

Forecast of Platinum SUPPLY & DEMAND IN 2015

SUMMARY: PLATINUM

- Platinum supplies will recover strongly in 2015, but demand will rise too, leaving the market in a 652,000 oz deficit.
- At 4.30 million oz, South African supplies will be the highest since 2011, but low prices will cause a 13% drop in recycling volumes.
- Auto demand will rise by 6% to 3.47 million oz, a seven year high, due to higher diesel car output and tighter EU emissions limits.
- Jewellery demand will fall 9% to 2.65 million oz, as strong growth in India partly offsets weak Chinese purchasing.
- Japanese investment surged as platinum fell below ¥4,000 per gram in July 2015, and will outweigh ETF selling in the USA and Europe.

While price weakness and poor market sentiment have overshadowed the platinum market in 2015, underlying demand trends have been largely positive. The use of platinum in autocatalysts is forecast to rise again this year, industrial demand should show further steady growth, and investment will benefit from strong sales of platinum bars in Japan. This will outweigh a drop in purchasing by Chinese jewellery makers, leaving total gross demand up by 100,000 oz. On the supply side, a recovery in platinum shipments from South Africa will be partly offset by a drop in the recycling of scrapped catalytic converters, and the market will remain in significant fundamental deficit.

Platinum supplies from South Africa are forecast to rise by over 20% to 4.30 million oz, representing an increase in shipments of around 750,000 oz compared to last year's severely strike-impacted total.

The 2012–2014 period witnessed unprecedented disruption to South African pgm mining, with legal and illegal strike action costing the industry at least 2 million oz of platinum production, of which more than 1.3 million oz in 2014 alone. This year, output at the mines affected by last year's AMCU strike has returned to near-normal levels more quickly than many observers expected. Despite widespread expectations of disruption due to electricity shortages, and some losses due to safety stoppages, community unrest and industrial action, interruptions to production have been short-lived and have had a less serious impact than in recent years. Thus, despite widespread shaft closures and rationalisation in the period since 2011, shipments of platinum are forecast to reach a four year high in 2015.

This forecast is based on the assumption that producers will sell all the metal they produce: the imperative to generate cash flow has limited the ability of producers to replenish stocks that were severely depleted during the strike. In 2014, South African producers sold over 430,000 oz of platinum from refined and pipeline stocks.

Output from the Western Bushveld operations affected by the 2014 strike is forecast to almost double, from just under 1.2 million oz in 2014 to around 2.35 million oz this year. Elsewhere,

Anglo American Platinum's Mogalakwena open-cast operation is on course to set a new production record, despite some disruption due to community unrest in the third quarter, while Northam's Booyendal mine continues its ramp-up, and Platinum Group Metals Limited's new Western Bushveld Joint Venture (WBJV) mine is scheduled to deliver its first concentrate in the final quarter of this year. However, in October 2015, Glencore closed its struggling Eland mine, while output is also set to fall at Royal Bafokeng Platinum's BRPM operation and at Atlas's Bokoni mine.

This has been a year of major changes in the ownership of South African platinum assets. In February, it was announced that Aquarius Platinum had

Platinum Supply and Demand '000 oz			
Supply	2013	2014	2015
South Africa	4,205	3,547	4,295
Russia	725	709	699
Others	871	870	847
Total Supply	5,801	5,126	5,841
Gross Demand			
Autocatalyst	3,114	3,270	3,468
Jewellery	3,028	2,894	2,648
Industrial	1,652	1,764	1,818
Investment	871	273	367
Total Gross Demand	8,665	8,201	8,301
Recycling	-2,019	-2,071	-1,808
Total Net Demand	6,646	6,130	6,493
Movements in Stocks	-845	-1,004	-652



“ **Strike action cost South African mines over 1.3 million oz of platinum production in 2014. This year, output at the strike-affected mines has returned to near-normal levels.** ”

“ **In 2015, the three major pgm producers in South Africa have announced significant cuts to their capital spending programmes and some further shaft closures.** ”

entered an agreement to sell the Everest mine plus associated mining and processing infrastructure to Northam Platinum for R450 million. The approval of the South African authorities for the transaction was received in October.

In September 2015, Anglo American Platinum announced that it had reached an agreement with Sibanye Gold under which the latter will buy Anglo's Rustenburg assets, comprising the Bathopele, Siphumelele and Thembelani mines with their associated processing infrastructure, a chrome recovery plant, and the Western Limb Tailings Retreatment facility. Sibanye is to sell all concentrate from the Rustenburg operations to Anglo until the end of 2018, and thereafter will enter a toll treatment arrangement whereby Anglo will continue to process the pgm but Sibanye will market its own metal.

The following month, Aquarius Platinum announced that it too had reached an agreement with Sibanye, under which a wholly owned subsidiary of Sibanye is to acquire all of the shares in Aquarius for a cash consideration of \$0.195 per share. Aquarius operates and has a 50% share in the Kroondal Pool and Share operation adjacent to Anglo's Rustenburg mines, with Anglo owning the remaining half share. Aquarius also owns a 92% stake in the Platinum Mile pgm tailings treatment facility, a half share in the Mimosa mine in Zimbabwe, and two mothballed platinum operations at Marikana and Blue Ridge.

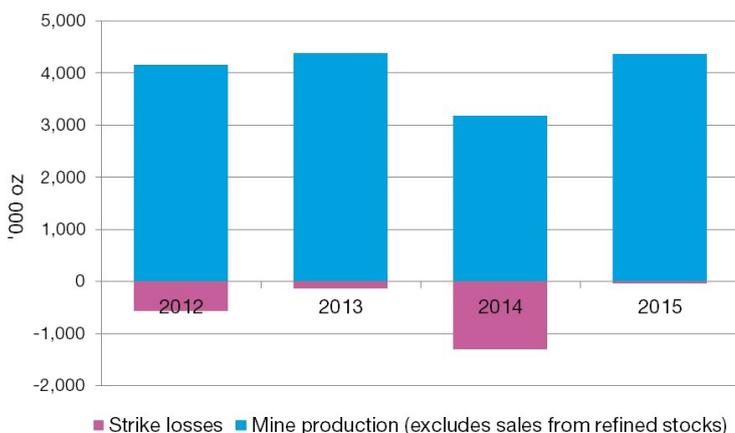
Further changes in ownership are possible: Anglo continues to seek buyers for its Union mine and its share of the Pandora joint venture, and Glencore is rumoured to be looking to exit its platinum business (which includes the mothballed Eland mine and a 50% stake in the Mototolo joint venture). Glencore has already divested its 24% stake in Lonmin by distributing its shareholding in the latter to its own shareholders.

In late 2014, Eastern Platinum agreed the sale of its South African pgm assets, including the mothballed Crocodile River mine, to the Chinese company Hebei Zhongbo Platinum Co. The transaction received approval from the South African authorities in September 2015, but at the time of writing there was uncertainty as to whether the deal would be completed. An agreement to sell Aquarius Platinum's shuttered Blue Ridge mine to a Chinese consortium fell through in October 2014.

In addition, all three major producers have announced significant cuts to their capital spending programmes and, in some cases, further shaft closures. Anglo has cut its capital expenditure forecast by R6 billion over the next two years, by restructuring its businesses to focus around large mining complexes, and deferring spending on projects such as a planned concentrator debottlenecking at Mogalakwena, a new mechanised mine at Twickenham, and an ore replacement project at Amandelbult. These will be re-evaluated in 2017.

In July, Lonmin announced plans to close several shafts, with the loss of 6,000 jobs. At the Hossy and Newman shafts, mining operations will continue in the short term, in order to extract available ore reserves, but development work will cease. In addition, three small, older shafts – W1, E1 and 1B – will be/have been put on care-and-maintenance. These shaft closures will ultimately reduce Lonmin's annual platinum production by around 100,000 oz.

South African platinum production: strike losses



“ Platinum’s rand price has dropped 8% from its January 2015 peak, compared with a fall of over 20% in the dollar price. ”

Impala Platinum is also undertaking further shaft closures and delaying capital spending. In September 2015 it announced that two more small shafts are due to close by the end of 2015, while capital spending on 17 shaft will be slowed down. Overall, the company has reduced its planned output by a total of 180,000 oz over the next five years, and has cut its target output to 815–830,000 oz by 2020 (previously 850,000 oz by 2019).

The mine sales, rationalisations and reductions to capital spending discussed above have been driven largely by weak prices. Rand depreciation has protected producers from the full impact of this year’s collapse in dollar-denominated pgm prices, but platinum’s rand price has nevertheless dropped by about 8% from its January 2015 peak of nearly R15,000 per oz, to around R13,650 in late October (this compares to a fall of over 20% in dollar platinum prices over the same period). There is now clear evidence that the industry is making progress in containing mining cost inflation, but lower prices mean that margins remain insufficient to support the investment required to maintain future production.

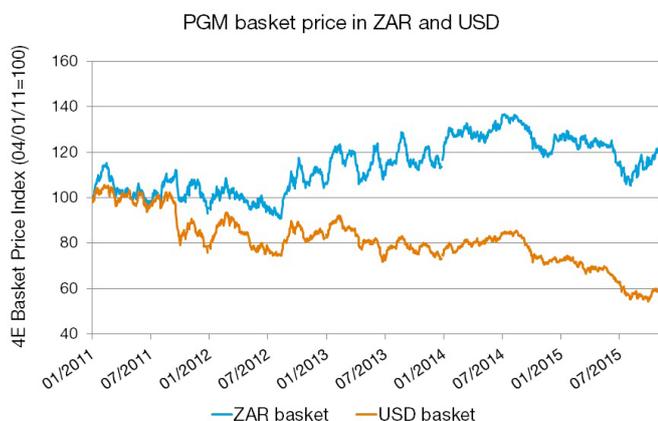
Shipments by producers in other regions will be slightly weaker in 2015, with modest reductions in Russian, North American and other supplies, only partly offset by higher output in Zimbabwe.

In July 2014, a major collapse occurred at Zimplats’ Bimha portal, resulting in the mine’s temporary closure. Redevelopment has begun, with the aim of ramping back up to design production levels by April 2018. In order to compensate for lost production, Zimplats has reallocated mining assets to other portals, and has resuscitated a discontinued open-pit operation. Going forward, this should allow Zimplats to fully utilise its installed milling capacity of 6.2 million tonnes per annum. We expect total Zimbabwean output to rise by around 4% this year, matching or slightly exceeding the previous record set in 2013.

Shipments of platinum from North America are forecast to decline marginally, with output from all the region’s major pgm producers likely to be flat or down. Platinum production at Stillwater was flat in the first half, while Vale reported a modest decline in by-product pgm output in the nine months to September 2015. However, Lundin Mining’s Eagle nickel-copper mine in Michigan, USA, should make its first measurable contribution to pgm supplies this year. This operation was commissioned in 2014, and produced over 13,000 tonnes of nickel and nearly 12,000 tonnes of copper in the first half of 2015. Its ores contain modest amounts of pgm by-products.

In Russia, we expect output from Norilsk Nickel to be stable, but we anticipate further declines in productivity at alluvial operations in the Far East of the country, where grades have been falling for several years. It appears that it is no longer possible to compensate for lower grades by increasing the quantity of sands processed, and we believe that output from this source could fall below 100,000 oz this year. We also expect a sharp contraction in alluvial mining in Colombia, where first-quarter platinum output shrank to 3,340 oz, down by two thirds compared with the same period of 2014.

While overall primary shipments will grow strongly this year, the opposite will be true of secondary supplies. In our May report, we predicted that recoveries of platinum from end-of-life vehicles



“ The autocatalyst recycling market has experienced hoarding in the past, but the stockpiling seen in 2015 has been unusual in its duration and magnitude. ”

would rise strongly this year, following unexpectedly lacklustre growth in 2014, when the platinum content of scrap failed to rise in line with predictions and some modest inventory building was observed in response to falling prices. In the past, such stock-building has generally been a short-lived phenomenon that has quickly been reversed.

However, since early this year, the recycling industry has witnessed a significant and prolonged slowdown in the volume of catalytic converters being collected, processed and refined. Part of this decline seems to relate to a fundamental reduction in the number of cars reaching scrap yards. A deterioration in the steel price since 2014 has resulted in a fall in exchange values offered to owners of end-of-life vehicles, and this in turn has led to fewer cars being scrapped. There is evidence that, in developed countries, consumers are holding onto their vehicles for longer, often as a second or third family car, leading to a rise in the average age of vehicles being retired and an increase in per capita vehicle ownership.

In addition, it seems autocatalyst collectors began to stockpile converters around the turn of the year, in response to low pgm prices. This is not the first time that the market has experienced collector hoarding, but the stockpiling seen in 2015 has been unusual in its duration and magnitude, because of the long downward trend in pgm prices. It is clear that collectors 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.

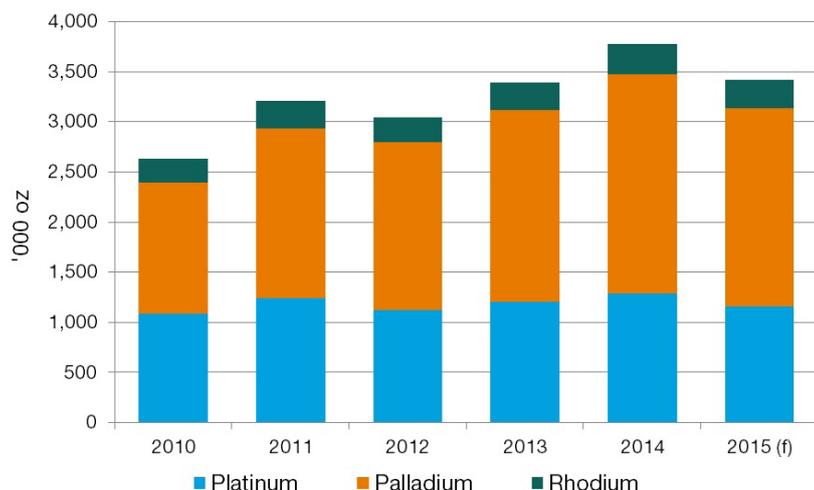
This phenomenon has been particularly visible in the North American and European regions, which account for the great majority of platinum recovered globally. While we expect some gains in autocatalyst recovery in Japan and China, these increases will be overshadowed by the contraction in volumes in the two major recycling markets.

Lower scrappage rates and collector hoarding have affected recoveries of all three autocatalyst pgm. However, platinum recycling has also been impacted by a third factor: the platinum content of autocatalyst scrap has not grown as fast as we had predicted based on historic trends in automotive pgm demand. Our previous forecast called for platinum recoveries to grow by 14% in 2015, more than twice as fast as those of palladium and rhodium, reflecting trends in catalyst fitment on European vehicles in the 2000–2005 period. During that time, platinum usage on European vehicles more than trebled, in line with

significant growth in diesel's share of the passenger car market at a time when loadings were climbing steeply. However, in the first half of 2015, collector data suggests that growth in the platinum content of autocatalyst scrap has once again lagged expectations, perhaps because the fall in the scrappage rate has resulted in an increase in the average age of vehicles reaching collectors' yards.

Globally, we expect autocatalyst recycling of platinum to fall by nearly 10% to 1.16 million oz in 2015, down 126,000 oz on last year's total. Overall, we predict that recycling of platinum from autocatalyst, jewellery and electrical scrap will fall by 13%, to 1.81 million oz, with jewellery scrap collection also contracting significantly, in line with lower platinum prices and a fall in gross demand

Autocatalyst recovery by metal



PGM MARKET REPORT NOVEMBER 2015

Platinum Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
Europe	1,321	1,536	1,728	-457	-530	-470	864	1,006	1,258
Japan	558	500	449	-83	-62	-71	475	438	378
North America	345	366	400	-563	-571	-485	-218	-205	-85
China	130	138	149	-19	-25	-30	111	113	119
Rest of World	760	730	742	-83	-94	-100	677	636	642
Total	3,114	3,270	3,468	-1,205	-1,282	-1,156	1,909	1,988	2,312

“Since September 2015, Euro 6b emissions limits have applied to all new passenger cars registered in Europe. Euro 6b diesels require NOx aftertreatment to meet the stricter limits.”

to reach 8.30 million oz. There will be further steady growth in automotive demand, which will set a new record high, and modest gains in most industrial applications, but this will be offset by a sharp fall in purchasing by jewellery makers. Had investment been negative this year, as we predicted in our May report, overall demand would have fallen compared with 2014. However, a fall in the yen platinum price has triggered a surge in buying by Japanese investors that is forecast to lift net investment to 367,000 oz.

Automotive demand for platinum is predicted to total 3.47 million oz this year. Since September 2015, Euro 6b emissions limits have been enforced on all new passenger cars registered in Europe. (For an explanation of the various stages of Euro 6 emissions legislation, see page 40). While the new legislation has had no impact on gasoline catalyst systems (for which emissions limits have not changed significantly), Euro 6b diesels require the addition of NOx aftertreatment in order to meet the stricter limits. 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. Some vehicles use a combination of LNT and SCR technology.

The implementation of Euro 6b legislation has had a material impact on average platinum loadings on European diesel cars, which we now expect to rise by around 7% this year. Not only has the total pgm content of a diesel catalyst system increased, but there has also been some substitution of palladium with platinum, partly reversing the trend towards decreasing platinum:palladium ratios that was seen over the 2007–2013 period.

There are two reasons for this. Firstly, platinum may be added to catalyst bricks upstream of the SCR in order to improve control of the NO to NO₂ ratio in the exhaust gas stream, necessary in order to optimise NOx aftertreatment. Secondly, in vehicles fitted with lean NOx traps, platinum is favoured by the higher platinum:palladium ratios on these catalysts as compared to particulate filters or oxidation catalysts.

This gain will be magnified by higher vehicle production. Although diesel's share of the European light duty market is likely to fall marginally this year, to just below 48%, strong overall growth in car sales in this region will nevertheless lift output of light duty diesels by 4% to more than 9.35 million units.

European output of gasoline passenger cars will grow even more strongly, up more than 6.5% to 9.8 million units. While the majority of gasoline vehicles sold in Europe have no platinum in their catalyst systems, heavily-loaded NOx traps are fitted to a small number of

in China. As a result, total availability of platinum, from combined primary and secondary sources, will grow by a rather modest 6%, from 7.20 million oz in 2014 to 7.65 million oz this year, despite the recovery in South African supplies.

We now expect gross platinum demand to rise by 100,000 oz in 2015,



“ Although diesel's share of the European market may fall marginally, light duty diesel production will nevertheless grow by 4%, and platinum use in this segment will rise by over 12%. ”

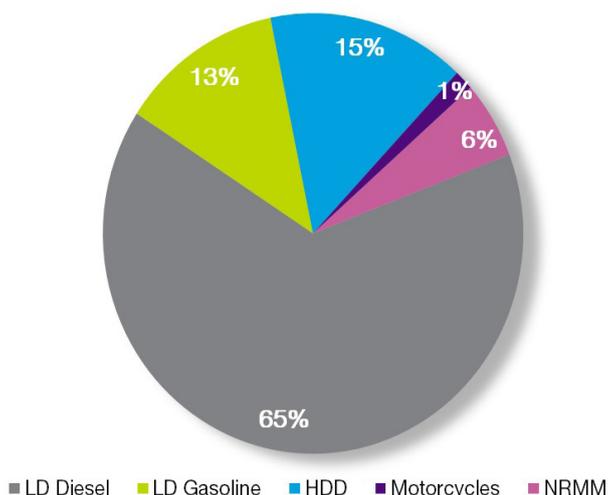
lean-burn gasoline direct injection (GDI) vehicles. These engines are the gasoline equivalent of diesel technology, in that they operate under more fuel-efficient, oxygen-rich 'lean' conditions. Like their diesel counterparts, they require the addition of NOx aftertreatment to the catalyst system in order to meet emissions regulations. Higher sales of lean-burn gasoline vehicles will contribute to an increase in European consumption of platinum on gasoline cars of around a quarter in 2015.

The introduction of lean-burn gasoline vehicles in Europe is primarily a response to tightening limits on fleet average CO₂ emissions, which present a particular challenge for manufacturers who sell larger vehicles or who have a lower proportion of diesels in their engine mix. CO₂ standards are already tough to meet, and will become progressively more stringent over the next decade, with manufacturers facing substantial financial penalties if they exceed the limits. Fuel efficient lean-burn engines, particularly diesels, are therefore expected to remain an essential part of the vehicle mix in Europe.

It remains to be seen by how much European diesel share will be affected by the Volkswagen emissions scandal and subsequent media spotlight on real world NOx emissions. Starting in January 2016, the company is expected to recall affected vehicles, including 8.5 million cars in Europe; some of these may require the replacement of elements of the emissions control system. At the time of writing, it was too early to assess the likely impact on sales of diesel cars or on platinum consumption. It should be noted that a change in European diesel share of one percentage point results in a swing in annual platinum demand of between 25,000 and 30,000 oz.

Global diesel car production is expected to total 15.9 million units in 2015; of these, European-made vehicles will account for an estimated 59%. This share has decreased significantly in recent years: prior to the financial crisis, seven out of every ten diesel cars produced globally were made in Europe. Similarly, platinum demand has become less concentrated in this region. In 2008, cars made in Europe accounted for nearly 80% of global platinum demand in light duty diesels; this figure has now fallen to around 62%.

Platinum demand by auto sector 2015



Whilst this is partly due to the increasing use of palladium in European diesel catalysts, there are two other major reasons for the shift. Firstly, diesel output has expanded significantly in a number of developing markets, including India, China and Thailand, and diesels have also gained share in North America in recent years. Total light duty diesel production outside Europe is set to top 6.5 million units in 2015, up by nearly 40% compared with the 2008 total. Secondly, emissions legislation has tightened in the last seven to eight years, especially in China and the Rest of World region. In 2007–2008, one in every five diesel cars built outside Europe was not fitted with a catalyst system, whereas this year almost all diesels worldwide will be equipped with at least an oxidation catalyst, and some will also carry particulate filters and lean NOx traps.

In this report, we have made some adjustments to our Rest of World autocatalyst numbers for the period 2013 to 2015, to account



“ In 2007–2008, one in five diesel cars built outside Europe had no catalyst. This year, almost all will carry an oxidation catalyst, and many will have DPFs and LNTs. ”

for greater adoption of palladium in diesel catalysts. In addition, there has been a sharp downward adjustment in industry forecasts of diesel vehicle output in some Asian markets this year; expected growth in Thailand and India has failed to materialise, and Rest of World diesel car production is now expected to be flat in 2015. Consequently, platinum demand in this region is now expected to rise only modestly.

In contrast to diesel, demand for platinum in gasoline applications is in almost universal retreat, with the exception of the European lean-burn GDI sector as noted above. This decline is most noticeable in Japan, the only region where platinum still sees significant use in three-way catalysts. Platinum consumption on Japanese-made gasoline cars has halved in just three years, due to a combination of palladium substitution, thrifting, weak domestic vehicle demand, and a geographic shift in production of Japanese-branded exports to overseas transplants. Globally, light duty gasoline output was stable at 69 million units in 2015, but platinum usage in this application fell by 12%.

Global heavy duty production will fall by about 6% in 2015, but the proportion of vehicles equipped with a pgm-containing emissions control system will rise; overall platinum demand is expected to be stable. Worldwide, we estimate that 57% of heavy trucks will be equipped with catalyst systems this year, up from 50% in 2014. Euro VI legislation has been fully implemented since January 2014, so all heavy duty trucks sold in Europe are equipped with platinum-rich catalyst systems. There has also been some increase in the fitment of catalyst systems to Chinese trucks.

The outlook for industrial demand is for modest growth. We expect global sales of platinum to industrial consumers to rise by 3% to 1.82 million oz, with the bulk of this gain coming from the glass industry, following sales of surplus platinum back to the market by Japanese LCD glass makers in 2013–2014. This year has seen some improvement in demand for platinum in the display glass sector, while there has been continued investment in new fibreglass capacity, particularly in China.

In the electrical sector, there has been a trend towards solid state memory devices in some high-end consumer applications, such as tablets and laptop computers, but hard disks remain the most cost-effective way to store data, and their use in high-volume storage applications is not under threat.

Growth in hard disk media production is currently being driven by the ‘near-line’ drive market: multi-disk products used in cloud computing and business data storage. These sectors are able to store data very efficiently and to use disk capacities effectively, and this has led to a disconnect between the growth in data storage requirements (which continue to expand at 30–40% a year) and the number of disk drives produced. In 2015, we expect shipments of hard disk drives to fall slightly, but this will be offset by a rise in the number of disks per drive, supporting platinum demand. Overall, we expect sales of platinum to hard disk manufacturers to rise moderately this year.

Fuel cell demand has been stable in the 10–15,000 oz per annum range in recent years primarily due to demand from the large stationary power generation and residential CHP (combined heat and power) sectors. This year, these two applications will both see a rise in platinum use. There have also been encouraging signs of expansion in the telecoms and



“ There have been significant developments in the use of fuel cells for road transport, with encouraging sales of Toyota’s Mirai fuel cell car, and a large deal for fuel cell buses in China.”

off-grid segment, where adoption of fuel cells to power remote mobile base stations is beginning to gain momentum, particularly in India.

There have been significant developments in the use of fuel cells for road transport applications this year. Following its initial launch in Japan, Toyota’s Mirai fuel cell car went on sale in California in August 2015, and in Germany, the UK and Denmark a month later, and early demand has been encouraging. While both sales and platinum consumption remain small in absolute terms – Toyota expects to produce around 700 units this year and 2,000 in 2016 – this is the first time that commercial fuel cell models have been available for purchase by ordinary consumers.

Hyundai also offers a fuel cell car, although sales to date have been small, while commercial launches of fuel cell passenger vehicles are expected by Honda in 2016 and Daimler in 2017. In China, a government drive to reduce urban air pollution has led to a deal involving several hundred fuel cell buses, which are due to be deployed from 2016.

“ Purchases of platinum by the chemicals industry are at record highs, with further investment in new propane and butane dehydrogenation plants.”

Purchases of platinum by the chemicals industry remain at record highs. Investment in dehydrogenation capacity continues to add to demand, with new on-purpose propane dehydrogenation (PDH) and isobutane dehydrogenation (BDH) plants being built in 2015. Demand also remains strong in the paraxylene and silicones sectors, which together account for over half of our chemical demand figure.

The one exception to the generally positive industrial trend will be the petroleum refining sector, where overcapacity has led to refinery closures in Europe, Australia and China, which in turn has resulted in the return of some platinum to the market, partly offsetting demand for new metal. There remains some risk of further refinery closures, especially in Europe, although low oil prices, and the consequent pick-up in demand for refinery products, has helped boost refiners’ margins.

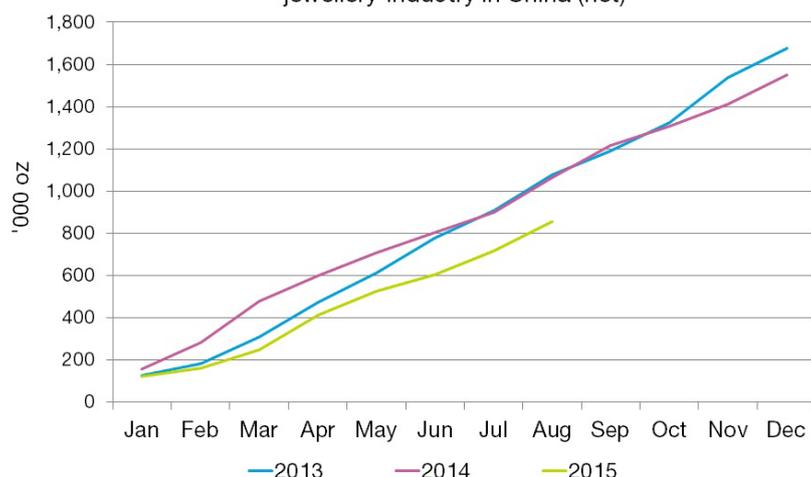
In our previous report, in May 2015, we predicted that Chinese jewellery demand could fall by around 5% in 2015, on the basis that a period of prolonged low prices had reduced the

incentive for jewellery makers to buy into low prices, and had affected retail purchasing patterns, since Chinese consumers are attracted to products that appreciate steadily in value.

Since the first quarter of 2015, the conjunction of a number of negative influences on Chinese jewellery demand has resulted in a sharp decline in sales of new metal to jewellery fabricators, leading us to reduce our forecast of demand this year to 1.63 million oz, 16% lower than in 2014. These factors can broadly be separated into those linked with a general deterioration in the jewellery market in China, and those specific to platinum.

Expansion of the retail jewellery market has slowed markedly since the ‘gold rush’ of 2013, and there

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



PGM MARKET REPORT NOVEMBER 2015

Platinum Demand: Jewellery '000 oz									
	Gross			Recycling			Net		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
Europe	219	207	212	-5	-5	-5	214	202	207
Japan	309	313	310	-282	-275	-269	27	38	41
North America	213	215	220	0	-23	0	213	192	220
China	2,100	1,935	1,630	-500	-455	-345	1,600	1,480	1,285
Rest of World	187	224	276	-3	-4	-4	184	220	272
Total	3,028	2,894	2,648	-790	-762	-623	2,238	2,132	2,025

has been an increase in store closures in 2015. This is due to a sharp drop in retail demand for gold jewellery, with consumers deterred by a prolonged period of lower prices. Retailers' difficulties have been exacerbated by government anti-corruption measures, which have hit sales of gold bars and ornaments.

“ The conjunction of several negative influences on the Chinese jewellery industry has resulted in a 16% fall in demand in this region. ”

Although the rate of retail expansion is primarily driven by the gold jewellery market, it also has a material impact on demand for platinum. While gold jewellery accounts for the bulk of inventory in most jewellery stores, a new outlet might purchase 2–6 kg of platinum jewellery for stock, depending on the size of the store and its location. When stores close, inventory is usually redistributed among remaining stores in the owner's network, postponing the need to order new stock.

In addition to the above primarily gold-driven factors, demand has also been hit by some issues that are specific to platinum. The retail price for platinum jewellery has been in decline for some time, broadly reflecting the downtrend in the international platinum price since 2011; because Chinese consumers like to see the value of their purchases appreciate over time, this has had negative consequences for consumer perceptions of value.

However, while retail prices have fallen, they do not fully reflect the decline in the international market price – in most cases, the retail price per gram of platinum jewellery is higher than that of gold, despite platinum trading at a discount on international markets. This means that when consumers attempt to exchange an old piece of platinum jewellery for a new one, they may feel that they do not receive value for money. Exchanges form an important part of the Chinese jewellery market, and the exchange value of a metal plays a critical role in perceptions of its worth.

“ Lower retail platinum jewellery prices have been negative for consumer perceptions of value, because Chinese consumers like to see their purchases appreciate over time. ”

We also believe that platinum's market share has been eroded by 18 carat white gold jewellery, particularly at the lower end of the Chinese fashion jewellery market. While the white gold market is limited by the fact that many retailers will not offer an exchange price on white gold items, this does not necessarily deter younger consumers buying less expensive styles of jewellery: they may be less concerned about value, and more interested in style and design. White gold is easier to work with than platinum, and manufacturers are therefore able to offer a wider range of more intricate designs.

These factors together made for an unusually difficult first half of 2015 for the platinum jewellery industry. Despite declines in international market prices, there has been little evidence of manufacturers taking advantage of price dips to replenish their metal stocks; as we observed in our last report, this strategy makes sense in a generally rising market, but it is less rational in a situation of prolonged price weakness. Indeed, in early 2015 it appears that some manufacturers actively reduced their stock levels. However, there have since been signs of a recovery in purchasing by jewellery makers, leading us to believe that full year demand will be down by around 16%.



“ European and US investors have reduced their platinum ETF holdings, with market sentiment hit by uncertainty in the diesel car and Chinese jewellery markets. ”

In contrast, the Indian platinum jewellery sector is forecast to expand by nearly 30% to 225,000 oz in 2015, making it the third largest global market behind China and Japan. A new industry marketing campaign, named ‘Evara’, was launched in late 2014, promoting the concept of parents giving their blessings to newly married couples in the form of a platinum jewellery set. This promotion aims to create a new bridal segment, rather than positioning platinum as a direct competitor with gold in the traditional wedding jewellery market. A jewellery set typically contains a combination of items such as a necklace, bangles and earrings for the bride, and bracelet and chain for the groom, and weighs between 25 and 60 grams, compared with an average weight of 5 grams for a bridal ring.

Outside China and India, we expect jewellery demand to be little changed this year. In Japan, demand for bridal jewellery continues to fall, in line with demographic changes that have resulted in a steady decline in the number of marriages. However, fashion demand is expected to increase slightly this year, as the market recovers from the negative impact of a consumption tax rise in April 2014.

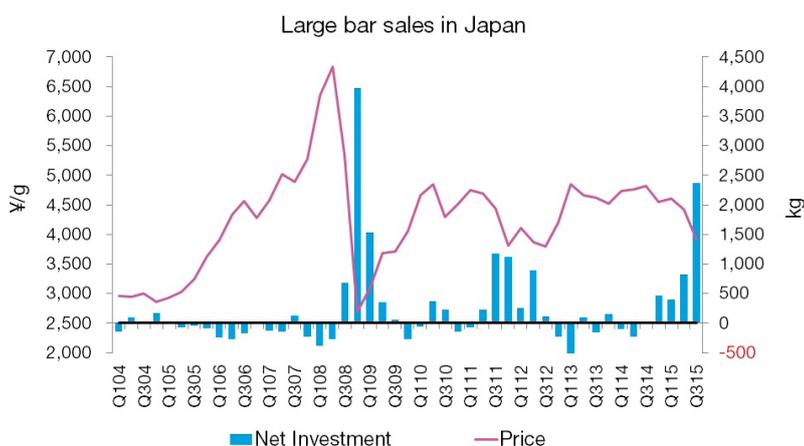
In the first ten months of 2015, economic conditions and price movements were unfavourable for platinum investment in the longer-established ETF markets in Europe and North America. Prices moved steadily lower during the first half, and platinum traded either side of \$1,000 during the July–October period. Investor sentiment has turned negative, due to a combination of uncertainty over the outlook for the diesel vehicle and Chinese jewellery markets, and an orderly return to full production in South Africa. At the same time, an expectation that US interest rates will begin to rise in due course has been a drag on precious metal investment. As a result, European and North American investors reduced their holdings of platinum ETFs by around 150,000 oz between January and late October 2015.

“ In July, the platinum price fell below ¥4,000 per gram, and this triggered a surge of interest from Japanese investors. ”

The situation has been rather different in Japan and South Africa. As we observed on page 3, over the January to October 2015 period rand depreciation has partly offset declines in the dollar price, leaving the rand-denominated platinum price down only around 8% (versus over 20% for the dollar price). In addition, these are newer funds, with a different set of investors who may take a longer term view of platinum fundamentals. In total, South African

investors added a little under 50,000 oz of platinum to their ETF holdings during the first ten months of 2015, despite net redemptions in the first quarter, and a flurry of selling in late October.

Japanese investor behaviour regularly diverges from that of Western investors, and this has again been the case in 2015. While the European and North American markets typically see a lack of buying interest, or even disinvestment, during periods of low prices, Japanese buyers have a long history of buying into dips in the market. In the past this trend has mainly been confined to ‘over the counter’ purchases of large platinum bars, and this remains by far the largest contributor to Japanese



“ South African investors added nearly 50,000 oz of platinum to their ETF holdings in the first ten months of 2015, despite a flurry of selling in late October. ”

investment demand. However, this year similar trends have also been seen in Mitsubishi's yen-denominated ETF, with holdings in this fund up 39,000 oz at the time of writing.

In July, the yen platinum price fell below the important psychological barrier of ¥4,000 per gram for the first time since September 2012, and this has triggered a surge of interest in platinum. Consequently, large bar purchases in Japan are on track to reach their highest annual level since the post-financial crisis collapse in the platinum price in 2008. Combined with moderately positive ETF investment in South Africa, and small amounts of demand in coins and small bars, we believe that global investment demand should exceed 350,000 oz in 2015.

Strong investment demand means that the platinum market will remain in significant fundamental deficit this year, despite the recovery in primary supplies. While investment flows remain an important factor in determining platinum's supply-demand balance, it is worth noting that, in the last two years, the market would have been in deficit even if investment demand had been zero. This is in sharp contrast to the 2008 to 2013 period, when the market would have been in continuous surplus had it not been for investment purchasing.

Non-South African ETF holdings: Platinum



South African ETF holdings: Platinum



Outlook for Platinum

SUPPLY & DEMAND IN 2016

FORECAST: PLATINUM

- Primary platinum supplies are expected to be flat in 2016, but there is potential for a double digit rise in autocatalyst recovery.
- The full impact of Euro 6b regulations will be felt in 2016, leading to another year of moderate growth in auto demand.
- Chinese jewellery demand may stabilise, but sustained higher prices are needed to lift retail sales and encourage restocking.
- Japanese investment is likely to fall from current high levels, while ETF demand could turn negative if prices rise.
- Nevertheless, weak supply growth should keep the platinum market in overall deficit.

There is little prospect of material growth in primary platinum supplies in 2016, but there is potential for shipments of metal from secondary sources to rise sharply, assuming that hoarding in the autocatalyst recycling sector is reversed. Steady growth in automotive and industrial consumption will underpin platinum demand, but the outlook for jewellery and investment is less clear. Sales of platinum to Chinese jewellery makers have improved since mid-2015, though it is too early to be confident of a sustained recovery, while this year's surge in Japanese investment is unlikely to be repeated.

Following 2015's strong recovery in South African mine output, production is expected to stabilise next year. While there will be some additional ounces from newer operations, this will be offset by the impact of previously-announced shaft closures and cuts in capital spending, and should leave overall shipments little changed. (This assumes that there are no additional closures; at the time of writing, the future of Lonmin's operations was in doubt, with the outcome of a proposed rights issue still uncertain.)

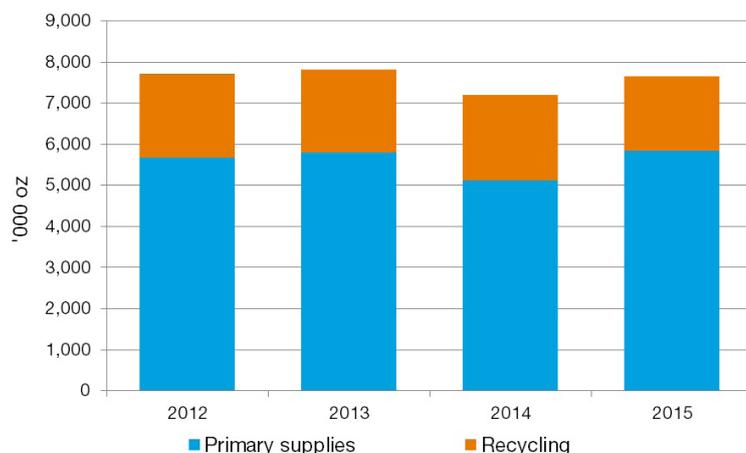
Platinum Group Metals Limited's Western Bushveld Joint Venture (WBJV) mine is scheduled to produce its first concentrate in the final quarter of 2015, but significant quantities of refined production will not be seen until next year. The company expects to produce 116,000 oz of pgm in 2016, ramping up to 185,000 oz the following year.

Royal Bafokeng Platinum's BRPM mine should also generate some additional production next year, even though the ramp-up of its Styldrift expansion has been delayed due to low prices. We also think there is potential for further improvements at some of the large Western Bushveld operations, especially Impala Platinum's lease area, where production from new shafts is building up, and Anglo's Amandelbult mine.

However, these gains will be offset by some mine and shaft closures. Glencore has shut its Eland mine, removing around 30,000 oz of platinum supply next year, while Atlatsa is in the process of mothballing two older, high cost shafts at its Bokoni mine. Lonmin's decision to close some older shafts and to mine out its Hossy and Newman shafts will result in lower production going forward, although we do not think that the full impact of the closures will be felt in 2016.

While we see some potential for modest near-term gains in South Africa, the risk of disruption remains present, and the most likely outlook is for a flat supplies profile. In other regions, there is little prospect of any significant expansion in pgm production. We anticipate some incremental

Global primary supplies plus recycling



“ We expect autocatalyst scrap hoarding to be reversed progressively, but the speed at which this occurs may partly be determined by price. ”

growth in Zimbabwe, but production at Norilsk is expected to be flat, and alluvial mining in the Far East of Russia is in decline.

This leaves recycling as the only potential source of additional supplies in the immediate future. Jewellery recycling levels could rise modestly, assuming some recovery in price, but fluctuations in autocatalyst scrap volumes will be the key element in determining secondary pgm supplies in 2015.

Weak pgm and steel prices have contributed to some stockpiling of autocatalyst scrap this year, and a consequent fall in pgm recycling, but we do not expect this decline to be repeated in 2016. It is likely that hoarding will be reversed progressively over the coming year, although the speed at which this occurs may partly be determined by price movements.

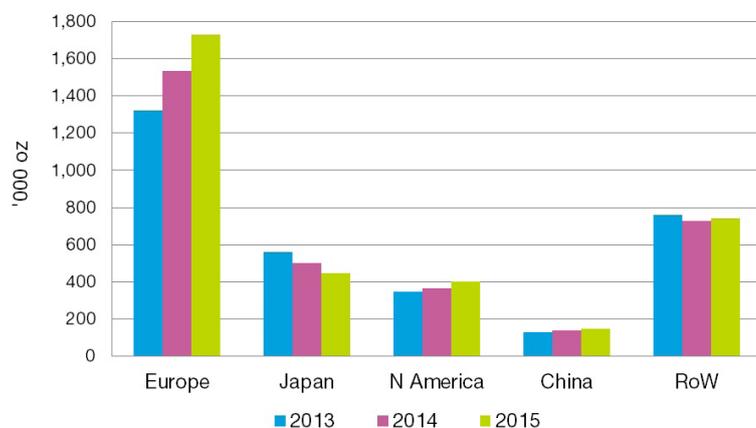
In addition, we continue to anticipate an underlying rise in the platinum content of scrap, especially in Europe, where diesel cars from the early and mid-2000s are now entering the recycling stream in greater numbers. These vehicles typically carry platinum catalysts with relatively high loadings – in some cases higher than on modern diesel cars.

“ All diesel passenger cars sold in Europe in 2016 will be equipped with emissions control systems that comply with Euro 6b regulations. ”

Our current view is that we should see a double digit rise in the recycling of platinum from auto scrap in 2016. However, there is considerable uncertainty about the extent of the increase, with prices likely to continue to influence scrap flows. In addition, the pgm mix in scrap has become increasingly challenging to forecast in recent years. This is a direct consequence of the enormous and very rapid changes in catalyst fitment that took place during the late 1990s and early 2000s, a period during which platinum’s share of the mainly gasoline US market faltered, while platinum usage in the European diesel segment saw unprecedented expansion. In the last two to three years, growth in the platinum content of scrap has consistently been below industry expectations, and data from refiners suggests that this has once again been the case during 2015.

On the demand side, we expect another year of growth in the use of platinum in autocatalysts, albeit at a slower rate than in the last two years. At the time of writing, global output of light duty diesel vehicles was forecast to rise by 4% next year, and that of heavy duty trucks by 6%. We would expect platinum demand to slightly outstrip increases in vehicle production, due to incremental growth in loadings on European diesel vehicles.

Platinum demand for autocatalyst (gross)



All diesel passenger cars sold in Europe in 2016 will be equipped with emissions control systems that comply with Euro 6b regulations. In addition, by September 2016 all light commercial vehicles (LCVs) will fall within the scope of this legislation. In terms of pgm use, we expect to see a continuation of the trends seen in 2014 and 2015: average pgm loadings on diesel vehicles will increase, while there will be a further move towards platinum and away from palladium in the diesel catalyst mix. The impact on demand will depend on diesel production volumes, currently expected to rise marginally next year. However, industry forecasts do not yet fully capture the potential impact of the Volkswagen recall and any knock-on effects on consumer purchasing behaviour.



“ Real Driving Emissions (RDE) testing will be introduced in Europe from September 2017. ”

Further tightening of the existing European regulations, in the form of ‘real world’ emissions testing, will take place starting in 2017. This phase of legislation is currently referred to as Euro 6d (previously Euro 6c) and will involve Real Driving Emissions (RDE) testing, in addition to existing laboratory tests.

It is widely recognised that on-road emissions, both of noxious gases and of CO₂, tend to exceed those achieved in type approval testing. Real world driving conditions are much more challenging for emissions control technology than highly-controlled non-road tests: vehicle speeds and loads may be higher, acceleration harsher, and road conditions, traffic and temperature more variable. As a result, under real driving conditions, most vehicles emit higher levels of pollutants than those mandated by current Euro 6b legislation. Euro 6d regulations are intended to limit the margin by which engines may exceed type approval emissions limits during on-road testing.

Under RDE testing, NOx emissions will be measured using portable emissions monitoring systems (PEMS) while the vehicle is driven on a real road and subject to random acceleration and deceleration patterns. A ‘conformity factor’ will mandate the multiple by which the vehicle’s emissions are permitted to exceed Euro 6b emissions limits. A proposal was made by the European Commission in October 2015 regarding the value of the conformity factor, which will initially be set at 2.1 (from September 2017) and subsequently reduced to 1.5 (from January 2020).

“ In the Chinese jewellery market, any improvement in platinum prices should ultimately feed through into higher consumer demand and an increased willingness to hold stocks. ”

Outside Europe, growth in automotive platinum demand will mainly be linked to trends in diesel vehicle output, with India, Russia and Thailand all scheduled to see moderate growth in diesel production volumes. However, significant expansion in platinum demand outside Europe is not expected to occur until the next round of diesel emissions legislation is implemented in China and India towards the end of this decade.

Industrial demand should remain firm in 2016. We expect the current cycle of investment in the chemicals sector to continue for at least one more year, maintaining demand at record levels. In the petroleum refining sector, the pace of refinery closures in Europe has eased, while new demand will be supported by investment in both reforming capacity and lubricant base oil production in the Rest of the World region. There are also good prospects for higher demand from the electrical industry, both in hard disks and in large stationary fuel cells.

Overall, we expect combined growth in automotive and industrial applications to be incremental, in the 3–5% range. This means that in 2016, the direction of change in total platinum demand is likely to be determined by jewellery and investment offtake.

In 2015, weakness in the Chinese jewellery market has been offset by strong investment demand in Japan, with trends in both these markets strongly influenced by price. The platinum market has experienced a period of prolonged decline, which culminated in a collapse to seven year lows of around \$900 in late September 2015. While prices have since recovered to trade either side of \$1,000, there are as yet no clear signs of an impending recovery in either market sentiment or price.

Persistently low prices are not generally conducive to strong retail jewellery demand in China. In local currency terms, the retail platinum price has been on a generally declining trend since 2011, and it is not yet clear whether this has done permanent damage to consumer perceptions of value which are so important in the Chinese jewellery market.



“Sustained low prices are not in themselves attractive to Japanese bar purchasers; spikes in buying are associated with sharp downward price movements.”

Nor are consistently weak prices positive for purchasing by jewellery manufacturers, who have become less willing to buy into price dips.

In 2016, as in the last three years, we think that the fortunes of platinum will be closely linked to those of the gold jewellery sector. In 2013, a correction in the gold price led to increased retail footfall by bargain-hunting consumers, which benefited platinum in two ways: it encouraged expansion of the retail network, leading to growth in retail stock levels, and also provided retailers with additional opportunities to ‘upsell’ platinum items. Since then, 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.

Chinese gold jewellery consumption was particularly weak in the first half of 2015, as consumers diverted cash that might otherwise have been spent on retail purchases into the booming stock market. There were signs of an improvement in gold jewellery demand mid-year, after a collapse in equity values and a dip in the gold price below \$1,100, but it is too early to be confident that this recovery will be sustained.

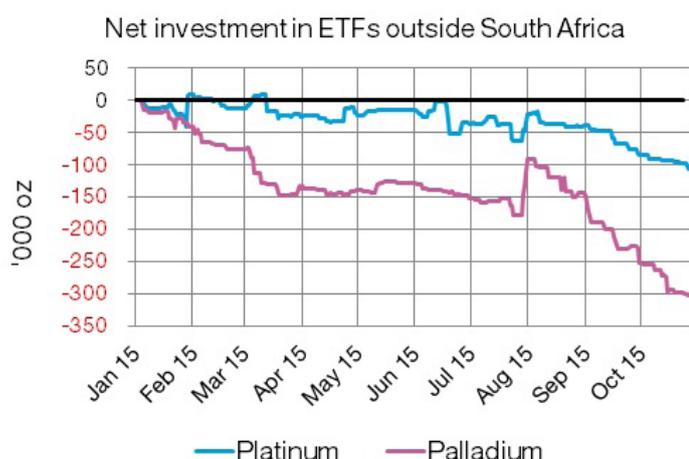
Nevertheless, forecasts of Chinese consumer spending remain positive, while loss of confidence in the equity markets has helped increase the attractiveness of gold, and these factors should be broadly supportive of jewellery demand going forward. However, their precise impact on short-term trends in platinum demand is rather uncertain. Much will depend on changes in industry stock levels, which in turn will be influenced by price movements: any improvement in the platinum price should ultimately feed through into higher consumer demand, and an increased propensity to hold stock at both the retail and manufacturer level. In the longer term, economic and demographic factors suggest that there is potential for growth in Chinese platinum jewellery demand, but we believe that further investment in marketing and promotion will be essential.

The effectiveness of targeted marketing programmes has been demonstrated by recent demand trends in India, where promotional campaigns have been instrumental in developing new market segments for platinum jewellery. We are confident that 2016 will see further strong growth in this region in sales of platinum to jewellery makers.

In 2015, price weakness has been generally positive for investment demand, because of the propensity of Japanese investors to buy into a falling market. However, low prices are not

in themselves attractive to Japanese purchasers of platinum bars: spikes in buying may occur at any price level but tend to be associated with sudden and sharp downward price movements, especially where the yen price crosses significant psychological price barriers. Thus, there is no guarantee that Japanese investment demand will continue at current levels even if prices remain low.

In Europe and the USA, investors are unlikely to resume buying while sentiment remains negative, but at the same time, if prices remain low this should act to limit profit taking. Funds in these regions currently hold just under 1.4 million oz of platinum, almost all of which was acquired between 2007 and mid-2011 at prices above \$1,200. To date, US and European investors have been noticeably less willing to sell



“ Any increase in prices could trigger a return of European and US investors to the ETF market, but would also increase the potential for profit taking. ”

platinum ETFs as compared to palladium, supporting our view that investors in these regions are reluctant to cash in their holdings while they are ‘out of the money’.

Conversely, rising prices imply improving sentiment, which could trigger a return of European and US investors to the ETF market, but would also increase the potential for profit taking. Our analysis suggests that in the 2012–2015 period, while investors in these mature funds have tended to disinvest moderately during periods of falling prices, there is no clear association between rising prices and positive investment.

In contrast, exchange rate movements have ensured that much of the investment in rand-denominated ETFs remains ‘in the money’ even at depressed dollar prices. During the first nine months of 2015, these funds continued to accumulate platinum during a period when both dollar price movements and market sentiment were overwhelmingly negative. While there was significant selling in October, the rand-denominated ETFs remain in positive territory for the year to date, suggesting that South African investors may, on average, be longer-term holders who are more positive about platinum’s fundamentals than investors in other regions. This leaves some opportunity for further growth in holdings, especially as these funds are still relatively new.

Overall, we think that 2016 is likely to see a drop in investment demand, especially in Japan, offset by some modest gains in sales to jewellery makers in India and perhaps in China. Assuming that increased recovery of platinum from scrapped vehicles is balanced by growth in autocatalyst and industrial demand, this would leave the market in deficit for a fifth consecutive year.



Forecast of Palladium SUPPLY & DEMAND IN 2015

SUMMARY: PALLADIUM

- Palladium supplies will rise by 6% to 6.45 million oz, as South African output recovers.
- Weak pgm prices have led to hoarding by scrap collectors, and autocatalyst recovery will fall by 10% this year.
- Gross palladium demand will drop 12% to 9.39 million oz, as ETF investment falls by 1.33 million oz.
- Auto consumption will set a new record of 7.50 million oz, but the rate of demand growth will fall as the Chinese car market slows.
- Despite negative investment demand, the palladium market will remain in a fundamental deficit of 427,000 oz.

Excluding investment, this will be a year of relatively modest changes in palladium supply and demand. A recovery in South African supplies will be largely offset by a fall in the recovery of palladium from autocatalyst scrap, leaving combined primary and secondary supplies up only 1%. Modest growth in palladium usage in the automotive and industrial sectors will be balanced by a further retreat in jewellery fabrication, leaving palladium demand in ‘consuming applications’ (i.e. not including investment) almost unchanged compared with last year. However, investment demand is forecast to move from strongly positive in 2014 to significantly negative this year. This will result in a narrowing of the gap between supply and demand, leaving the market in an overall deficit of 427,000 oz.

Primary supplies of palladium are forecast to total 6.45 million oz in 2015, a rise of 6% on last year, but still well below the levels seen between the mid-1990s and 2011, when the bulk of Russia’s state stocks of palladium were sold. To date in 2015, no Russian government stocks have been sold, and we do not believe that any such sales are planned.

In March 2015, Norilsk Nickel announced that Russia’s Central Bank (which holds significant quantities of palladium acquired out of past surpluses) had agreed in principle to sell part of its stockpile to the company. No further movement on this transaction has been reported, perhaps because palladium price movements have not been conducive to a deal. Should the sale go ahead, it would represent a movement in above-ground stocks, and would not affect our assessment of the market balance.

As discussed on page 1, we expect South African pgm supplies to rebound strongly this year, lifting palladium shipments by nearly 20% to 2.55 million oz, the highest level since 2011. Palladium production has been boosted by a strong performance at Anglo American Platinum’s Mogalakwena open pit, which mines ores with a high palladium content, and a strong recovery at the strike-affected western Bushveld mines.

North American supplies are likely to decline slightly this year, with all the region’s major pgm producers expected to report slightly lower production, with the exception of Glencore which should refine additional palladium from its Raglan mine in the far north of Quebec. Lundin Mining’s Eagle mine will contribute modest amounts of by-product palladium for the first time.

In our previous report, we forecast that recoveries of palladium from autocatalyst scrap would rise by 7% this year, reflecting increases in palladium loadings on vehicles built in the late 1990s and early 2000s. However, these gains have not materialised, for the reasons discussed in greater detail on page 4: low exchange values are prompting European and US consumers to keep vehicles for longer, while weak pgm prices have led to significant hoarding of scrap by collectors. Although we do still expect some growth

Palladium Supply and Demand '000 oz			
Supply	2013	2014	2015
South Africa	2,464	2,127	2,547
Russia	2,610	2,614	2,603
Others	1,300	1,363	1,300
Total Supply	6,374	6,104	6,450
Gross Demand			
Autocatalyst	7,026	7,433	7,495
Jewellery	355	274	242
Industrial	2,127	2,033	2,057
Investment	-8	931	-400
Total Gross Demand	9,500	10,671	9,394
Recycling	-2,530	-2,752	-2,517
Total Net demand	6,970	7,919	6,877
Movements in Stocks	-596	-1,815	-427



PGM MARKET REPORT NOVEMBER 2015

Palladium Demand: Autocatalyst '000 oz									
	Gross			Recycling			Net		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
Europe	1,490	1,580	1,592	-410	-469	-401	1,080	1,111	1,191
Japan	755	765	725	-129	-119	-118	626	646	607
North America	1,787	1,958	2,046	-1,149	-1,335	-1,135	638	623	911
China	1,499	1,630	1,624	-57	-82	-116	1,442	1,548	1,508
Rest of World	1,495	1,500	1,508	-165	-184	-210	1,330	1,316	1,298
Total	7,026	7,433	7,495	-1,910	-2,189	-1,980	5,116	5,244	5,515

in collection and recovery in China and the Rest of World, we now predict that global recycling of palladium from scrapped catalytic converters will fall by 10% in 2015, dipping back below the 2 million oz level.

In recent years, the Chinese jewellery industry has also been a significant source of scrap palladium, but returns

“ We now predict that global recycling of palladium from scrapped catalytic converters will fall by 10% in 2015. ”

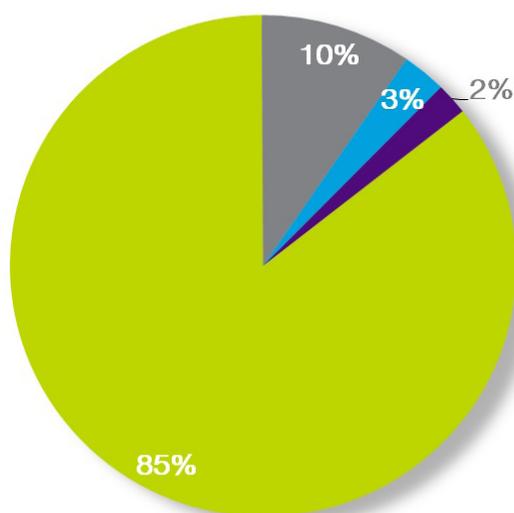
of old jewellery have now begun to dry up, and recoveries of palladium from this sector will contract sharply in 2015. While the total volume of electronics recycling is rising, pgm values in electronic scrap continue to decline, and any gain in palladium recoveries is expected to be marginal. Overall, we predict that secondary supplies of palladium will fall by 9% to 2.52 million oz, and that total availability of palladium from combined secondary and primary sources will rise by just 1% to 8.97 million oz.

“ Perceptions of poorer prospects for palladium in China have led some investors to reduce their palladium exposure. ”

In contrast, demand is set to fall significantly this year, as dramatic year-on-year swings in investment offtake once again obscure underlying market trends in consumption. Total gross demand will register a decline of nearly 1.3 million oz, to 9.39 million oz, all of which is explained by changes in ETF purchasing.

Between January and late October 2015, perceptions of poorer prospects for palladium demand in China, in line with slower economic growth and weaker vehicle production, led some investors to reduce their exposure to palladium. Over this period, European and US investors trimmed their palladium ETF holdings by over 320,000 oz, with selling intensifying during the September to October period. In South Africa, modest liquidation in the January to March period was reversed during the second and third quarters, leaving investment in the two rand-denominated funds in positive territory at the end of September. However, October saw South African investors liquidate over 180,000 oz of palladium holdings in a single month, leaving year-to-date net redemptions for this region at 100,000 oz.

Palladium demand by auto sector 2015



■ LD Gasoline ■ LD Diesel ■ HDD / Non Road ■ Motorcycles

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 is little scope for the palladium investment market to benefit from lower yen prices; while there is one yen-denominated ETF fund, it holds only small amounts of palladium. In the ten months to October, Japanese investors added about 3,800 oz to their ETF holdings, compared to ten times this figure in the equivalent platinum ETF, and several hundred thousand ounces of large platinum bar purchases.

While investment is clearly the 'swing' factor in the palladium market, the automotive sector continues to dominate consumption: sales to automakers are forecast to set a new record of 7.50 million oz in 2015, accounting for three quarters of demand at the gross level. However, the rate of growth in palladium auto demand has slowed markedly this year.



Johnson Matthey
Precious Metals Management

“ Palladium sales to automakers are forecast to set a new record of 7.50 million oz in 2015, accounting for three quarters of demand at the gross level. ”

“ Californian LEV III emissions standards are being phased in, leading US automakers to increase their output of vehicles meeting ULEV standards. ”

During the five year period between 2010 and 2014, growth in palladium usage on light duty vehicles outstripped gains in vehicle production. Over this period, global light duty output rose by 20%, but palladium consumption on these vehicles grew by over 30%, as emissions legislation tightened in many markets, and automakers substituted platinum with palladium in both gasoline and diesel catalysts.

In 2015, growth in light duty vehicle production will fall below 1%, primarily as a consequence of a slow-down in the Chinese market. At the same time, we expect global average palladium loadings on gasoline cars to remain broadly stable, while loadings on diesel catalysts will decline slightly, because current European emissions limits favour a higher proportion of platinum in the diesel catalyst mix. (This is discussed in more detail on page 5). The result is that gross palladium consumption will rise more slowly than light duty output this year.

Light duty gasoline catalysts remain far and away the most important autocatalyst application, accounting for over 85% of all palladium auto demand. Now that the vast majority of gasoline vehicles worldwide carry palladium-based catalysts, increases in loadings are primarily dictated by changes in emissions legislation.

In North America, Californian LEV III emission standards (also adopted by other ‘Green States’) are being phased in starting with the 2015 model year. As a result, US automakers have increased their output of vehicles meeting ULEV (Ultra Low Emission Vehicle) standards, contributing to higher average palladium loadings on US gasoline vehicles. Along with a small underlying increase in gasoline car output in the region – up 2% in 2015 – this will contribute to an increase in palladium demand from US automakers.

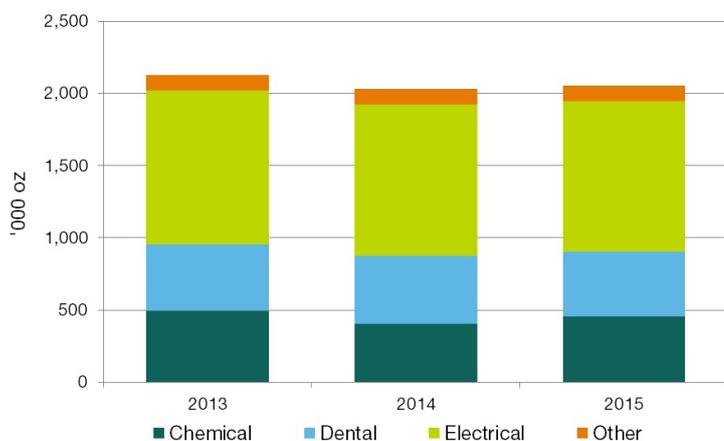
However, these gains will be partly offset by a decline in palladium usage in Japan, Russia and Brazil, all of which have seen sharp falls in car production this year. Chinese light duty gasoline output is slated to rise by 1%, but palladium use in this region may for the first time see a small retreat, in line with modest thrifting on three-way catalysts.

Palladium consumption in industrial applications is now expected to be up slightly this year, with strong sales of palladium catalysts to the chemicals industry offsetting gradual erosion of demand in the electronics and dental sectors. However, jewellery demand is forecast to fall by a further 12%. In China, the use of palladium in jewellery has collapsed to the extent that net demand is close to zero. The palladium jewellery market is now dominated by its

traditional uses, in white gold alloys worldwide, in platinum jewellery alloys in Japan, and as a jewellery metal in its own right in a small number of western markets, including the USA, the UK and Germany.

Despite lower jewellery demand and liquidation in the investment sector, the palladium market remains in fundamental deficit. During the 2012–2014 period, palladium usage in the ‘consuming applications’ – automotive, industrial and jewellery – consistently exceeded the level of supplies from primary and secondary sources by at least half a million ounces per annum, and in 2015 this gap will widen to over 800,000 oz. Our headline deficit figure of 427,000 oz takes into account our expectation that investment demand will be in negative territory this year.

Gross industrial demand for palladium



Outlook for Palladium

SUPPLY & DEMAND IN 2016

FORECAST: PALLADIUM

- Primary palladium supplies are expected to be flat, but recycling should rise strongly, assuming that 2015's hoarding is reversed.
- Autocatalyst demand will rise modestly, with growth in global gasoline car production partly offset by thrifiting.
- There is potential for further ETF selling, especially in the USA and Europe, where many investors are 'in the money'.
- The deficit in the palladium market could narrow next year, depending on investment flows.

In 2016, combined primary and second supplies should rise, mainly due to the anticipated reversal of hoarding in the autocatalyst recovery sector. On the demand side, we expect a continuation of the trends seen in 2015. Some further incremental growth in automotive and industrial demand will be balanced by a modest decline in jewellery offtake, leaving demand in 'consuming applications' little changed. Once again, the direction of change in overall demand will depend on investment.

The prospect of any increase in primary palladium shipments in 2016 is rather limited, and will depend largely upon the ability of producers to sustain incremental increases in capacity utilisation in South Africa and Zimbabwe, as discussed on page 12. At Norilsk Nickel, the world's largest palladium producer, mine output is expected to be stable. The company is currently reconfiguring its process flow sheet, with the transfer of nickel smelting and refining operations to the company's Kola site. This will involve some changes to the pgm process flow sheet and could result in temporary fluctuations in refined output, but is unlikely to have any longer term impact on palladium production.

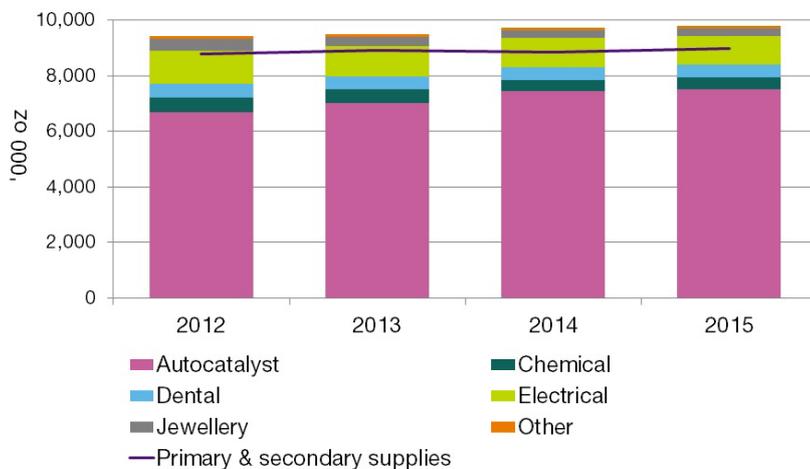
Overall, we expect primary shipments to be flat to marginally up next year. Secondary supplies, in contrast, should increase significantly, assuming that recent inventory building by scrap collectors is reversed. Destocking will be accompanied by further growth in the palladium content of scrap, especially in North America.

These predicted increases in palladium content relate to changes in catalyst fitment strategies and the automotive pgm mix that occurred between the mid-1990s and mid-2000s. This period saw an unprecedented expansion in the use of palladium, initially on

US and then on European gasoline vehicles, due to the replacement of platinum catalysts with more heavily-loaded palladium equivalents. Because fuel was less clean and catalyst technology less advanced than today, palladium loadings tended to be much higher than on modern cars, even though emissions limits were less stringent than now.

The rate of change was so rapid that it is difficult to accurately predict pgm ratios in scrap, especially in converters collected from vehicles built in the early 2000s, since small variations in vehicle age can have dramatic implications for the pgm content and mix. Our current expectation is that palladium's share of total pgm recovered from vehicles will decline slightly in 2016, but any changes in the pgm mix should be greatly outweighed by

Palladium demand in consuming applications (excluding investment)



“ Destocking by autocatalyst scrap collectors will be accompanied by further growth in the palladium content of scrap, especially in North America. ”

“ US emissions legislation has entered a new phase of tightening. LEV III and Tier 3 regulations will be implemented in 2015–2025 and 2017–2025, respectively. ”

the overall increase in both the volume and pgm grade of scrap, leading to double digit growth in recoveries.

On the demand side, sales of palladium to automakers have risen steeply in recent years, but have now entered a period of consolidation. Industry forecasts suggest that production of light duty gasoline vehicles in 2016 should rise by around 4%, assuming a modest recovery in the Chinese car market, where growth stalled in 2015.

Gains in vehicle output are also expected in some Rest of World countries, including Mexico, which primarily supplies vehicles to the buoyant US market, and Thailand, where strong exports are expected to offset weak domestic demand. Output of passenger cars is slated to recover somewhat in Japan, following this market’s contraction in 2015, but growth in gasoline car production in Europe and North America is predicted to be modest.

In terms of palladium demand, overall growth in gasoline car volumes will be offset by some limited thrifting of pgm, especially in North America, where automakers are taking the opportunity to thrift heavily-loaded catalysts on some light duty truck models ahead of the next round of emissions legislation. As a result, we expect global demand for palladium in autocatalysts to advance only marginally in 2016.

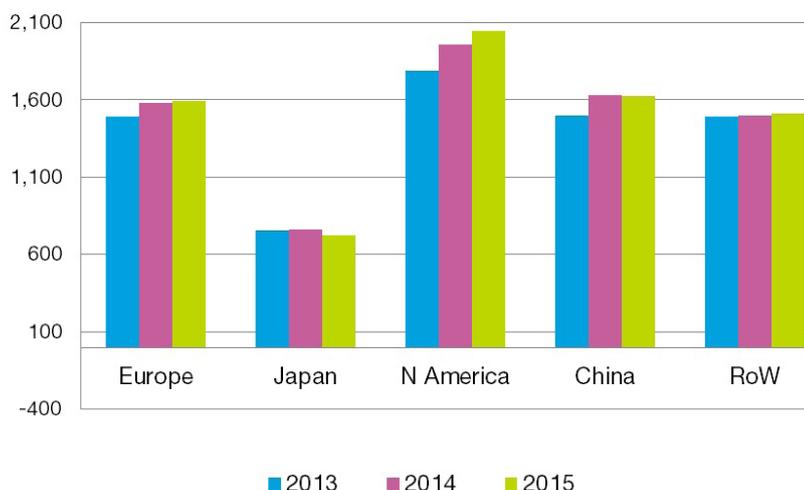
US emissions legislation is at the beginning of a new phase of tightening that should ultimately have a strongly positive impact on North American gasoline catalyst loadings. California’s LEV III regulations, which have also been adopted by a number of other ‘Green States’, will be implemented between the 2015 and 2025 model years, while Federal Tier 3 legislation will be brought in over the 2017–2025 period. In both cases, the legislation combines emissions limits for NMOG (non-methane organic gases, including CO) and NOx into a single standard, which will be tightened progressively such that fleet average emissions are ultimately reduced by 70–80%, and also applies stricter limits for particulate matter (PM). In addition, durability requirements for emissions control systems will gradually be increased to 150,000 miles.

While automakers have some flexibility in terms of how they meet the new fleet average limits, in practice the main impact will be to increase the number of vehicles that are equipped

with catalyst systems capable of meeting ULEV standards. Stricter durability requirements are also likely to prove positive for pgm demand. However, while production of ULEV vehicles is beginning to increase, the impact on demand will primarily be felt after 2016, when the federal legislation begins to take effect.

In industrial applications, we see little reason to expect any change in existing demand trends. While palladium sales to the chemical industry are forecast to remain strong, we expect continued substitution of palladium with base metals and other materials in the electronics and dental sectors. This will leave total industrial demand little changed. Jewellery demand is expected to fall for the seventh consecutive year as Chinese demand withers to almost nothing.

Palladium demand for autocatalyst (gross)



“ Much of the metal held in US and European ETFs was acquired prior to 2011 at below \$600, so investors are in a position to take profits should they choose. ”

Overall, we expect palladium demand in ‘consuming’ applications (automotive, industrial and jewellery combined) to be stable or marginally higher. If we are correct about the prospect for a large increase in autocatalyst recycling, this suggests that the gap between supply and demand could narrow next year. However, the ultimate market balance will be dependent upon investment flows.

The palladium investment market has been in negative territory during 2015. Despite the dollar palladium price touching five year lows, there has been steady profit taking by investors in the longer-established European and US ETFs. Much of the metal held in these funds was acquired prior to 2011 at prices below \$600, so many investors are in a position to take profits should they choose.

Detailed analysis of investment flows suggests that, in the mature ETF markets, rising prices may no longer lead to net additions to holdings, at least in the short term. Broadly speaking, over the last three years, US and European investors have shown themselves at least as likely to sell as to buy into rising prices; this is probably partly a function of the relative longevity of these holdings, but may also reflect a gradual erosion of confidence in the outlook for palladium. We therefore believe that there is the potential for US and European disinvestment to continue into 2016, even if palladium prices begin to recover.

In contrast, the South African funds were launched in early 2014, and much of the metal bought before the second half of this year was acquired at prices close to or above current levels. Net buying outweighed redemptions in the first nine months of 2015, but these gains were reversed by a sudden surge of liquidation in late October. This abrupt change in investor behaviour makes it difficult to predict the direction of investment going forward. On balance, we think that compared to other regions there is less potential for further significant profit taking, and some scope for investors to add to their holdings given that these funds have been in existence for less than two years.

Non-South African ETF holdings: Palladium



South African ETF holdings: Palladium



Forecast of Rhodium SUPPLY & DEMAND IN 2015

SUMMARY: RHODIUM

- A rebound in South African supplies to four year highs is expected to push rhodium into a surplus of 33,000 oz.
- Primary supplies will rise by 18% to 736,000 oz, partly offset by a 9% drop in autocatalyst recoveries of rhodium.
- Auto demand will fall slightly, reflecting flat global production of gasoline cars, and further thrifting on Japanese vehicles.
- Industrial and other demand will also contract, with lower sales to glass makers, and negative ETF investment.

After posting two years of deficit, the rhodium market is forecast to move into surplus in 2015. With supplies from South Africa recovering strongly from last year's strike, growth in primary supplies will more than offset a sharp drop in recoveries from autocatalyst scrap. At the same time, gross demand will fall by 20,000 oz, with lower sales to glass makers and ETF investors.

The use of rhodium in autocatalysts continues to dominate demand, accounting for 83% of gross consumption of rhodium in 2015. Sales of rhodium to automakers are set to contract slightly this year, to 820,000 oz, with thrifting on three-way catalysts fitted to gasoline cars outweighing an increase in rhodium use for diesel emissions control.

Global production of light duty gasoline vehicles is expected to stagnate in 2015, with growth in China slowing sharply, and weak demand for passenger cars in some large Rest of World markets including Russia and Brazil. At the same time, there have been no major changes in emissions legislation this year, and thus no reason for pgm loadings on gasoline catalysts to rise.

As is typical between cycles of legislative tightening, automakers have instead focused on reducing the cost of their catalyst systems, by thrifting platinum and to a lesser extent rhodium. This has been particularly evident in Japan, where loadings of both these metals are significantly higher than in other automotive markets with comparable emissions legislation; the scope for reducing the rhodium content on Japanese catalyst systems is therefore greater than elsewhere. Overall, rhodium usage on gasoline cars will decline by 2% this year.

Nevertheless, three-way catalysts fitted to gasoline cars and motorbikes will still account for over 95% of rhodium auto demand in 2015. In addition, small amounts of rhodium are used in lean NOx traps fitted to diesel cars (and also to a small number of lean-burn gasoline vehicles – see pages 5 and 6). This year will see a near doubling of rhodium consumption in this segment, albeit off a low base.

Increased use of LNTs has been driven by tighter legislation in Europe. Since September 2015, all new passenger cars registered in this region have had to meet Euro 6b emissions limits, which for diesel vehicles impose a 56% reduction in NOx emissions compared with

Euro 5. We estimate that at least half of all diesel cars manufactured in Europe this year will meet Euro 6b standards, and that a significant proportion of these will use an LNT. Broadly speaking, the rhodium loading on a diesel vehicle containing an LNT is comparable to that on a European gasoline car.

The use of LNTs is primarily a European phenomenon, but our estimates include small amounts of rhodium used in diesel emissions control in Japan and North America.

Rhodium Supply and Demand '000 oz			
Supply	2013	2014	2015
South Africa	551	467	593
Russia	80	91	82
Others	63	65	61
Total Supply	694	623	736
Gross Demand			
Autocatalyst	786	824	820
Other	213	179	163
Total Gross Demand	999	1,003	983
Recycling	-278	-307	-280
Total Net Demand	721	696	703
Movements in Stocks	-27	-73	33



“ At current prices, rhodium ETF investors are ‘out of the money’, so further redemptions are unlikely unless a spike in the price offers a selling opportunity. ”

Demand for rhodium in industrial and other applications (including investment and jewellery) is expected to fall by 9% in 2015. While offtake by the chemicals industry is forecast to rise, in line with buoyant demand for rhodium catalyst from the agrochemical industry in Europe, sales to glass makers will drop by 16%.

Platinum–rhodium alloys are used in bushings, tanks, stirrers and other equipment used in the manufacture of fibreglass, LCD substrates, and some other speciality types of glass. Thus, it might be assumed that trends in rhodium demand would closely follow those of platinum. However, this is not always the case, for two reasons.

Firstly, the rhodium content of platinum alloys used in glass making depends partly on the relative price of the two metals: when rhodium prices are low, glass manufacturers often choose to switch to alloys with a higher rhodium content, which offer some technical benefits. Thus, trends in rhodium use were more positive than for platinum over the 2012 to 2014 period. However, manufacturers intending to adopt higher rhodium-content alloys have already done so, and rhodium has not benefited from alloy switching this year.

Secondly, our estimates are of net sales to glass makers, and take account of any metal that is returned to the market following plant closures. In 2013 and 2014, Japanese LCD glass makers sold platinum that was surplus to immediate requirements, depressing demand in those years. In contrast, manufacturers have generally chosen to retain surplus rhodium, and use it gradually to meet their ongoing, top-up requirements. Thus, variations in annual demand have been much less significant for rhodium than for platinum.

Investors in the Deutsche Bank rhodium ETF are expected to be net sellers this year. The fund saw steady accumulation between its launch in 2011 and the final quarter of 2014, when the first significant redemptions occurred. This year, ETF holdings have been in negative territory: in the first ten months of 2015, there was a net reduction in holdings of around 3,600 oz. At current prices of below \$800, we believe that all rhodium investors are ‘out of the money’ and consequently, further redemptions are unlikely unless a spike in the price offers a selling opportunity.

Weak rhodium prices reflect improved availability of this metal following the end of the AMCU strike in July last year. Production at the affected mines has recovered rapidly, despite some shaft closures, and shipments by South African producers are set to approach 600,000 oz in 2015 - their highest level since 2011. While output in other regions will be flat or slightly down, global primary supplies will nevertheless grow by 18% to 736,000 oz. This is a faster rate of increase than will be seen in platinum or palladium, and reflects the extent to which the rhodium market is reliant upon the South African mines.

As discussed on pages 3 and 4, the recycling of autocatalysts removed from end-of-life vehicles has been significantly weaker than we had previously anticipated. This is a consequence of an underlying reduction in the number of vehicles being scrapped in Europe and North America, as well as some price-related hoarding in these two key markets. We now expect only 280,000 oz of rhodium to be recovered this year, down 9% on 2014’s total.

We estimate that at least 30,000 oz of potential rhodium recycling has been deferred, through a combination of delayed scrapping by vehicle owners, and hoarding by scrap collectors. Despite this shortfall, the rhodium market has moved back into surplus, with combined secondary and primary supplies expected to exceed demand by 33,000 oz in 2015.

“ At least 30,000 oz of rhodium recycling has been deferred, due to delayed vehicle scrapping and catalyst hoarding. ”



Outlook for Rhodium

SUPPLY & DEMAND IN 2016

FORECAST: RHODIUM

- Primary supplies are unlikely to grow significantly, but recycling should see double digit gains.
- Modest expansion in global gasoline car production will lead to small gains in the use of rhodium in autocatalyst.
- Combined industrial and other demand should be flat, with significant liquidation of ETF holdings unlikely at current prices.

In 2016, mine production of rhodium is unlikely to increase significantly, but there is potential for a significant rebound in secondary supplies, with growth in autocatalyst recycling expected to be in double digits. With only modest gains expected in sales of metal to automakers, rhodium looks set to remain in surplus. However, if low pgm prices were to precipitate a major mine closure, this would tip the market decisively into deficit.

Autocatalyst demand for rhodium is expected to improve modestly next year, in line with improving global car production following a year of weak growth in 2015. Industry forecasts predict that global light duty vehicle output will expand by around 4%, with gains concentrated in China and some Rest of World countries, including Iran, Thailand and Russia. However, it should be noted that forecasts of vehicle output in the less mature car markets tend to have relatively large uncertainties. In the developed markets of Europe, Japan and North America, overall growth in gasoline car volumes is expected to be around 2%.

Three-way catalysts for gasoline emissions control account for more than 95% of total autocatalyst usage of rhodium, so demand in this segment is critical for rhodium demand. Assuming that the global car market returns to growth, then rhodium consumption should expand too. However, the rate of increase will be moderated by further thrifing of rhodium loadings in Japan.

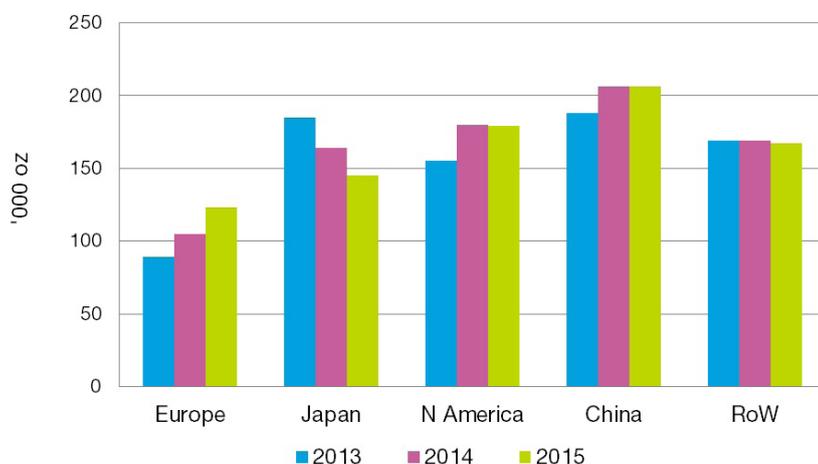
We expect at least one more year of double digit growth in demand for rhodium in light duty diesel applications. All new passenger cars registered in Europe in 2016 will need to meet Euro 6b emissions limits. In addition, the tighter standards will apply to new light commercial vehicle models starting in September next year. While the absolute number

of European vehicles fitted with LNTs will grow in 2016, we expect SCR technology to account for an increasing share of the NOx control market, limiting the potential for growth in rhodium demand.

In other industrial sectors, steady growth is forecast, with a cooling in chemical demand more than offset by stronger demand from the glass industry, where rhodium inventories have been gradually depleted.

The rhodium investment market has been in negative territory during 2015, and holdings are unlikely to change significantly while the price remains at current depressed levels. Should the price rise, it is possible that further profit taking will occur, especially as some investors have now been holding metal for several years. However, the fund

Rhodium demand for autocatalyst (gross)



“ Unlike palladium, and to a lesser extent platinum, above-ground stocks of rhodium are thought to be relatively limited. ”

has seen only very limited redemptions over the course of its five year existence, and it is probable that ETF holders are knowledgeable investors who take a long-term view of the rhodium market. Thus, a rising price could just as easily drive new investment into the fund.

The volume of autocatalyst scrap processed has fallen in 2015, but is expected to recover next year, assuming a more positive pgm price environment. (Because rhodium is recovered along with much larger amounts of platinum and palladium, rhodium prices on their own are unlikely to have a material influence on the volume of scrap collected and refined.) We expect double digit growth in autocatalyst recycling of all three pgm, in line with increases in both overall scrap volumes and in loadings on scrapped catalysts.

Primary supplies rebounded strongly in 2015, but there is only limited scope for further improvement in 2016. Based on the mines' current plans, we think that production increases from new and ramp-up operations in South Africa will be broadly offset by shaft closures, with producers including Impala, Glencore and Lonmin shutting shafts that mine entirely or mainly from the rhodium-rich UG2 reef.

If our assumptions regarding primary and secondary supplies are correct, we would expect the rhodium market to remain in surplus next year. However, at the time of writing, there was some doubt over Lonmin's future, with the outcome of a proposed rights issue uncertain. Should Lonmin be forced to cease production, this would remove at least 90,000 oz of annual rhodium production from the market, which would thereby move decisively into deficit. Unlike palladium, and to a lesser extent platinum, above-ground stocks of rhodium are thought to be relatively limited, and the closure of a major producer could have significant near-term implications for the availability of this metal.



PGM MARKET REPORT NOVEMBER 2015

PLATINUM '000 oz - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	4,635	4,860	4,110	4,205	3,547	4,295
	Russia ²	825	835	801	725	709	699
	North America	200	350	306	318	339	331
	Zimbabwe ³	280	340	337	410	401	416
	Others ³	110	100	126	143	130	100
	Total Supply	6,050	6,485	5,680	5,801	5,126	5,841
Demand⁴	Autocatalyst ⁴	3,075	3,185	3,158	3,114	3,270	3,468
	Chemical	440	470	452	546	549	566
	Electrical ⁴	230	230	176	218	225	243
	Glass	385	515	153	97	191	243
	Investment	655	460	450	871	273	367
	Jewellery ⁴	2,420	2,475	2,783	3,028	2,894	2,648
	Medical and Biomedical ⁵	230	230	223	214	211	211
	Petroleum	170	210	112	159	165	121
	Other	300	320	395	418	423	434
	Total Gross Demand	7,905	8,095	7,902	8,665	8,201	8,301
Recycling⁶	Autocatalyst	-1,085	-1,240	-1,120	-1,205	-1,282	-1,156
	Electrical	-10	-10	-22	-24	-27	-29
	Jewellery	-735	-810	-895	-790	-762	-623
	Total Recycling	-1,830	-2,060	-2,037	-2,019	-2,071	-1,808
	Total Net Demand⁷	6,075	6,035	5,865	6,646	6,130	6,493
	Movement in Stocks⁸	-25	450	-185	-845	-1,004	-652

PGM MARKET REPORT NOVEMBER 2015

PLATINUM '000 oz - Gross Demand by Region

		2010	2011	2012	2013	2014	Forecast 2015
Europe	Autocatalyst	1,495	1,505	1,323	1,321	1,536	1,728
	Chemical	110	120	110	98	103	104
	Electrical	15	20	17	15	14	14
	Glass	10	30	2	6	10	10
	Investment	140	155	135	-40	-77	-70
	Jewellery	175	175	179	219	207	212
	Medical and Biomedical	90	90	78	72	70	69
	Petroleum	20	35	-3	-12	22	-1
	Other	100	95	115	117	115	116
Total		2,155	2,225	1,956	1,796	2,000	2,182
Japan	Autocatalyst	550	500	591	558	500	449
	Chemical	50	35	35	42	42	42
	Electrical	30	25	21	27	28	30
	Glass	90	130	-3	-20	-96	6
	Investment	45	250	98	-40	20	395
	Jewellery	325	310	312	309	313	310
	Medical and Biomedical	20	20	20	19	19	18
	Petroleum	5	5	3	-1	3	3
	Other	40	40	63	64	62	63
Total		1,155	1,315	1,140	958	891	1,316
N. America	Autocatalyst	405	370	395	345	366	400
	Chemical	100	95	106	102	113	116
	Electrical	25	25	21	19	18	18
	Glass	10	-5	7	7	12	12
	Investment	465	10	187	57	6	-40
	Jewellery	175	185	187	213	215	220
	Medical and Biomedical	90	90	89	85	83	84
	Petroleum	25	50	46	23	24	26
	Other	105	110	118	124	122	121
Total		1,400	930	1,156	975	959	957
China	Autocatalyst	100	105	93	130	138	149
	Chemical	80	100	89	146	119	135
	Electrical	30	30	31	36	38	40
	Glass	130	10	53	99	191	187
	Investment	0	0	0	0	0	0
	Jewellery	1,650	1,680	1,950	2,100	1,935	1,630
	Medical and Biomedical	10	10	15	17	17	17
	Petroleum	15	15	21	56	30	19
	Other	25	30	40	49	52	57
Total		2,040	1,980	2,292	2,633	2,520	2,234
RoW	Autocatalyst	525	705	756	760	730	742
	Chemical	100	120	112	158	172	169
	Electrical	130	130	86	121	127	141
	Glass	145	350	94	5	74	28
	Investment	5	45	30	894	324	82
	Jewellery	95	125	155	187	224	276
	Medical and Biomedical	20	20	21	21	22	23
	Petroleum	105	105	45	93	86	74
	Other	30	45	59	64	72	77
Total		1,155	1,645	1,358	2,303	1,831	1,612
Grand total		7,905	8,095	7,902	8,665	8,201	8,301



PGM MARKET REPORT NOVEMBER 2015

PLATINUM Tonnes - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	144.2	151.2	127.8	130.8	110.3	133.6
	Russia ²	25.7	26.0	24.9	22.5	22.1	21.7
	North America	6.2	10.9	9.5	9.9	10.6	10.3
	Zimbabwe ³	8.7	10.6	10.5	12.8	12.5	12.9
	Others ³	3.4	3.1	3.9	4.4	4.0	3.1
	Total Supply	188.2	201.7	176.6	180.4	159.5	181.6
Demand⁴	Autocatalyst ⁴	95.6	99.1	98.2	96.8	101.7	107.9
	Chemical	13.7	14.6	14.1	16.9	17.0	17.5
	Electrical ⁴	7.2	7.2	5.5	6.8	7.0	7.5
	Glass	12.0	16.0	4.7	3.1	6.0	7.6
	Investment	20.4	14.3	13.9	27.2	8.5	11.5
	Jewellery ⁴	75.3	77.0	86.6	94.1	90.0	82.3
	Medical and Biomedical ⁵	7.2	7.2	7.0	6.6	6.6	6.5
	Petroleum	5.3	6.5	3.5	4.9	5.1	3.8
	Other	9.3	10.0	12.3	13.0	13.1	13.6
	Total Gross Demand	245.9	251.8	245.8	269.4	255.0	258.2
Recycling⁶	Autocatalyst	-33.7	-38.6	-34.9	-37.5	-39.9	-35.9
	Electrical	-0.3	-0.3	-0.7	-0.7	-0.8	-0.9
	Jewellery	-22.9	-25.2	-27.9	-24.7	-23.7	-19.4
	Total Recycling	-56.9	-64.1	-63.5	-62.9	-64.4	-56.2
	Total Net Demand⁷	189.0	187.7	182.3	206.5	190.6	202.0
	Movement in Stocks⁸	-0.8	14.0	-5.7	-26.1	-31.1	-20.4

PGM MARKET REPORT NOVEMBER 2015

PLATINUM Tonnes - Gross Demand by Region

		2010	2011	2012	2013	2014	Forecast 2015
Europe	Autocatalyst	46.5	46.8	41.1	41.1	47.8	53.8
	Chemical	3.4	3.7	3.4	3.0	3.2	3.2
	Electrical	0.5	0.6	0.5	0.5	0.4	0.4
	Glass	0.3	0.9	0.1	0.2	0.3	0.3
	Investment	4.4	4.8	4.2	-1.2	-2.4	-2.2
	Jewellery	5.4	5.4	5.6	6.8	6.4	6.6
	Medical and Biomedical	2.8	2.8	2.4	2.2	2.2	2.1
	Petroleum	0.6	1.1	-0.1	-0.4	0.7	0.0
	Other	3.1	3.0	3.6	3.6	3.6	3.6
Total		67.0	69.2	60.8	55.8	62.2	67.8
Japan	Autocatalyst	17.1	15.6	18.4	17.4	15.5	14.0
	Chemical	1.6	1.1	1.1	1.3	1.3	1.3
	Electrical	0.9	0.8	0.6	0.8	0.9	0.9
	Glass	2.8	4.0	-0.1	-0.6	-3.0	0.2
	Investment	1.4	7.8	3.0	-1.2	0.6	12.3
	Jewellery	10.1	9.6	9.7	9.6	9.7	9.6
	Medical and Biomedical	0.6	0.6	0.6	0.6	0.6	0.6
	Petroleum	0.2	0.2	0.1	0.0	0.1	0.1
	Other	1.2	1.2	2.0	2.0	1.9	2.0
Total		35.9	40.9	35.4	29.9	27.6	41.0
N. America	Autocatalyst	12.6	11.5	12.3	10.7	11.4	12.4
	Chemical	3.1	3.0	3.3	3.2	3.5	3.6
	Electrical	0.8	0.8	0.7	0.6	0.5	0.6
	Glass	0.3	-0.2	0.2	0.2	0.4	0.4
	Investment	14.5	0.3	5.8	1.8	0.2	-1.2
	Jewellery	5.4	5.8	5.8	6.6	6.7	6.8
	Medical and Biomedical	2.8	2.8	2.8	2.6	2.6	2.6
	Petroleum	0.8	1.6	1.4	0.7	0.7	0.8
	Other	3.3	3.4	3.7	3.9	3.8	3.8
Total		43.5	28.9	36.0	30.3	29.8	29.8
China	Autocatalyst	3.1	3.3	2.9	4.0	4.3	4.6
	Chemical	2.5	3.1	2.8	4.5	3.7	4.2
	Electrical	0.9	0.9	1.0	1.1	1.2	1.2
	Glass	4.0	0.3	1.6	3.1	6.0	5.8
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	51.3	52.3	60.7	65.3	60.2	50.7
	Medical and Biomedical	0.3	0.3	0.5	0.5	0.5	0.5
	Petroleum	0.5	0.5	0.7	1.7	0.9	0.6
	Other	0.8	0.9	1.2	1.5	1.6	1.8
Total		63.5	61.6	71.4	81.7	78.4	69.4
RoW	Autocatalyst	16.3	21.9	23.5	23.6	22.7	23.1
	Chemical	3.1	3.7	3.5	4.9	5.3	5.2
	Electrical	4.0	4.0	2.7	3.8	4.0	4.4
	Glass	4.5	10.9	2.9	0.2	2.3	0.9
	Investment	0.2	1.4	0.9	27.8	10.1	2.6
	Jewellery	3.0	3.9	4.8	5.8	7.0	8.6
	Medical and Biomedical	0.6	0.6	0.7	0.7	0.7	0.7
	Petroleum	3.3	3.3	1.4	2.9	2.7	2.3
	Other	0.9	1.4	1.8	2.0	2.2	2.4
Total		35.9	51.2	42.2	71.7	57.0	50.2
Grand total		245.9	251.8	245.8	269.4	255.0	258.2



PGM MARKET REPORT NOVEMBER 2015

PALLADIUM '000 oz - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	2,640	2,560	2,359	2,464	2,127	2,547
	Russia: Primary ²	2,720	2,705	2,627	2,510	2,614	2,603
	Russia: Stock Sales ²	1,000	775	260	100	0	0
	North America	590	900	811	829	912	873
	Zimbabwe ³	220	265	266	323	328	327
	Others ³	185	155	162	148	123	100
Total Supply		7,355	7,360	6,485	6,374	6,104	6,450
Demand⁴	Autocatalyst ⁴	5,580	6,155	6,673	7,026	7,433	7,495
	Chemical	370	440	524	496	406	454
	Dental	595	540	510	457	468	452
	Electrical ⁴	1,410	1,375	1,190	1,070	1,049	1,039
	Investment	1,095	-565	467	-8	931	-400
	Jewellery ⁴	595	505	442	355	274	242
	Other	90	110	104	104	110	112
Total Gross Demand		9,735	8,560	9,910	9,500	10,671	9,394
Recycling⁶	Autocatalyst	-1,310	-1,695	-1,675	-1,910	-2,189	-1,980
	Electrical	-440	-480	-443	-463	-474	-477
	Jewellery	-100	-210	-194	-157	-89	-60
Total Recycling		-1,850	-2,385	-2,312	-2,530	-2,752	-2,517
Total Net Demand⁷		7,885	6,175	7,598	6,970	7,919	6,877
Movement in Stocks⁸		-530	1,185	-1,113	-596	-1,815	-427

PGM MARKET REPORT NOVEMBER 2015

PALLADIUM '000 oz - Gross Demand by Region

							Forecast
		2010	2011	2012	2013	2014	2015
Europe	Autocatalyst	1,330	1,485	1,427	1,490	1,580	1,592
	Chemical	105	80	79	76	-15	83
	Dental	80	80	81	80	77	70
	Electrical	195	190	151	119	111	109
	Investment	-5	-35	163	-14	-76	-145
	Jewellery	65	60	64	61	61	64
	Other	30	25	24	24	25	25
	Total	1,800	1,885	1,989	1,836	1,763	1,798
Japan	Autocatalyst	820	680	799	755	765	725
	Chemical	20	20	17	18	18	17
	Dental	250	220	220	184	205	204
	Electrical	295	300	320	245	249	245
	Investment	10	5	0	-4	-2	5
	Jewellery	75	70	70	70	67	64
	Other	10	10	9	9	9	9
	Total	1,480	1,305	1,435	1,277	1,311	1,269
N. America	Autocatalyst	1,355	1,545	1,803	1,787	1,958	2,046
	Chemical	65	80	87	70	73	84
	Dental	250	225	190	168	160	152
	Electrical	160	145	163	159	155	153
	Investment	1,090	-535	304	10	-215	-210
	Jewellery	65	45	44	44	44	44
	Other	25	45	39	38	42	43
	Total	3,010	1,550	2,630	2,276	2,217	2,312
China	Autocatalyst	1,005	1,155	1,325	1,499	1,630	1,624
	Chemical	65	145	213	210	208	153
	Dental	0	0	3	8	8	8
	Electrical	360	270	176	168	170	171
	Investment	0	0	0	0	0	0
	Jewellery	360	305	238	155	78	47
	Other	10	10	14	15	16	17
	Total	1,800	1,885	1,969	2,055	2,110	2,020
RoW	Autocatalyst	1,070	1,290	1,319	1,495	1,500	1,508
	Chemical	115	115	128	122	122	117
	Dental	15	15	16	17	18	18
	Electrical	400	470	380	379	364	361
	Investment	0	0	0	0	1,224	-50
	Jewellery	30	25	26	25	24	23
	Other	15	20	18	18	18	18
	Total	1,645	1,935	1,887	2,056	3,270	1,995
	Grand total	9,735	8,560	9,910	9,500	10,671	9,394



PGM MARKET REPORT NOVEMBER 2015

PALLADIUM Tonnes - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	82.1	79.6	73.4	76.6	66.2	79.2
	Russia: Primary ²	84.6	84.1	81.7	78.1	81.3	81.0
	Russia: Stock Sales ²	31.1	24.1	8.1	3.1	0.0	0.0
	North America	18.4	28.0	25.2	25.8	28.4	27.1
	Zimbabwe ³	6.8	8.2	8.3	10.0	10.2	10.2
	Others ³	5.8	4.8	5.0	4.6	3.8	3.1
Total Supply		228.8	228.9	201.7	198.2	189.9	200.6
Demand⁴	Autocatalyst ⁴	173.6	191.4	207.5	218.5	231.1	233.1
	Chemical	11.5	13.7	16.3	15.5	12.6	14.0
	Dental	18.5	16.8	15.8	14.1	14.6	14.1
	Electrical ⁴	43.9	42.8	37.1	33.2	32.6	32.3
	Investment	34.1	-17.6	14.6	-0.2	29.1	-12.4
	Jewellery ⁴	18.5	15.7	13.8	11.1	8.5	7.6
	Other	2.8	3.4	3.2	3.3	3.5	3.5
Total Gross Demand		302.8	266.2	308.3	295.5	332.0	292.2
Recycling⁶	Autocatalyst	-40.7	-52.7	-52.2	-59.4	-68.1	-61.6
	Electrical	-13.7	-14.9	-13.7	-14.4	-14.8	-14.8
	Jewellery	-3.1	-6.5	-6.0	-4.9	-2.7	-1.9
Total Recycling		-57.5	-74.2	-71.9	-78.7	-85.6	-78.3
Total Net Demand⁷		245.3	192.1	236.4	216.8	246.4	213.9
Movement in Stocks⁸		-16.5	36.9	-34.7	-18.6	-56.5	-13.3

PGM MARKET REPORT NOVEMBER 2015

PALLADIUM Tonnes - Gross Demand by Region							Forecast
		2010	2011	2012	2013	2014	2015
Europe	Autocatalyst	41.4	46.2	44.4	46.3	49.1	49.5
	Chemical	3.3	2.5	2.5	2.4	-0.5	2.6
	Dental	2.5	2.5	2.5	2.5	2.4	2.2
	Electrical	6.1	5.9	4.7	3.7	3.5	3.4
	Investment	-0.2	-1.1	5.1	-0.4	-2.3	-4.5
	Jewellery	2.0	1.9	2.0	1.9	1.9	2.0
	Other	0.9	0.8	0.7	0.7	0.8	0.8
	Total	56.0	58.6	61.9	57.1	54.9	56.0
Japan	Autocatalyst	25.5	21.2	24.8	23.5	23.8	22.6
	Chemical	0.6	0.6	0.5	0.6	0.6	0.5
	Dental	7.8	6.8	6.8	5.7	6.4	6.4
	Electrical	9.2	9.3	10.0	7.6	7.7	7.6
	Investment	0.3	0.2	0.0	-0.1	0.0	0.2
	Jewellery	2.3	2.2	2.2	2.2	2.1	2.0
	Other	0.3	0.3	0.3	0.3	0.3	0.3
	Total	46.0	40.6	44.6	39.8	40.9	39.6
N. America	Autocatalyst	42.1	48.1	56.1	55.6	60.9	63.6
	Chemical	2.0	2.5	2.7	2.2	2.3	2.6
	Dental	7.8	7.0	5.9	5.2	5.0	4.7
	Electrical	5.0	4.5	5.1	4.9	4.8	4.8
	Investment	33.9	-16.6	9.5	0.3	-6.7	-6.5
	Jewellery	2.0	1.4	1.4	1.4	1.4	1.4
	Other	0.8	1.4	1.2	1.2	1.3	1.3
	Total	93.6	48.2	81.9	70.8	69.0	71.9
China	Autocatalyst	31.3	35.9	41.2	46.6	50.7	50.5
	Chemical	2.0	4.5	6.6	6.5	6.4	4.7
	Dental	0.0	0.0	0.1	0.2	0.3	0.2
	Electrical	11.2	8.4	5.5	5.2	5.3	5.3
	Investment	0.0	0.0	0.0	0.0	0.0	0.0
	Jewellery	11.2	9.5	7.4	4.8	2.4	1.5
	Other	0.3	0.3	0.4	0.5	0.5	0.5
	Total	56.0	58.6	61.2	63.8	65.6	62.7
RoW	Autocatalyst	33.3	40.1	41.0	46.5	46.6	46.9
	Chemical	3.6	3.6	4.0	3.8	3.8	3.6
	Dental	0.5	0.5	0.5	0.5	0.5	0.6
	Electrical	12.4	14.6	11.8	11.8	11.3	11.2
	Investment	0.0	0.0	0.0	0.0	38.1	-1.6
	Jewellery	0.9	0.8	0.8	0.8	0.7	0.7
	Other	0.5	0.6	0.6	0.6	0.6	0.6
	Total	51.2	60.2	58.7	64.0	101.6	62.0
Grand total		302.8	266.2	308.3	295.5	332.0	292.2



PGM MARKET REPORT NOVEMBER 2015

RHODIUM '000 oz - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	632	641	577	551	467	593
	Russia ²	70	70	90	80	91	82
	North America	10	23	22	23	24	22
	Zimbabwe ³	19	29	28	36	36	34
	Others ³	3	2	3	4	5	5
Total Supply		734	765	720	694	623	736
Demand⁴	Autocatalyst ⁴	727	715	775	786	824	820
	Chemical	67	72	80	83	90	99
	Electrical	4	6	6	5	4	5
	Glass	68	77	35	47	52	43
	Other	21	38	63	78	33	16
Total Gross Demand		887	908	959	999	1,003	983
Recycling⁶	Autocatalyst	-241	-277	-252	-278	-307	-280
	Total Recycling	-241	-277	-252	-278	-307	-280
Total Net Demand⁷		646	631	707	721	696	703
Movement in Stocks⁸		88	134	13	-27	-73	33

PGM MARKET REPORT NOVEMBER 2015

RHODIUM Tonnes - Supply and Demand							Forecast
		2010	2011	2012	2013	2014	2015
Supply¹	South Africa	20.6	19.7	17.9	17.1	14.5	18.4
	Russia ²	2.2	2.2	2.8	2.5	2.8	2.5
	North America	0.5	0.3	0.7	0.7	0.7	0.7
	Zimbabwe ³	0.6	0.6	0.9	1.1	1.1	1.1
	Others ³	0.1	0.1	0.1	0.2	0.2	0.2
	Total Supply		23.9	22.8	22.4	21.6	19.3
Demand⁴	Autocatalyst ⁴	19.3	22.6	24.1	24.4	25.7	25.5
	Chemical	1.7	2.1	2.5	2.6	2.8	3.1
	Electrical	0.1	0.1	0.2	0.1	0.1	0.1
	Glass	0.6	2.1	1.0	1.5	1.6	1.3
	Other	0.7	0.7	2.0	2.5	1.0	0.5
	Total Gross Demand		22.3	27.6	29.8	31.1	31.2
Recycling⁶	Autocatalyst	-5.8	-7.5	-7.8	-8.7	-9.6	-8.7
	Total Recycling	-5.8	-7.5	-7.8	-8.7	-9.6	-8.7
	Total Net Demand⁷	16.5	20.1	22.0	22.4	21.6	21.8
	Movement in Stocks⁸	7.5	2.7	0.4	-0.8	-2.3	1.1

PGM MARKET REPORT NOVEMBER 2015

IRIDIUM '000 oz - Demand							Forecast
		2010	2011	2012	2013	2014	2015
Demand	Chemical	18	19	19	20	20	20
	Electrical	201	195	28	35	44	80
	Electrochemical	79	76	73	50	55	57
	Other	40	42	75	81	89	94
Total Demand		338	332	195	186	208	251

IRIDIUM Tonnes - Demand							Forecast
		2010	2011	2012	2013	2014	2015
Demand	Chemical	0.6	0.6	0.6	0.6	0.6	0.6
	Electrical	6.3	6.1	0.9	1.1	1.4	2.5
	Electrochemical	2.5	2.4	2.3	1.6	1.7	1.8
	Other	1.2	1.3	2.3	2.5	2.8	2.9
Total Demand		10.6	10.4	6.1	5.8	6.5	7.8

PGM MARKET REPORT NOVEMBER 2015

RUTHENIUM '000 oz - Demand

							Forecast
		2010	2011	2012	2013	2014	2015
Demand	Chemical	100	273	134	312	246	215
	Electrical	679	536	247	337	360	445
	Electrochemical	124	130	172	146	154	158
	Other	42	58	79	106	108	117
Total Demand		945	997	632	901	868	935

RUTHENIUM Tonnes - Demand

							Forecast
		2010	2011	2012	2013	2014	2015
Demand	Chemical	3.1	8.5	4.2	9.7	7.7	6.7
	Electrical	21.1	16.7	7.7	10.5	11.2	13.8
	Electrochemical	3.9	4.0	5.3	4.5	4.8	4.9
	Other	1.3	1.8	2.5	3.3	3.4	3.6
Total Demand		29.4	31.0	19.7	28.0	27.1	29.0



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

For the first time in this report, we make reference to different stages of Euro 6 legislation, because the various stages have different implications for pgm demand.

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 particulate 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 2020. 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 particulate number emissions down, in line with those from diesel vehicles.

Euro 6d is still at the proposal stage, but 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 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. It is currently proposed that the phase-in of CFs will take place in two stages. In the first stage, a CF of 2.1 will be introduced for new type approvals of passenger cars from September 2017 (all vehicles from September 2020). In the second stage, the 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.



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