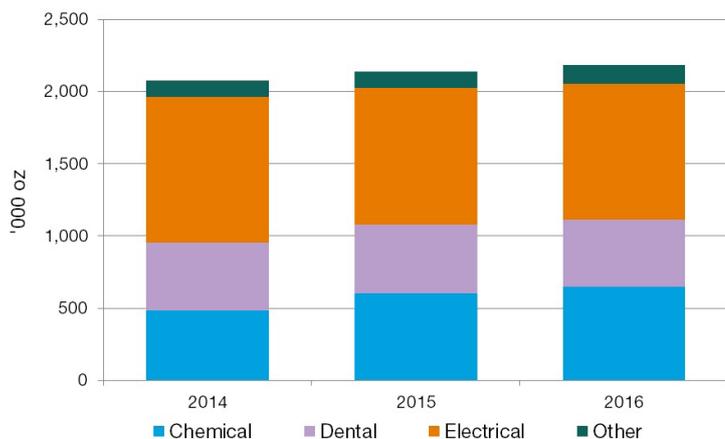
The only region to see notable tightening of gasoline emissions limits in 2015 was North America, where the phase-in of California LEV III standards (also adopted by other ‘Green States’) began with the 2015 model year. In order to comply with the legislation, US automakers increased their output of vehicles meeting ULEV (Ultra Low Emission Vehicle) standards, contributing to higher average palladium loadings. This helped increase palladium usage on US gasoline cars by 5%, lifting total sales of the metal to North American automakers above 2 million oz, the highest level since the peak years of auto demand for palladium in 1998–2001.



Globally, gasoline cars account for more than 85% of total palladium usage in autocatalysis. The remaining demand is primarily in light duty diesel applications, with smaller quantities used in heavy duty, non-road and motorcycle catalysts. Global consumption of palladium in diesel cars was flat in 2015, mainly due to lower loadings on Euro 6b vehicles: the need to control exhaust gas composition for optimal SCR operation has led to some substitution of palladium with platinum in aftertreatment systems. However, there was some increase in palladium loadings on heavy duty diesel catalysts in Europe, North America and Japan. Engines on heavy trucks tend to operate at higher temperatures and to favour passive regeneration of the particulate filter; these factors tend to limit the potential for palladium substitution. As a result, truck



Gross industrial demand for palladium



“Industrial use of palladium rose by 3%, mainly due to exceptionally strong demand for palladium process catalysts.”

makers have been slower than car manufacturers to adopt palladium in diesel emissions catalysis, but are now doing so where technically feasible.

The use of palladium in industrial applications rose by 3% to 2.14 million oz, mainly due to exceptionally strong demand for palladium process catalysts. As a result, chemical demand for palladium set an all-time record of over 600,000 oz. Expansion of the Chinese chemical industry has been supported by government programmes focusing on strengthening the country’s position as a leading manufacturing nation: this has helped to sustain palladium demand at unusually high levels, with strong sales of catalysts for applications including hydrogen peroxide (a bleaching agent) and purified terephthalic acid (an intermediate used in polyester production).

Demand for palladium in dental applications has contracted significantly in recent years, falling from over 1 million oz per annum during the 1990s to a low of 457,000 oz in 2013. In the last two years there has been some recovery in Japan, the largest market for palladium dental alloys. Dental treatments using palladium-rich ‘kinpala’ alloys are covered by the government health insurance scheme, and current reimbursement levels for these materials are more than sufficient to cover metal costs. This has helped to encourage additional use of palladium alloys.

In contrast, the use of palladium in electronic applications continues to shrink. We have adjusted our demand figures to account for new information which suggests that thrifting of palladium in the multi-layer ceramic capacitor (MLCC) and hybrid integrated circuit (HIC) sectors has been more aggressive than we had previously assumed. However, the use of palladium to plate connectors and lead frames remains robust.

Jewellery demand for palladium has been on a steeply declining trend since it peaked in 2005 at nearly 1.5 million oz, on the back of huge but ephemeral growth in the Chinese market for palladium jewellery. Last year, world consumption of palladium in jewellery alloys shrank to just 225,000 oz, down 17% year on year.

Demand for palladium as a jewellery metal in its own right is now largely restricted to the USA, UK and Germany, where it is mainly used in men’s wedding rings. Elsewhere, its main jewellery application is as a whitening agent in white gold alloys, and as a component of platinum jewellery alloys in Japan. Japanese demand has been affected by a move away from Pt900 alloys (which contain 10% palladium) in favour of Pt950 alloys.

Forecast of Palladium **SUPPLY & DEMAND IN 2016**

FORECAST: **PALLADIUM**

- Growth in gross demand is forecast to push the palladium market more deeply into deficit in 2016.
- A slight fall in primary palladium supplies will be balanced by some recovery in autocatalyst recycling.
- Autocatalyst demand will rise modestly, with growth in global gasoline car production partly offset by thrifting.
- There is likely to be a reduction in profit-taking from ETFs, but total investment demand is expected to remain negative.

The deficit in the palladium market is expected to widen in 2016, in line with an anticipated reduction in profit-taking by ETF investors and growth in other demand sectors. Combined primary and secondary supplies are forecast to rise marginally, with a decrease in South African shipments being offset by a modest recovery in autocatalyst recycling. Excluding investment, demand for palladium in ‘consuming applications’ (autocatalyst, industrial and jewellery) will exceed 10 million oz for the first time: we anticipate significant growth in sales to automakers in China, while demand from the Chinese chemical industry is also set to reach record levels.

After outperforming other precious metals over the 2013–2014 period, palladium’s price performance has been relatively weak since the start of 2015. Last year, palladium prices fell by more than 30%, compared with 28% and 10% declines, respectively, for platinum and gold. In the first quarter of 2016, palladium recovered less strongly than other precious metals, rising just 4% versus gains of 10% and 15% for platinum and gold. This weak price performance reflects the dramatic fall in investor interest since mid-2014: the net long futures position in palladium has plunged from a peak of over 3 million oz in August 2014 to an average of just over 500,000 oz in the first quarter of this year, while ETF investors liquidated around 750,000 oz of physical holdings over the same period.

The collapse in investor interest has been triggered by a number of factors, including general weakness in commodities markets, concerns about the potential impact of slower Chinese growth on automotive and industrial demand, and uncertainty over the size of market inventories. The availability of stocks of palladium – mainly consisting of Russian metal exported in the 1994–2011 period – continues to constrain prices despite a growing fundamental market deficit. Excluding physical investment, demand for palladium will again exceed supplies by more than 1.1 million oz in 2016.

There is little prospect of any near-term increase in primary palladium supplies; indeed, we expect shipments to fall this year. South African sales of palladium are forecast to decline by 6% to 2.52 million oz, reflecting our assumption that producers no longer have much flexibility to supplement shipments with metal from inventories.

Underlying mine production in South African is forecast to be approximately flat, after allowing for disruptions due to labour, safety and technical stoppages. With wage talks now underway between AMCU and the major platinum miners, and the existing three-year agreement due to expire in June, the possibility of fresh strikes cannot be excluded.

Refined production of palladium from Norilsk Nickel’s Polar mining operations will decrease in 2016, as a consequence of a major reconfiguration of the company’s processing flowsheet. This will result in a one-off, permanent increase in the company’s processing pipeline. During

“ South African palladium sales are forecast to decline by 6%, with underlying mine production approximately flat. ”

“ Refined production at Norilsk will fall, but the company intends to maintain sales by selling from stocks put aside in 2015. ”

the first half of 2016, the now old and obsolete nickel smelter at the Polar mining site will be closed, with the nickel refining facility being phased out by the year end; these sites will undergo a gradual clean-up over the next five years.

Following the closure of the nickel plant, high-grade nickel matte from the Nadezhda Metallurgical Plant will be shipped for further processing on the Kola Peninsula and at Norilsk Nickel Harjavalta in Finland (in comparison, last year, only 50% of nickel matte produced at the Polar division was transferred to the Kola and Harjavalta sites). While the new processing flowsheet will reduce emissions of polluting gases such as sulphur dioxide and generate some operational efficiencies, it will result in a longer total processing time and hence a permanent increase in pipeline stocks of all metals.

Norilsk Nickel forecasts that its Russian palladium production will be in the range of 2.29–2.39 million oz in 2016, a decline of between 7% and 11% compared with last year, due to a predicted increase in work-in-progress of 230,000–240,000 oz. Our forecast assumes that Norilsk will be able to maintain and even increase its palladium sales by mobilising the refined inventory that it put aside in 2015.

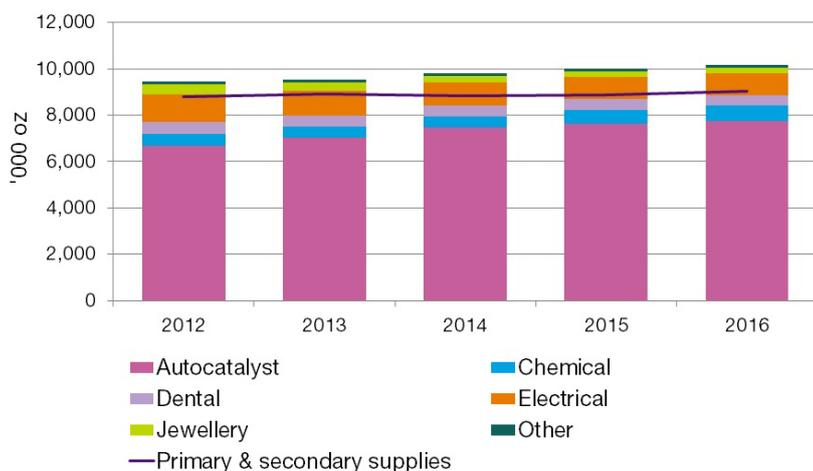
Shipments by Zimbabwean and North American producers are forecast to show modest growth this year. In Zimbabwe, output from Zimplats will be supplemented by the refining of some stocks of pgm in matte that remained untreated at the end of last year. We also believe that some North American producers may have had higher-than-normal pipeline inventories at the end of 2015. Underlying palladium output in North America is not expected to change significantly this year, although it remains possible that continued low palladium prices could have a negative impact on primary production. Around two-thirds of the palladium mined in North America comes from operations that extract pgm as their primary metals, while the remainder is a by-product of nickel–copper mining.

A slight decline in total primary supplies will be offset by modest growth in shipments of secondary palladium derived from autocatalyst scrap, forecast to rise by 9% to 2.11 million oz. This figure assumes that scrap collection volumes will show a modest recovery from the very depressed levels seen throughout last year and into the first quarter

of 2016. We also expect to see some growth in the palladium content of scrapped catalytic converters collected in the USA, consistent with historic trends in catalyst loadings.

Our estimate of autocatalyst recycling is subject to a greater than usual degree of uncertainty. With steel prices remaining depressed, the speed at which collection rates might improve during the remainder of 2016 is hard to predict. In addition, many vehicles now being scrapped were constructed during a time of unprecedented change in autocatalyst technology. During the late 1990s and early 2000s, North American automakers moved swiftly to adopt palladium catalysts on their gasoline fleet, often using very high loadings in order to ensure durability. Subsequently, improvements in both

Palladium demand in consuming applications (excluding investment)



“ This year should see a return to significant growth in global output of gasoline cars. ”

autocatalyst technology and fuel quality permitted significant thrifting. This makes it more challenging than usual to predict catalyst loadings and pgm splits on scrapped vehicles from this period.

The recovery of palladium from vehicles in Rest of World and Asian markets is now becoming increasingly significant. We expect nearly 500,000 oz of palladium to be processed this year from ELVs in Japan, China and the Rest of World region, an increase of 14%.

In the auto sector, this year should see a return to significant growth in global output of gasoline cars, following a relatively flat year in 2015 when the market expanded by only 1%. The best prospects are in Europe, with the southern European markets that suffered the worst post-2007 losses now rebounding strongly, and in China, where relatively modest government tax incentives on vehicles under 1.6 litres have provided a significant stimulus to car sales, especially in lower tier cities.

“ Palladium will benefit from tighter emissions limits in China, where eleven provinces have implemented China 5 legislation. ”

Chinese per capita car ownership remains low, at just over 100 cars in use per 1,000 adults, compared to around 550 per 1,000 in Japan, and over 600 in major European economies. This suggests that there is significant potential for growth in car sales, especially outside the more congested Tier 1 and 2 cities which have borne the brunt of the recent slowdown.

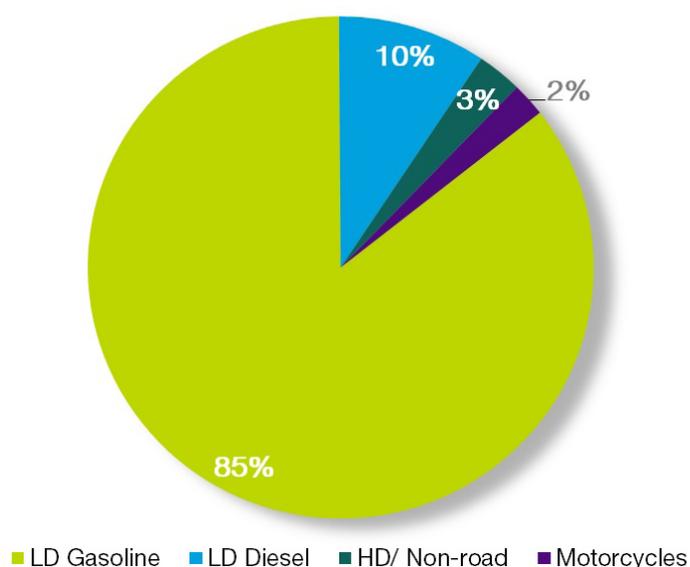
In middle and lower tier cities with lower vehicle ownership rates and less traffic congestion, vehicle sales growth was in double figures last year, and is expected to accelerate in 2016 under the impetus of government incentives. It is likely that the major beneficiaries of this growth will be Chinese brands, and this will have a positive impact on domestic car production.

The effect on palladium consumption will be large, with sales to Chinese automakers expected to rise by 14% in 2016. Palladium will also benefit from tightening emissions legislation, as eleven provinces including Beijing and Shanghai implement China 5 legislation starting in April 2016. In most cases, it will be necessary to increase pgm loadings in order to comply with these regulations.

Further tightening of gasoline emissions legislation in China is in the pipeline. China 5 limits will be extended nationwide over the next two years, while much stricter Beijing 6 standards will apply to vehicles sold in the Chinese capital starting in 2017. Beijing 6 legislation may introduce a particle number limit, which would be difficult to meet for vehicles with gasoline direct injection (GDI) engines, and could lead to some use of gasoline particulate filters (GPFs).

Europe should also see another year of strong gains in light duty vehicle output. In the major southern European markets of Spain and Italy, demand for new cars collapsed in the post financial crisis period, hitting a low point in 2012–2013. However, a recovery in auto sales in these countries is now firmly underway and is expected to continue during 2016, contributing to a 5% increase in European output of gasoline

Palladium demand by auto sector 2016



“ Euro 6c gasoline vehicles will need to meet a much tighter particle number limit, as already imposed on diesels. ”

cars this year. However, palladium demand in this region will increase by only 2% due to modest thrifting.

European car makers are considering their options for meeting the next stage of legislation, Euro 6c, under which gasoline vehicles will need to meet a much tighter particle number limit, the same as that already imposed on diesels. Some manufacturers will be able to meet the new standards via engine calibration, but there may also be some adoption of gasoline particulate filters over the next few years, primarily on GDI vehicles, which account for over half of European gasoline car output.

North American emissions legislation is also tightening, as first Californian LEV III and then Federal Tier 3 standards are phased in. Both these regulations mandate a gradual increase in the proportion of vehicle sales meeting the strictest emissions limits. Going forward, this should lead to increases in palladium loadings, as more ULEV (Ultra Low Emissions Vehicle) and SULEV (Super Ultra Low Emission Vehicle) cars are manufactured and sold. However, in 2016, average palladium loadings will be hit by significant thrifting on some existing vehicle platforms, ahead of Tier 3 implementation.

“ Industrial demand for palladium will remain firm in 2016, but sales to Chinese jewellery makers will fall once again. ”

Demand for palladium in industrial applications will remain firm in 2016, with record demand from the chemicals industry and increased use of palladium catalysts in stationary pollution control applications offsetting slight declines in the electrical and dental sectors.

We forecast that chemicals producers will consume 648,000 oz of palladium this year. This figure is underpinned by robust demand in China, where investment in bulk chemical production has been boosted by the government policies aimed at reducing reliance on imports despite a slowdown on economic growth. This year, we expect strong demand for palladium in a number of applications, particularly purified terephthalic acid, used in textiles and packaging, and hydrogen peroxide, used as a chemical feedstock in polyurethane and nylon production as well as in bleaching applications.

In contrast, jewellery demand is forecast to remain lacklustre. Sales to Chinese jewellery makers are now negligible: we predict that gross consumption will fall to just 25,000 oz this year, and after accounting for recycling, net demand will be close to zero. We expect little change in jewellery demand in other regions.

Overall, we are confident that 2016 will see further growth in gross demand for palladium in its ‘consuming applications’ (automotive, industrial and jewellery). It is likely that combined demand from these sectors will exceed 10 million oz for the first time: this represents a gain of over 1 million oz in the last five years.

There is much more uncertainty about palladium investment. ETFs account for almost all palladium investment demand: unlike platinum, palladium does not benefit from over-the-counter sales to Japanese investors, nor is there any significant use of palladium in coins. In the first quarter of 2016, ETF investors sold around 110,000 oz of palladium, with liquidation occurring in European, North American and South African funds. However, this was significantly lower than the rate of redemptions seen in the October to December 2015 period, when investors sold nearly 500,000 oz of palladium. Our forecast assumes that a repeat of last year’s heavy selling is unlikely, but that uncertainty over world economic growth and the size of palladium inventories will continue to weigh upon investor sentiment, leaving total investment demand in negative territory again.

“ Uncertainty over world economic growth and the size of palladium inventories will continue to weigh upon investor sentiment. ”



Summary of Rhodium SUPPLY & DEMAND IN 2015

SUMMARY: RHODIUM

- A rebound in South African supplies to four-year highs pushed rhodium into a surplus of 33,000 oz.
- Primary supplies rose by 23% to 754,000 oz, but rhodium recovered from autocatalysts fell by 12%.
- Auto demand grew slightly, as gasoline catalyst thrifting was offset by an increase in rhodium on European diesels.
- Other demand shrank, due to lower sales of rhodium to glass makers and negative ETF investment.

The rhodium market moved back into surplus in 2015, after two years of deficit. Gross demand fell slightly: small gains in autocatalyst consumption were offset by a fall in purchasing by glass makers and investors. Meanwhile, supplies rose strongly, as South African production returned to near-normal levels following the AMCU strike in 2014. This outweighed a decline in the recycling of rhodium from scrapped vehicles, leaving combined primary and secondary shipments up 11%.

South African mine production of rhodium rose by 47% in 2015, following a 31% decline the previous year, the result of prolonged strike action at the large western Bushveld mines operated by Anglo American Platinum, Impala Platinum and Lonmin. These operations typically account for around 60% of South African rhodium production, and nearly half of total world output; in comparison, mining of both platinum and palladium is less geographically concentrated. Consequently, swings in production caused by the strike and the subsequent recovery were proportionally greater for rhodium than for either platinum or palladium.

However, in terms of supply to the market, these very large fluctuations in output have been partly masked by stock sales. In 2014, producers sold large quantities of rhodium from pipeline and refined inventories, in order to fulfil their commitments to customers. Last year, there were further shipments from stock, albeit at much reduced rates. As a result, supplies from South Africa fell by only 15% in 2014, and rose by 30% last year. Over these two years, we estimate that around 60,000 oz of metal was supplied from producer stocks.

Combined primary and secondary supplies rose by 11% to 1.02 million oz in 2015, despite a 12% decline in the recovery of rhodium from scrapped catalytic converters. As we noted on page 4, weak steel prices have resulted in fewer vehicles reaching scrap yards, especially in Europe and North America, while there has also been some hoarding of catalyst scrap by collectors hoping to benefit from future increases in pgm prices. We estimate that this removed at least 40,000 oz of potential rhodium supply from the market last year.

Gross demand for rhodium declined by 1% in 2015, to 991,000 oz, with marginal growth in sales to automakers failing to compensate for weaker industrial and investment demand. While consumption in autocatalysts was boosted by a sharp increase in the number of European diesels carrying rhodium-containing NOx traps, this was largely offset by thrifting on gasoline catalysts, especially in Japan.

Between 2007 and 2015, the use of rhodium in light duty gasoline catalysis fell by over 10%, while global gasoline car production rose by more than a third. Over this period, the average rhodium content of a gasoline catalyst system decreased by over 35%, with the largest declines occurring in Europe and North America. In both these regions, thrifting occurred mainly between 2007 and 2011, largely in response to the 2008 price spike.

Rhodium Supply and Demand '000 oz			
Supply	2014	2015	2016
South Africa	469	611	600
Russia	80	80	73
Others	65	63	66
Total Supply	614	754	739
Gross Demand			
Autocatalyst	823	827	854
Other	176	164	194
Total Gross Demand	999	991	1,048
Recycling	-307	-270	-293
Total Net Demand	692	721	755
Movements in Stocks	-78	33	-16



“ Rhodium usage in NOx traps fitted to diesel cars doubled in 2015, albeit off a small base. ”

In contrast, the thrifting process in Japan has been slower and less aggressive. Japanese vehicles typically carry catalysts with a higher rhodium content than in other regions, and this means that there is more potential for thrifting than elsewhere. In 2015, rhodium sales to Japanese automakers fell by 11%, the result of a modest decline in average loadings, combined with a 9% decline in domestic production of gasoline vehicles. However, on a global basis, increases in car output in China and Europe helped limit the overall decrease in rhodium utilisation on gasoline catalysts.

Until recently, the use of rhodium in autocatalysis was effectively confined to light duty gasoline applications (cars and motorcycles). Since 2014, there has been some growth in the consumption of rhodium in the light duty diesel sector, primarily in Europe, where NOx traps have been adopted on some diesel cars. While usage in this application remains small as a proportion of the total market, it doubled in 2015, reflecting increased production of Euro 6b vehicles.

“ 2015 saw record use of rhodium in catalysts used for agrochemical, acetic acid and oxo-alcohol production. ”

Demand for rhodium in industrial and other applications (including investment and jewellery) fell by 7% last year. This decline was primarily a result of lower sales to glass manufacturers and investors: in contrast, consumption of rhodium by the chemicals sector posted an all-time record of over 100,000 oz, in line with buoyant sales to the agrochemical industry in Europe, and firm demand from acetic acid and oxo-alcohols producers elsewhere.

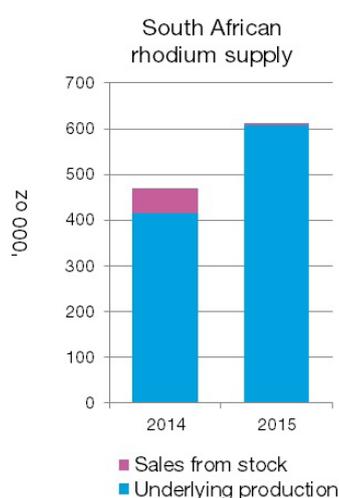
In the glass sector, rhodium demand is largely determined by sales of platinum–rhodium alloys to manufacturers of LCD substrates and fibreglass. However, in any individual year, trends in platinum and rhodium demand can diverge quite widely; in 2015, there was a modest increase in platinum offtake, but rhodium demand fell by a quarter.

There are two reasons for this discrepancy. Firstly, the rhodium content of platinum alloys is not fixed; during times of significant change in the relative prices of platinum and rhodium, glass manufacturers may choose to adopt alloys with a higher or lower rhodium content. Alloy-switching benefited rhodium demand, relative to platinum, during the 2012–2014 period, but there were no further significant changes in alloy composition last year.

Secondly, changes in inventories can have a significant impact on our demand estimates in any single year. This is particularly true following plant closures, when companies may choose to return metal to the market. In 2013 and 2014, Japanese LCD glass makers sold platinum that was surplus to immediate requirements; in contrast, manufacturers have generally chosen to retain rhodium and use it gradually to meet ongoing requirements.

The fall in glass sector demand for rhodium in 2015 was primarily due to a sharp drop in investment in new LCD production capacity in China. There was very strong capacity growth in this sector between 2011 and 2014; expansion continued last year, but at much lower rates than in the previous four years.

The other sector to see a decline in demand last year was investment (included in our ‘other’ demand number). Between 2011, when Deutsche Bank launched the first rhodium ETF, and 2014, investors added to their rhodium holdings each year. However, in 2015, redemptions outweighed new purchases, leaving total ounces under management down slightly at the year end. The launch of a new rand-denominated rhodium ETF in December 2015 did not attract any fresh investment.



Forecast of Rhodium SUPPLY & DEMAND IN 2016

FORECAST: RHODIUM

- Primary rhodium supplies are expected to fall slightly, while recycling is likely to post a modest recovery.
- Tightening legislation and growth in global gasoline car production will boost auto demand for rhodium.
- Other demand for rhodium will rebound strongly, but investment demand is expected to remain low.
- The rhodium market is forecast to return to deficit in 2016.

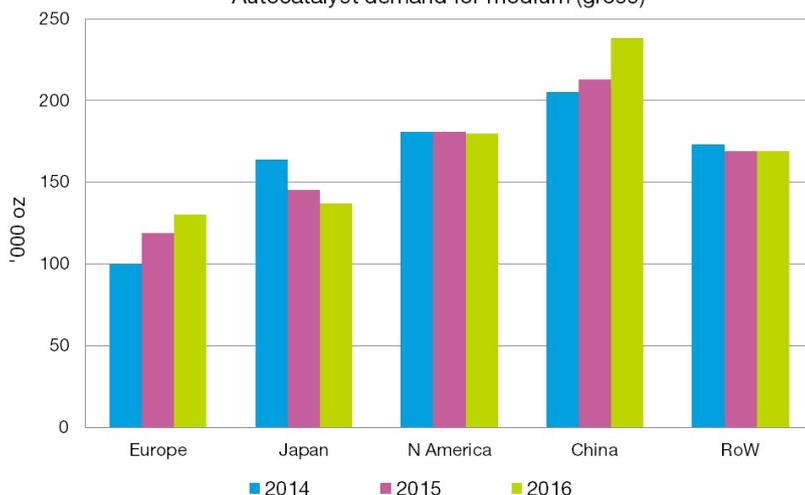
Gross demand for rhodium is predicted to rise by 6% in 2016, as auto demand is lifted by strong car sales and tighter legislation in China, and greater use of NOx traps in Europe. It should also be a good year for industrial demand: purchasing by glass makers is set to rise significantly, while consumption in the chemicals industry remains unusually firm. With mine supplies expected to fall, and any recovery in autocatalyst recycling volumes likely to be modest, combined primary and secondary shipments will rise by less than 1%, pushing the market back into deficit.

Sales of rhodium to automakers are forecast to rise by 3% to 854,000 oz, with gains once again concentrated in China and Europe. The Chinese market enjoyed a strong finish to 2015, as the introduction of government tax incentives for the purchase of smaller vehicles provided a significant stimulus to car sales, especially in lower tier cities where car ownership is still low. This trend is expected to continue during 2016: Chinese output of gasoline cars is predicted to expand by 7% this year. At the same time, tightening emissions legislation will result in some modest increases in the average rhodium content of Chinese gasoline catalysts. In April 2016, eleven provinces including Beijing and Shanghai implemented China 5 legislation; these limits are slated to be extended nationwide at the beginning of next year.

In Europe, production of gasoline vehicles is to expand by 5% in 2016, in line with a recovery in auto sales in southern European markets, resulting in a modest increase in rhodium consumption on gasoline catalysts. However, the largest gains in European demand will come from the light duty diesel sector. While output of diesel vehicles is not expected to rise much, all new cars sold this year will be equipped with Euro 6b compliant catalyst systems, leading to a significant increase in the consumption of rhodium in lean NOx traps (LNTs).

As discussed on page 15, we expect the forthcoming implementation of Euro 6d legislation to result in some changes in the mix of catalyst bricks and pgm used on European diesels. The introduction of real driving emissions (RDE) testing under Euro 6d is likely to result in greater use of selective catalytic reduction (SCR), as manufacturers seek to optimise NOx control over a broader range of driving conditions. However, many vehicles will use a combination of both LNT and SCR.

Autocatalyst demand for rhodium (gross)



“ Rhodium use in industrial applications will rise 18%, with strong consumption in the glass and chemicals sectors. ”

Growth in rhodium consumption in Europe and China will be partly offset by further falls in sales to Japanese automakers. While gasoline car output in Japan is slated to rise by 2–3% this year, we expect domestic automakers to continue to thrift the rhodium content of their catalysts. In North America, the gradual phasing-in of first Californian LEV III and then Federal Tier 3 regulations should ultimately be positive for rhodium loadings, but only a small minority of vehicles will meet tighter limits this year, and any gains will be offset by minor thrifting on existing vehicle platforms.

Demand for rhodium in other applications is set to rise by 18% to 194,000 oz. Last year, sales to LCD glass makers were hit by a temporary dip in capacity expansions in China, but we expect this trend to be reversed in 2016. This should also be an exceptionally strong year for fibreglass investment, with Chinese-owned companies making significant capacity additions not just in their domestic market but also in North America and the Rest of World region. In the chemicals sector, purchasing of rhodium catalysts by acetic acid and oxo-alcohols producers will remain unusually firm.

Our other demand figure assumes that rhodium ETF investment will be neutral this year. During the first quarter of 2016, there was some selling in the European fund, but a corresponding increase in South African holdings, leaving the number of ounces under management little changed.

“ Growth in combined primary and secondary supplies will be weak this year, and will fail to keep pace with demand. ”

Mine shipments of rhodium are forecast to fall by 2% to 739,000 oz in 2016. In South Africa, rhodium output is likely to underperform versus platinum and palladium. Expansions that are forecast to come on-stream this year – including Royal Bafokeng Platinum’s Styldrift and Platinum Group Metals Limited’s Maseve – will mine mainly from the Merensky reef, and will therefore produce only modest amounts of rhodium.

Russian output of rhodium is also likely to fall this year, due to the changes in the processing flowsheet at Norilsk Nickel, which are discussed in more detail on pages 26 and 27. This is expected to result in a significant lengthening of the processing pipeline, and a temporary decline in production of all metals.

In contrast, we predict that recoveries of rhodium from scrapped autocatalysts will rise by 9% to 293,000 oz. This is based on an assumption that we will see some improvement in recycling rates during the second half of 2016. While the prices of all three autocatalyst pgm have risen during the first quarter of this year, steel prices remain depressed, and this is likely to delay any rebound in scrap collection volumes.

As a result, growth in combined primary and secondary supplies will be weak this year, and will fail to keep pace with demand. We forecast that the market will move into a deficit of 16,000 oz in 2016.

PGM MARKET REPORT MAY 2016

PLATINUM '000 oz - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	4,860	4,110	4,208	3,537	4,569	4,288
	Russia ²	835	801	736	700	670	679
	North America	350	306	318	339	319	361
	Zimbabwe ³	340	337	410	401	401	458
	Others ³	100	126	143	131	117	113
Total Supply		6,485	5,680	5,815	5,108	6,076	5,899
Demand⁴	Autocatalyst ⁴	3,185	3,158	3,100	3,241	3,433	3,497
	Chemical	470	452	528	520	528	553
	Electrical ⁴	230	176	218	225	230	259
	Glass	515	153	90	212	223	291
	Investment	460	450	871	277	451	332
	Jewellery ⁴	2,475	2,783	3,028	2,897	2,827	2,929
	Medical and Biomedical ⁵	230	223	214	211	211	213
	Petroleum	210	112	159	165	129	156
	Other	320	395	418	422	428	447
Total Gross Demand		8,095	7,902	8,626	8,170	8,460	8,677
Recycling⁶	Autocatalyst	-1,240	-1,120	-1,206	-1,282	-1,122	-1,219
	Electrical	-10	-22	-24	-27	-29	-32
	Jewellery	-810	-895	-790	-762	-574	-666
Total Recycling		-2,060	-2,037	-2,020	-2,071	-1,725	-1,917
Total Net Demand⁷		6,035	5,865	6,606	6,099	6,735	6,760
Movement in Stocks⁸		450	-185	-791	-991	-659	-861



PGM MARKET REPORT MAY 2016

PLATINUM '000 oz - Gross Demand by Region							Forecast
		2011	2012	2013	2014	2015	2016
Europe	Autocatalyst	1,505	1,323	1,279	1,487	1,657	1,726
	Chemical	120	110	98	103	105	102
	Electrical	20	17	15	14	14	16
	Glass	30	2	6	11	11	11
	Investment	155	135	-40	-73	-88	52
	Jewellery	175	179	219	204	203	200
	Medical and Biomedical	90	78	72	70	69	68
	Petroleum	35	-3	-12	22	-1	6
	Other	95	115	117	115	117	118
Total		2,225	1,956	1,754	1,953	2,087	2,299
Japan	Autocatalyst	500	591	558	500	471	461
	Chemical	35	35	42	42	41	43
	Electrical	25	21	27	28	29	33
	Glass	130	-3	-20	-96	6	4
	Investment	250	98	-40	19	700	205
	Jewellery	310	312	309	313	314	313
	Medical and Biomedical	20	20	19	19	18	18
	Petroleum	5	3	-1	3	3	3
	Other	40	63	64	64	61	62
Total		1,315	1,140	958	892	1,643	1,142
N. America	Autocatalyst	370	395	345	356	383	376
	Chemical	95	106	102	113	115	104
	Electrical	25	21	19	18	18	21
	Glass	-5	7	7	12	12	34
	Investment	10	187	57	7	-32	130
	Jewellery	185	187	213	220	240	244
	Medical and Biomedical	90	89	85	83	84	85
	Petroleum	50	46	23	24	25	35
	Other	110	118	124	122	122	124
Total		930	1,156	975	955	967	1,153
China	Autocatalyst	105	93	130	140	141	148
	Chemical	100	89	146	106	151	154
	Electrical	30	31	36	38	38	41
	Glass	10	53	92	211	170	191
	Investment	0	0	0	0	0	0
	Jewellery	1,680	1,950	2,100	1,935	1,796	1,850
	Medical and Biomedical	10	15	17	17	17	18
	Petroleum	15	21	56	30	31	21
	Other	30	40	49	52	55	67
Total		1,980	2,292	2,626	2,529	2,399	2,490
RoW	Autocatalyst	705	756	788	758	781	786
	Chemical	120	112	140	156	116	150
	Electrical	130	86	121	127	131	148
	Glass	350	94	5	74	24	51
	Investment	45	30	894	324	-129	-55
	Jewellery	125	155	187	225	274	322
	Medical and Biomedical	20	21	21	22	23	24
	Petroleum	105	45	93	86	71	91
	Other	45	59	64	69	73	76
Total		1,645	1,358	2,313	1,841	1,364	1,593
Grand total		8,095	7,902	8,626	8,170	8,460	8,677



PGM MARKET REPORT MAY 2016

PLATINUM Tonnes - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	151.2	127.8	130.9	110.0	142.1	133.4
	Russia ²	26.0	24.9	22.9	21.8	20.8	21.1
	North America	10.9	9.5	9.9	10.5	9.9	11.2
	Zimbabwe ³	10.6	10.5	12.8	12.5	12.5	14.2
	Others ³	3.1	3.9	4.4	4.1	3.6	3.5
Total Supply		201.7	176.6	180.9	158.9	188.9	183.4
Demand⁴	Autocatalyst ⁴	99.1	98.2	96.4	100.8	106.7	108.7
	Chemical	14.6	14.1	16.4	16.2	16.5	17.2
	Electrical ⁴	7.2	5.5	6.8	7.1	7.2	8.1
	Glass	16.0	4.7	2.9	6.6	6.9	9.0
	Investment	14.3	13.9	27.2	8.6	14.1	10.3
	Jewellery ⁴	77.0	86.6	94.1	90.0	87.9	91.0
	Medical and Biomedical ⁵	7.2	7.0	6.6	6.6	6.5	6.6
	Petroleum	6.5	3.5	4.9	5.1	4.0	4.9
	Other	10.0	12.3	13.0	13.1	13.3	14.0
Total Gross Demand		251.8	245.8	268.3	254.1	263.1	269.8
Recycling⁶	Autocatalyst	-38.6	-34.9	-37.5	-39.9	-34.8	-37.9
	Electrical	-0.3	-0.7	-0.7	-0.8	-0.9	-1.0
	Jewellery	-25.2	-27.9	-24.6	-23.7	-17.9	-20.7
Total Recycling		-64.1	-63.5	-62.8	-64.4	-53.6	-59.6
Total Net Demand⁷		187.7	182.3	205.5	189.7	209.5	210.2
Movement in Stocks⁸		14.0	-5.7	-24.6	-30.8	-20.6	-26.8

PGM MARKET REPORT MAY 2016

PLATINUM Tonnes - Gross Demand by Region

		2011	2012	2013	2014	2015	Forecast 2016
Europe	Autocatalyst	46.8	41.1	39.8	46.2	51.5	53.7
	Chemical	3.7	3.4	3.0	3.2	3.3	3.2
	Electrical	0.6	0.5	0.5	0.4	0.4	0.5
	Glass	0.9	0.1	0.2	0.3	0.3	0.3
	Investment	4.8	4.2	-1.2	-2.3	-2.7	1.6
	Jewellery	5.4	5.6	6.8	6.3	6.3	6.2
	Medical and Biomedical	2.8	2.4	2.2	2.2	2.1	2.1
	Petroleum	1.1	-0.1	-0.4	0.7	-0.1	0.2
	Other	3.0	3.6	3.6	3.6	3.6	3.7
Total	69.2	60.8	54.5	60.6	64.7	71.5	
Japan	Autocatalyst	15.6	18.4	17.4	15.5	14.6	14.3
	Chemical	1.1	1.1	1.3	1.3	1.3	1.3
	Electrical	0.8	0.6	0.8	0.9	0.9	1.0
	Glass	4.0	-0.1	-0.6	-3.0	0.2	0.1
	Investment	7.8	3.0	-1.2	0.6	21.8	6.4
	Jewellery	9.6	9.7	9.6	9.7	9.8	9.7
	Medical and Biomedical	0.6	0.6	0.6	0.6	0.6	0.6
	Petroleum	0.2	0.1	0.0	0.1	0.1	0.1
	Other	1.2	2.0	2.0	2.0	1.9	1.9
Total	40.9	35.4	29.9	27.7	51.2	35.4	
N. America	Autocatalyst	11.5	12.3	10.7	11.1	11.9	11.7
	Chemical	3.0	3.3	3.2	3.5	3.6	3.2
	Electrical	0.8	0.7	0.6	0.6	0.6	0.7
	Glass	-0.2	0.2	0.2	0.4	0.4	1.1
	Investment	0.3	5.8	1.8	0.2	-1.0	4.0
	Jewellery	5.8	5.8	6.6	6.8	7.5	7.6
	Medical and Biomedical	2.8	2.8	2.6	2.6	2.6	2.6
	Petroleum	1.6	1.4	0.7	0.7	0.8	1.1
	Other	3.4	3.7	3.9	3.8	3.8	3.9
Total	28.9	36.0	30.3	29.7	30.2	35.9	
China	Autocatalyst	3.3	2.9	4.0	4.4	4.4	4.6
	Chemical	3.1	2.8	4.5	3.3	4.7	4.8
	Electrical	0.9	1.0	1.1	1.2	1.2	1.3
	Glass	0.3	1.6	2.9	6.6	5.3	5.9
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	52.3	60.7	65.3	60.2	55.8	57.5
	Medical and Biomedical	0.3	0.5	0.5	0.5	0.5	0.6
	Petroleum	0.5	0.7	1.7	0.9	1.0	0.7
	Other	0.9	1.2	1.5	1.6	1.7	2.1
Total	61.6	71.4	81.5	78.7	74.6	77.5	
RoW	Autocatalyst	21.9	23.5	24.5	23.6	24.3	24.4
	Chemical	3.7	3.5	4.4	4.9	3.6	4.7
	Electrical	4.0	2.7	3.8	4.0	4.1	4.6
	Glass	10.9	2.9	0.2	2.3	0.7	1.6
	Investment	1.4	0.9	27.8	10.1	-4.0	-1.7
	Jewellery	3.9	4.8	5.8	7.0	8.5	10.0
	Medical and Biomedical	0.6	0.7	0.7	0.7	0.7	0.7
	Petroleum	3.3	1.4	2.9	2.7	2.2	2.8
	Other	1.4	1.8	2.0	2.1	2.3	2.4
Total	51.2	42.2	72.1	57.4	42.4	49.5	
Grand total	251.8	245.8	268.3	254.1	263.1	269.8	



PGM MARKET REPORT MAY 2016

PALLADIUM '000 oz - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	2,560	2,359	2,465	2,125	2,683	2,521
	Russia: Primary ²	2,705	2,627	2,628	2,589	2,434	2,487
	Russia: Stock Sales ²	775	260	100	0	0	0
	North America	900	811	831	912	867	905
	Zimbabwe ³	265	266	322	327	320	356
	Others ³	155	162	148	135	122	121
Total Supply		7,360	6,485	6,494	6,088	6,426	6,390
Demand⁴	Autocatalyst ⁴	6,155	6,673	7,031	7,462	7,629	7,757
	Chemical	440	524	490	484	602	648
	Dental	540	510	457	468	475	463
	Electrical ⁴	1,375	1,190	1,070	1,014	950	944
	Investment	-565	467	-8	943	-659	-295
	Jewellery ⁴	505	442	354	272	225	215
	Other	110	104	108	110	111	130
Total Gross Demand		8,560	9,910	9,502	10,753	9,333	9,862
Recycling⁶	Autocatalyst	-1,695	-1,675	-1,905	-2,189	-1,939	-2,112
	Electrical	-480	-443	-463	-474	-475	-476
	Jewellery	-210	-194	-157	-89	-46	-41
Total Recycling		-2,385	-2,312	-2,525	-2,752	-2,460	-2,629
Total Net Demand⁷		6,175	7,598	6,977	8,001	6,873	7,233
Movement in Stocks⁸		1,185	-1,113	-483	-1,913	-447	-843

PGM MARKET REPORT MAY 2016

PALLADIUM '000 oz - Gross Demand by Region

							Forecast
		2011	2012	2013	2014	2015	2016
Europe	Autocatalyst	1,485	1,427	1,493	1,583	1,625	1,658
	Chemical	80	79	76	-19	88	95
	Dental	80	81	80	77	70	65
	Electrical	190	151	119	105	102	101
	Investment	-35	163	-14	-74	-200	-106
	Jewellery	60	64	61	60	59	59
	Other	25	24	24	25	25	26
	Total	1,885	1,989	1,839	1,757	1,769	1,898
Japan	Autocatalyst	680	799	756	769	722	741
	Chemical	20	17	18	18	17	17
	Dental	220	220	184	205	227	228
	Electrical	300	320	245	236	214	210
	Investment	5	0	-4	-2	4	1
	Jewellery	70	70	70	67	66	65
	Other	10	9	9	9	9	9
	Total	1,305	1,435	1,278	1,302	1,259	1,271
N. America	Autocatalyst	1,545	1,803	1,771	1,961	2,063	1,937
	Chemical	80	87	70	74	87	89
	Dental	225	190	168	160	152	144
	Electrical	145	163	159	153	147	146
	Investment	-535	304	10	-205	-181	-110
	Jewellery	45	44	43	44	44	44
	Other	45	39	42	42	43	44
	Total	1,550	2,630	2,263	2,229	2,355	2,294
China	Autocatalyst	1,155	1,325	1,499	1,623	1,680	1,913
	Chemical	145	213	210	281	277	303
	Dental	0	3	8	8	8	7
	Electrical	270	176	168	170	168	170
	Investment	0	0	0	0	0	0
	Jewellery	305	238	155	78	34	25
	Other	10	14	15	16	16	32
	Total	1,885	1,969	2,055	2,176	2,183	2,450
RoW	Autocatalyst	1,290	1,319	1,512	1,526	1,539	1,508
	Chemical	115	128	116	130	133	144
	Dental	15	16	17	18	18	19
	Electrical	470	380	379	350	319	317
	Investment	0	0	0	1,224	-282	-80
	Jewellery	25	26	25	23	22	22
	Other	20	18	18	18	18	19
	Total	1,935	1,887	2,067	3,289	1,767	1,949
	Grand total	8,560	9,910	9,502	10,753	9,333	9,862



PGM MARKET REPORT MAY 2016

PALLADIUM Tonnes - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	79.6	73.4	76.7	66.1	83.5	78.4
	Russia: Primary ²	84.1	81.7	81.7	80.5	75.7	77.4
	Russia: Stock Sales ²	24.1	8.1	3.1	0.0	0.0	0.0
	North America	28.0	25.2	25.8	28.4	27.0	28.1
	Zimbabwe ³	8.2	8.3	10.0	10.2	10.0	11.1
	Others ³	4.8	5.0	4.6	4.2	3.8	3.8
Total Supply		228.9	201.7	202.0	189.4	200.0	198.8
Demand⁴	Autocatalyst ⁴	191.4	207.5	218.6	232.1	237.3	241.2
	Chemical	13.7	16.3	15.3	15.0	18.6	20.2
	Dental	16.8	15.8	14.1	14.6	14.8	14.4
	Electrical ⁴	42.8	37.1	33.2	31.6	29.6	29.3
	Investment	-17.6	14.6	-0.2	29.3	-20.5	-9.2
	Jewellery ⁴	15.7	13.8	11.0	8.5	7.1	6.7
	Other	3.4	3.2	3.4	3.5	3.5	4.1
Total Gross Demand		266.2	308.3	295.4	344.6	290.4	306.7
Recycling⁶	Autocatalyst	-52.7	-52.2	-59.2	-68.1	-60.2	-65.7
	Electrical	-14.9	-13.7	-14.4	-14.8	-14.8	-14.8
	Jewellery	-6.5	-6.0	-4.9	-2.7	-1.4	-1.3
Total Recycling		-74.2	-71.9	-78.5	-85.6	-76.4	-81.8
Total Net Demand⁷		192.1	236.4	216.9	249.0	214.0	224.9
Movement in Stocks⁸		36.9	-34.7	-18.1	-59.6	-14.0	-26.1

PGM MARKET REPORT MAY 2016

PALLADIUM Tonnes - Gross Demand by Region							Forecast
		2011	2012	2013	2014	2015	2016
Europe	Autocatalyst	46.2	44.4	46.4	49.2	50.5	51.6
	Chemical	2.5	2.5	2.4	-0.6	2.7	3.0
	Dental	2.5	2.5	2.5	2.4	2.2	2.0
	Electrical	5.9	4.7	3.7	3.3	3.2	3.1
	Investment	-1.1	5.1	-0.4	-2.3	-6.2	-3.3
	Jewellery	1.9	2.0	1.9	1.9	1.8	1.8
	Other	0.8	0.7	0.7	0.8	0.8	0.8
	Total	58.6	61.9	57.2	54.7	55.0	59.0
Japan	Autocatalyst	21.2	24.8	23.5	23.9	22.5	23.0
	Chemical	0.6	0.5	0.6	0.6	0.5	0.5
	Dental	6.8	6.8	5.7	6.4	7.1	7.1
	Electrical	9.3	10.0	7.6	7.3	6.7	6.5
	Investment	0.2	0.0	-0.1	-0.1	0.1	0.0
	Jewellery	2.2	2.2	2.2	2.1	2.1	2.0
	Other	0.3	0.3	0.3	0.3	0.3	0.3
	Total	40.6	44.6	39.8	40.5	39.3	39.4
N. America	Autocatalyst	48.1	56.1	55.1	61.0	64.2	60.2
	Chemical	2.5	2.7	2.2	2.3	2.7	2.8
	Dental	7.0	5.9	5.2	5.0	4.7	4.5
	Electrical	4.5	5.1	4.9	4.8	4.6	4.5
	Investment	-16.6	9.5	0.3	-6.4	-5.6	-3.4
	Jewellery	1.4	1.4	1.3	1.4	1.4	1.4
	Other	1.4	1.2	1.3	1.3	1.3	1.4
	Total	48.2	81.9	70.3	69.4	73.3	71.4
China	Autocatalyst	35.9	41.2	46.6	50.5	52.2	59.5
	Chemical	4.5	6.6	6.5	8.7	8.6	9.4
	Dental	0.0	0.1	0.2	0.2	0.2	0.2
	Electrical	8.4	5.5	5.2	5.3	5.2	5.2
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	9.5	7.4	4.8	2.4	1.1	0.8
	Other	0.3	0.4	0.5	0.5	0.5	1.0
	Total	58.6	61.2	63.8	67.6	67.8	76.2
RoW	Autocatalyst	40.1	41.0	47.0	47.5	47.9	46.9
	Chemical	3.6	4.0	3.6	4.0	4.1	4.5
	Dental	0.5	0.5	0.5	0.6	0.6	0.6
	Electrical	14.6	11.8	11.8	10.9	9.9	9.9
	Investment	0.0	0.0	0.0	38.1	-8.8	-2.5
	Jewellery	0.8	0.8	0.8	0.7	0.7	0.7
	Other	0.6	0.6	0.6	0.6	0.6	0.6
	Total	60.2	58.7	64.3	102.4	55.0	60.7
Grand total		266.2	308.3	295.4	334.6	290.4	306.7



PGM MARKET REPORT MAY 2016

RHODIUM '000 oz - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	641	577	554	469	611	600
	Russia ²	70	90	80	80	80	73
	North America	23	22	23	24	23	23
	Zimbabwe ³	29	28	36	36	35	38
	Others ³	2	3	6	5	5	5
	Total Supply		765	720	699	614	754
Demand⁴	Autocatalyst ⁴	715	775	788	823	827	854
	Chemical	72	80	83	90	101	99
	Electrical	6	6	5	4	5	5
	Glass	77	35	46	54	40	64
	Other	38	63	77	28	18	26
	Total Gross Demand		908	959	999	999	991
Recycling⁶	Autocatalyst	-277	-252	-278	-307	-270	-293
	Total Recycling	-277	-252	-278	-307	-270	-293
	Total Net Demand⁷	631	707	721	692	721	755
	Movement in Stocks⁸	134	13	-22	-78	33	-16

PGM MARKET REPORT MAY 2016

RHODIUM Tonnes - Supply and Demand							Forecast
		2011	2012	2013	2014	2015	2016
Supply¹	South Africa	19.7	17.9	17.2	14.6	19.0	18.6
	Russia ²	2.2	2.8	2.5	2.5	2.5	2.3
	North America	0.3	0.7	0.7	0.7	0.7	0.7
	Zimbabwe ³	0.6	0.9	1.1	1.1	1.1	1.2
	Others ³	0.1	0.1	0.2	0.2	0.2	0.2
	Total Supply		22.8	22.4	21.7	19.1	23.5
Demand⁴	Autocatalyst ⁴	22.6	24.1	24.5	25.6	25.7	26.6
	Chemical	2.1	2.5	2.6	2.8	3.1	3.1
	Electrical	0.1	0.2	0.1	0.1	0.1	0.1
	Glass	2.1	1.0	1.4	1.7	1.3	1.9
	Other	0.7	2.0	2.5	0.9	0.6	0.9
	Total Gross Demand		27.6	29.8	31.1	31.1	30.8
Recycling⁶	Autocatalyst	-7.5	-7.8	-8.6	-9.5	-8.4	-9.1
	Total Recycling	-7.5	-7.8	-8.6	-9.5	-8.4	-9.1
	Total Net Demand⁷	20.1	22.0	22.5	21.6	22.4	23.5
	Movement in Stocks⁸	2.7	0.4	-0.8	-2.5	1.1	-0.5

PGM MARKET REPORT MAY 2016

IRIDIUM '000 oz - Demand							Forecast
		2011	2012	2013	2014	2015	2016
Demand	Chemical	19	19	20	20	20	21
	Electrical	195	28	35	44	80	67
	Electrochemical	76	73	50	55	57	57
	Other	42	75	81	89	94	99
Total Demand		332	195	186	208	251	244

IRIDIUM Tonnes - Demand							Forecast
		2011	2012	2013	2014	2015	2016
Demand	Chemical	0.6	0.6	0.6	0.6	0.6	0.7
	Electrical	6.1	0.9	1.1	1.4	2.5	2.1
	Electrochemical	2.4	2.3	1.6	1.7	1.8	1.8
	Other	1.3	2.3	2.5	2.8	2.9	3.1
Total Demand		10.4	6.1	5.8	6.5	7.8	7.7

PGM MARKET REPORT MAY 2016

RUTHENIUM '000 oz - Demand							Forecast
		2011	2012	2013	2014	2015	2016
Demand	Chemical	273	134	312	246	215	234
	Electrical	536	247	337	360	458	487
	Electrochemical	130	172	146	154	158	161
	Other	58	79	106	108	117	122
Total Demand		997	632	901	868	948	1,004

RUTHENIUM Tonnes - Demand							Forecast
		2011	2012	2013	2014	2015	2016
Demand	Chemical	8.5	4.2	9.7	7.7	6.7	7.3
	Electrical	16.7	7.7	10.5	11.2	14.2	15.1
	Electrochemical	4.0	5.3	4.5	4.8	4.9	5.0
	Other	1.8	2.5	3.3	3.4	3.6	3.8
Total Demand		31.0	19.7	28.0	27.1	29.4	31.2

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. Additionally, we continue to report sales of metal which we believe has not previously been priced, principally sales of Russian state stocks, as supplies.

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

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

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

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

⁶**Recycling** figures represent estimates of the quantity of metal recovered from open loop recycling (i.e. where the original purchaser does not retain control of the metal throughout). For instance, autocatalyst recycling represents the weight of metal recovered from end of life vehicles and aftermarket scrap in an individual region, allocated to where the car is scrapped 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.



NOTE ON EURO 6 EMISSIONS LEGISLATION

Euro 6 is a generic standard which defines emissions limits to be phased in on various dates and according to various tests and procedures.

Euro 6a was a voluntary stage which allowed vehicles to be introduced with Euro 6 type approval earlier than required. It had minimal impact on pgm demand.

Euro 6b has applied to new type approvals for passenger cars from September 2014, and will apply to all vehicles sold in the European market from September 2016. From this point vehicles must meet Euro 6 emissions limits when tested over the New European Drive Cycle (NEDC). At Euro 6b there is no change to the emissions limits for gasoline vehicles from Euro 5 limits, other than the introduction of a particle number limit on these engines. For diesel vehicles, allowable NOx emissions over the test cycle are reduced by 56% relative to Euro 5 legislation. This has significant implications for pgm loadings on diesel vehicles.

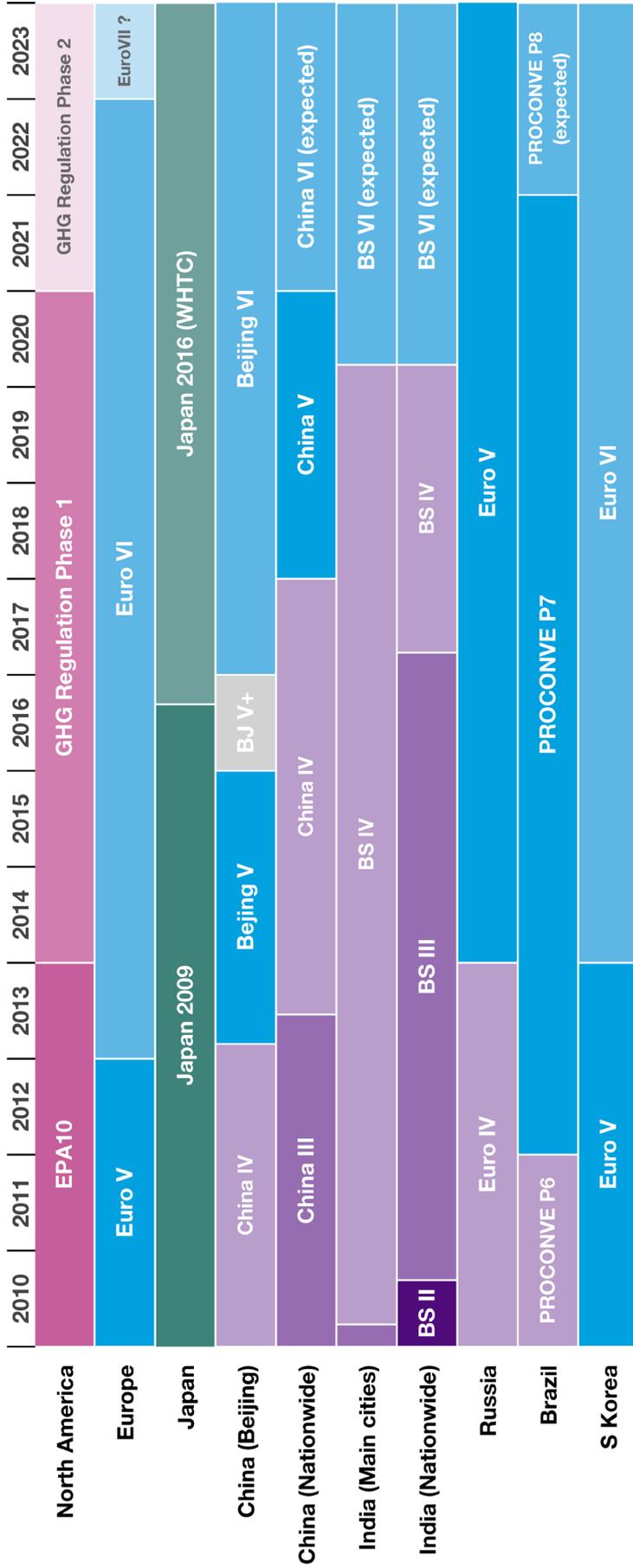
Euro 6c will be phased in between September 2017 and September 2019. In terms of emissions limits, there are no differences between 6b and 6c for diesel engines, and the only difference for gasoline engines is that 6c brings particle number emissions down, in line with those from diesel vehicles.

Euro 6d will be phased in over several years from September 2017. Euro 6d differs from 6b/6c in that it will change the way in which NOx emissions (and later, particle number emissions – see below) are tested and measured, with the introduction of Real Driving Emissions (RDE) testing. During RDE testing, vehicles will be driven on the road according to random acceleration and deceleration patterns, with emissions measured using portable emissions monitoring systems (PEMS).

Conformity Factors (CFs) have been introduced, which govern the multiple by which the vehicles' NOx emissions can exceed the emissions limits during RDE testing. The phase-in of CFs will take place in two stages. In the first stage (Euro 6d-TEMP), a NOx CF of 2.1 will be introduced for new type approvals of passenger cars from September 2017 (all vehicles, including light commercial vehicles, from September 2020). In the second stage (Euro 6d), the NOx CF will be reduced to 1.5, applying to new type approvals for passenger cars from January 2020, and all vehicles from January 2022. These transitions will inevitably lead to changes in catalyst system designs and loadings.

As well as NOx emissions, the European Commission is proposing to introduce a Conformity Factor for particle number to coincide with Euro 6d-TEMP implementation. This will have implications for gasoline particulate filter (GPF) fitment.

EMISSIONS LEGISLATION: HEAVY DUTY DIESEL



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

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