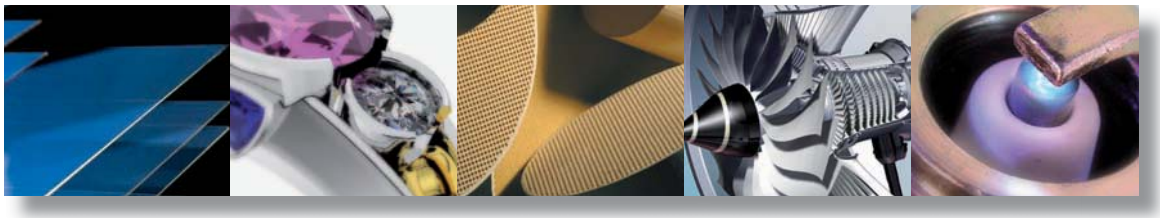
PLATINUM 2006



Johnson Matthey

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Platinum 2006 is based for the most part on information available up to the end of March 2006.

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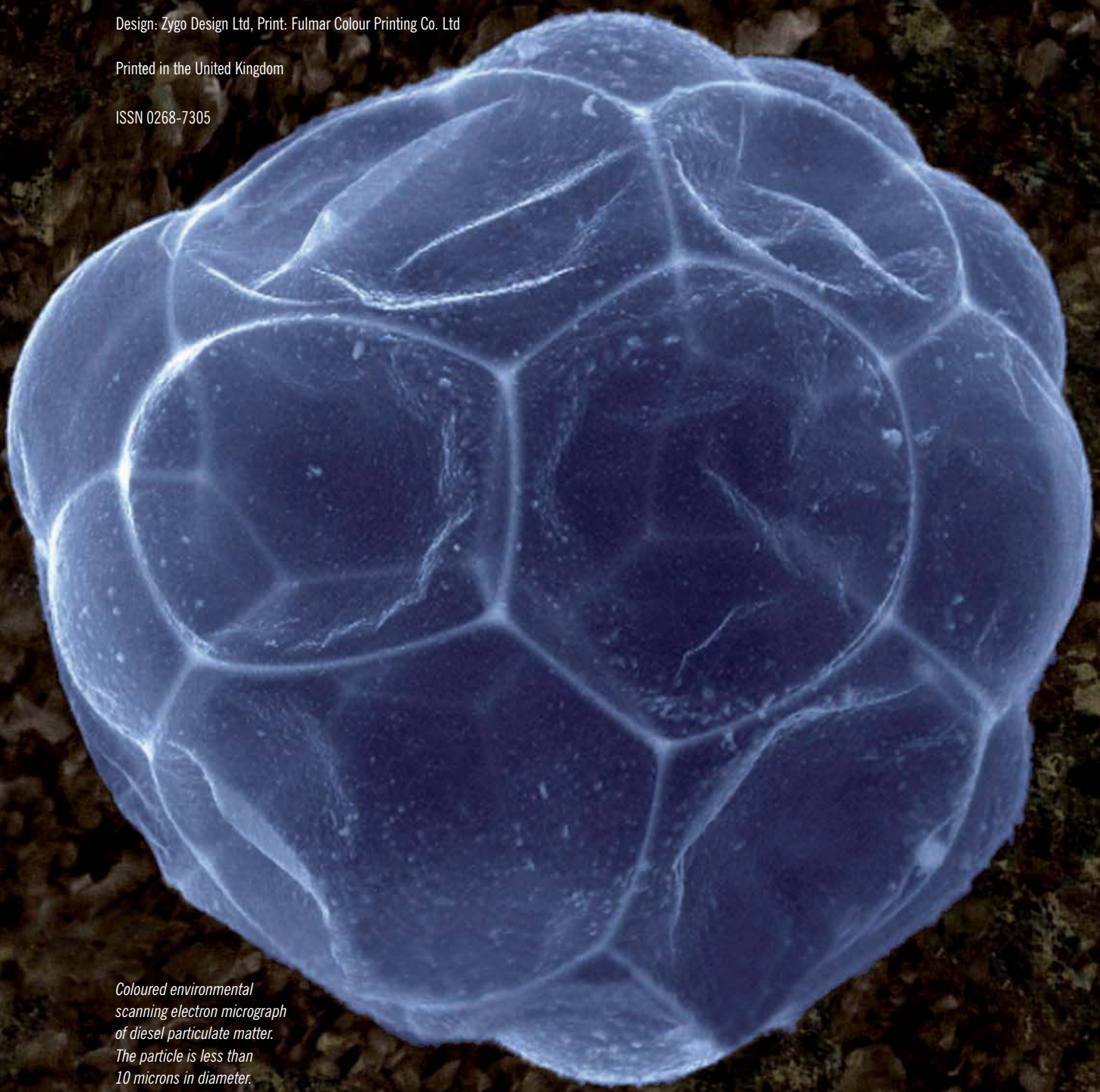


Coloured environmental scanning electron micrograph of diesel particulate matter. The particle is less than 10 microns in diameter.

PLATINUM 2006

by Tom Kendall

JM
Johnson Matthey

SUMMARY & OUTLOOK

PLATINUM

Demand for platinum reached 6.7 million oz in 2005, an annual rise of 160,000 oz. Purchases by the autocatalyst sector again grew strongly, and use of the metal in the glass industry and electrical applications also increased. However, jewellery demand for platinum fell for the third year in a row, a direct result of the rising price. Supplies of platinum expanded at a similar rate to demand, and so the market remained in deficit.

Purchases of platinum for use in **autocatalysts** surged by 330,000 oz (9 per cent) to a new high of 3.82 million oz in 2005. Most of the growth occurred in Europe as a result of tightening limits on diesel emissions, strong demand for catalysed soot filters (CSF), and further growth in diesel car sales. Rising production of light vehicles in China and elsewhere in Asia also boosted demand for platinum.

In contrast, purchases of platinum for **jewellery** manufacture dropped by 200,000 oz to 1.96 million oz, the weakest level of demand in a decade. A further sharp drop in purchases of metal by the Chinese jewellery trade accounted for much of the decline but demand in Japan and North America also contracted. In all regions, purchases of platinum for jewellery were adversely affected by the strength of the metal's price. The high cost of maintaining inventories of platinum jewellery prompted wholesalers and retailers to cut stock levels and led to an increase in the volume of older pieces being recycled to manufacturers.

- **Demand** for platinum grew by 2 per cent to 6.7 million oz in 2005. Use of the metal in autocatalysts continued to rise but purchases of platinum for jewellery weakened.
- **Autocatalyst** demand for platinum climbed by 330,000 oz to set a new record of 3.82 million oz. Most of this growth was generated by the light duty diesel sector in Europe.
- Purchases of platinum for the manufacture of **jewellery** dropped by 9 per cent to 1.96 million oz in response to higher metal prices. Chinese jewellery demand fell to its lowest level for seven years.
- Demand for platinum in **industrial** applications reached 1.675 million oz, driven by the construction of new LCD glass furnaces in Asia and greater consumption of the metal in hard disks.
- **Supplies** of platinum also increased by 2 per cent in 2005, rising to 6.63 million oz. South African output expanded by less than planned while supplies from North America and Russia fell.
- The platinum **price** ranged between $860 and $880 for most of the first half of 2005, with end user demand and fund buying providing support. During the second half, a surge of speculative investment propelled the price to a peak fixing of $1,012.

Platinum Supply and Demand
'000 oz

		2004	2005
Supply			
South Africa		5,010	5,110
Russia		845	890
North America		385	360
Others		250	270
Total Supply		**6,490**	**6,630**
Demand			
Autocatalyst:	gross	3,490	3,820
	recovery	(690)	(770)
Jewellery		2,160	1,960
Industrial		1,535	1,675
Investment		45	15
Total Demand		**6,540**	**6,700**
Movements in Stock		**(50)**	**(70)**

JM

Industrial demand for platinum climbed by 9 per cent to 1.675 million oz last year, an all time high. In the electrical sector there was further growth in the use of platinum in hard disks, whilst the ongoing expansion of LCD glass manufacturing capacity in Asia propelled glass demand for platinum to a record level. Consumption of platinum in the manufacture of catalysts for the chemicals and petroleum refining industries also increased.

Net demand for physical **investment** products in platinum slipped lower in 2005. Sales of bullion and proof coins were relatively stable but Japanese investors were net sellers of large bars, reflecting the move in the price through the key level of ¥3,000 per gram around the middle of the year and its rapid rally towards ¥4,000 per gram during December.

Supplies of platinum expanded by 140,000 oz to 6.63 million oz in 2005, with greater output from South Africa, Russia and Zimbabwe. South African production increased by 2 per cent to 5.11 million oz, less than anticipated as efforts to expand output were hampered by a number of operational problems. Russian production of platinum was boosted by the release of metal from Norilsk Nickel's process pipeline, whilst output in Zimbabwe edged higher.

The **price** of platinum was relatively stable during the first half of 2005, trading between $860 and $880 for much of that period. In contrast, the second half of the year was marked by an increase in volatility and a strong rally, as a substantial influx of fund money propelled platinum to $1,012 in December – the highest price for almost 25 years.

Retail sales of platinum jewellery remained relatively firm in luxury sectors of the market in 2005, despite the strength of the metal's price.

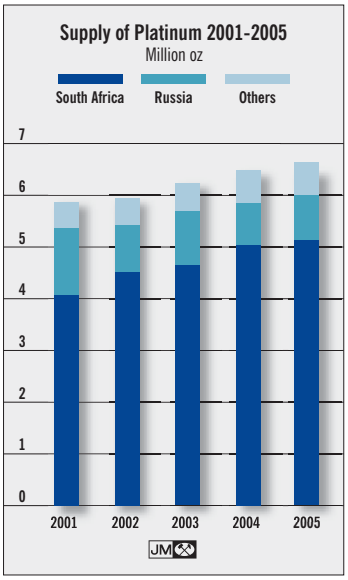
In this respect, platinum tracked the behaviour of gold and many base metals, as fund investment in commodities as a whole accelerated. At its peak in December, the combined net speculative position in platinum on the NYMEX and TOCOM futures exchanges exceeded 1 million oz, up from 200,000 oz six months earlier.

Supply

Platinum supplies from **South Africa** totalled 5.11 million oz in 2005, up by 100,000 oz compared with the previous year. Output of refined metal from Anglo Platinum was unchanged at just over 2.45 million oz, falling short of the company's intended output of 2.6 to 2.7 million oz. This was primarily due to an explosion at the group's Polokwane smelter in September that resulted in 120,000 oz of platinum accumulating in unprocessed stocks of concentrate.

Refined platinum production from Impala's main lease area on the western Bushveld rose by 6 per cent to almost 1.16 million oz last year thanks to increased mill throughput and a significant improvement in concentrator recoveries. The developing Marula Platinum mine on the eastern Bushveld, however, contributed only 31,000 oz of platinum in concentrate as the operation began making a transition from mechanised to conventional mining.

Lonmin produced 963,000 oz of platinum in 2005, a record for the group. Output from the company's western Bushveld mines increased as greater production from underground operations led to an improvement in head grades. Lonmin also gained a small volume of pgm output from the Messina mine on the eastern limb of the Bushveld complex, which it acquired in June 2005.



Northam's platinum production climbed to 225,000 oz, up 18 per cent on the previous year when the mine lost six weeks' output due to a fire. In addition, new technology at the company's UG2 concentrator contributed to an improvement in recoveries.

Purchases of platinum for the manufacture of hard disks expanded substantially last year, thanks to strong sales of personal computers and consumer electronics such as digital music players.

Aquarius Platinum's Kroondal and Marikana mines are both now operated under Pool & Share Agreements with Anglo Platinum. Platinum output attributable to Aquarius from the two operations in 2005 totalled just over 200,000 oz. The concentrator at the company's newest mine at Everest South was commissioned during December.

Platinum output from the Modikwa joint venture between Anglo Platinum and African Rainbow Minerals increased by 13 per cent to 129,000 oz, whilst the concentrator at the Crocodile River operations of Barplats was refurbished during the year.

Russian sales of platinum increased by 5 per cent to 890,000 oz in 2005. Norilsk Nickel was able to release details of its pgm output for the first time – the company produced 751,000 oz of platinum during the year, with output in the second half boosted by a reduction in pipeline stocks of pgm. Production from the alluvial mines in the Far East of Russia was relatively stable, whilst there was no evidence of sales by either the Ministry of Finance or the Central Bank.

Supplies of platinum from **North America** declined by almost 7 per cent to 360,000 oz in 2005. Sales of refined platinum by Stillwater Mining increased, despite a slight decline in average grades at its mining operations in Montana, but this was offset by lower output at Inco, Falconbridge and North American Palladium.

Production of platinum in **Zimbabwe** grew to 153,000 oz, up by 10,000 oz on the previous year as a result of increased output at both the Mimosa and Ngezi mines.

Demand

Demand for platinum in **autocatalysts** increased by 9 per cent in 2005 to 3.82 million oz. The diesel light vehicle sector in Europe continued to be the main driver of growth in platinum demand, with purchases by auto makers in the region climbing by 280,000 oz to reach 1.96 million oz.

Sales of diesels continued to rise, accounting for almost half of all new light vehicles registered in Western Europe, although the rate of growth slowed compared to the previous year. At the same time, the advent of Euro IV emissions limits plus the introduction of catalysed soot filters *(catalysed diesel particulate filters)* led to a significant rise in average platinum loadings. Public concern about particulate emissions, notably in Germany, resulted in an increasing number of vehicle models being manufactured with a CSF as standard equipment, despite most being able to meet the requirements of Euro IV without one.

The use of platinum on autocatalysts in Japan also increased in 2005 but purchases fell by 3 per cent to 595,000 oz as a result of year-to-year changes in auto manufacturers' inventories of the metal. The greater use of platinum was partly a consequence of higher light vehicle output and a small rise in average loading levels, with an increasing proportion of light vehicles meeting the strict Japanese Ultra Low Emissions Vehicle standards. The use of platinum was also boosted by new emissions regulations that necessitate the fitment of after-treatment to most new heavy duty diesel vehicles.

In North America, autocatalyst demand for platinum increased slightly to 820,000 oz, despite the fact that light vehicle production in the region weakened. This was a consequence of a slow but steady rise in the retrofitting of after-treatment systems to heavy duty diesel vehicles, plus changes in market share between domestic and foreign vehicle brands.

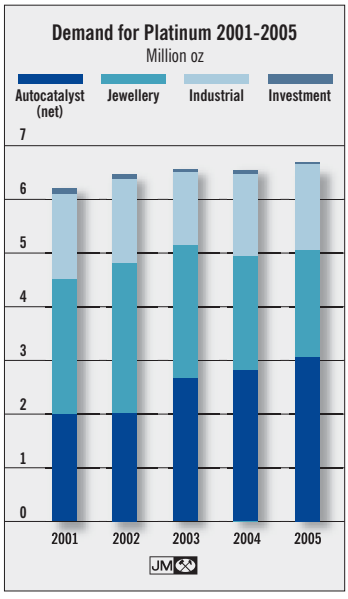
Demand for platinum from the autocatalyst sector in China jumped from 75,000 oz in 2004 to 110,000 oz in 2005 – a result of higher light vehicle production (up 14 per cent) and the ongoing tightening of vehicle emissions limits. Autocatalyst demand for platinum in the Rest of the World region also increased, rising by 5 per cent to 335,000 oz, driven by stronger light vehicle production in much of Asia and South America. There was, however, a notable acceleration of switching from platinum-based catalysts to palladium after-treatment systems by certain vehicle manufacturers.

In 2005, **jewellery** demand for platinum slipped below 2 million oz for the first time since the mid-1990s, falling by 9 per cent to 1.96 million oz. Purchases of metal by Chinese manufacturers fell substantially for the third year in a row, and demand in Japan and North America also declined.

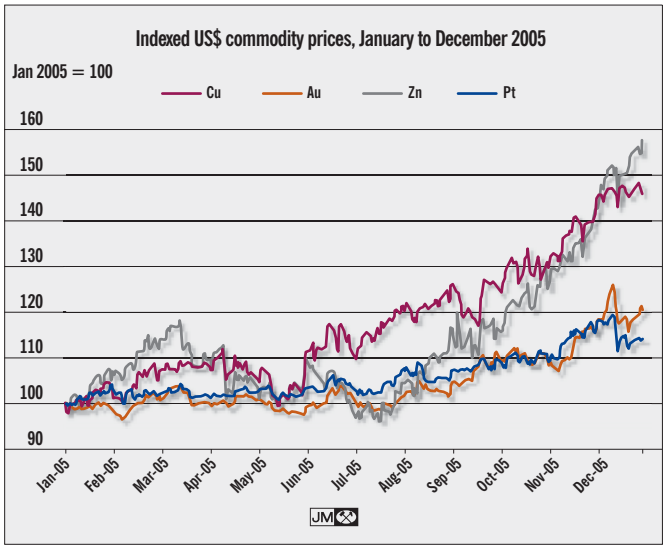
Chinese jewellery demand for platinum dropped by 13 per cent to 875,000 oz in 2005, a greater decrease than we had previously forecast. The rapid rally in the platinum price from $930 to over $1,000 during November and early December resulted in a sharp fall in purchasing by the Chinese jewellery trade, which made worse what had already been a relatively weak year for demand.

The rise in the price throughout the second half of 2005 led to reductions in inventories of platinum jewellery and increased recycling, as wholesalers and retailers cut their holdings in the face of escalating financing costs. With retailers tending to place smaller and less frequent orders for platinum, manufacturers switched a greater proportion of their output to more profitable white gold and palladium jewellery.

At the retail end of the Chinese market, platinum jewellery sales trended down in second and third tier cities. This was partly due to higher prices, but was also a consequence of there being less platinum on display and consumers having a greater choice of white gold and palladium products. Furthermore, 2005 was widely considered to be an inauspicious year to get married and sales of bridal jewellery dropped throughout China compared with the previous year.



Purchases of platinum by Japanese jewellery manufacturers also fell significantly in 2005, dropping by 50,000 oz to 510,000 oz. The rise in the platinum price led to an increase in the volume of metal being recycled by



The 14 per cent increase in the price of platinum in US$ over the course of 2005 was rather modest compared with some other commodity markets, notably copper and zinc (shown above) and crude oil.

manufacturers and wholesalers as they cut back on their product inventories. It also resulted in an upturn in the amount of old jewellery being sold back to the trade by consumers. At the same time, sales of wedding rings slipped as the marriage rate trended downwards, and white gold gained market share at lower price points.

Demand for platinum from the North American jewellery sector weakened by 5 per cent to 275,000 oz in 2005. Although platinum jewellery continued to sell well at the luxury end of the market, sales of both fashion and bridal products were hit by increased competition from white gold. As elsewhere, the high price of platinum also led to an increase in scrap returns and recycling of outdated platinum jewellery. European jewellery demand for platinum, however, remained stable at 195,000 oz, with the UK bridal market remaining relatively firm.

In contrast to the jewellery sector, purchases of platinum for **industrial** applications climbed to a new high of 1.675 million oz in 2005, up by 140,000 oz on the previous year.

Platinum purchases by the glass industry surged to 355,000 oz in 2005, an annual increase of 22 per cent. Demand was driven by substantial investment in Asia in new facilities for the production of glass for liquid crystal displays (LCD) and other flat panel displays.

Booming sales of computers and other consumer electronics also had a positive effect on consumption of platinum in the electrical sector, as these fed back to strong demand for hard disks. Combined with firm demand for platinum wire thermocouples and further development of fuel cells for portable applications, this resulted in electrical demand for platinum climbing by 20 per cent to 360,000 oz.

Consumption of platinum in the chemicals sector grew by 3 per cent to 335,000 oz in 2005. Demand for platinum-based catalysts for the production of silicones increased, thanks to the addition of new manufacturing capacity in Asia. However, the growth was partly offset by slightly lower consumption of the metal in other chemical catalyst applications and thrifting of platinum used in gauze for the nitric acid industry. Purchases of platinum by the petroleum refining industry increased moderately, rising to 155,000 oz on the back of the construction of new reforming and isomerisation capacity.

Total demand for platinum in other applications was stable in 2005 at 470,000 oz. *The major components of this demand are examined in detail in the special feature that begins on page 28.*

Outlook

Supplies of platinum and demand for the metal are both forecast to grow more strongly in 2006 than last year. Consequently, we expect the market to remain in moderate deficit. There are, however, significant uncertainties on both sides.

On the supply side, growth in output in 2006 will again depend on whether South African pgm mining expansions proceed according to plan, with substantially higher production expected from several operations and the first metal due from the Two Rivers and Everest South projects. In addition, Anglo Platinum should benefit from the release of metal that was caught up in its process pipeline as a result of the explosion at its Polokwane smelter last September.

The political situation in Zimbabwe, however, is still not conducive to any significant expansion of pgm mining, with considerable disquiet over the government's stated intention to obtain a majority shareholding in existing operations.

On the demand side, the autocatalyst market remains robust: purchases of platinum are almost certain to exceed 4 million oz in 2006, quite possibly by a significant margin.

Further good growth will be seen in Europe from the

light duty diesel sector. Average loadings per vehicle are forecast to continue to rise, driven by two factors: by October 2006 all new cars will have to meet Euro IV emissions limits (until now, only new models have had to meet Euro IV), and the proportion of diesel vehicles fitted with CSF will increase. At the same time, growth in diesel car sales should pick up this year after slowing in 2005. Although palladium will begin to make in-roads into the diesel after-treatment sector, this is unlikely to have a notable impact on demand for platinum in 2006.

North American demand for platinum in autocatalysts is also forecast to increase this year, despite further substitution of platinum by palladium in gasoline catalyst systems. The spur to increased demand for platinum will come instead from the heavy duty diesel sector, as a majority of new models manufactured this year will need to be fitted with either an oxidation catalyst or a CSF (or both) in order to meet new emissions regulations that come into effect in 2007.

Autocatalyst demand for platinum in China and the Rest of the World region is also projected to continue growing on the back of higher vehicle production and tightening emission limits. In South Korea, greater output of diesel cars (with higher average loading levels) for export to Europe will contribute to growth in autocatalyst demand for platinum.

The Japanese autocatalyst sector will be an exception in 2006, as platinum demand is expected to soften as a result of greater use of palladium-based catalysts on new light vehicle models. Demand will still be relatively strong, however, due to the fitment of after-treatment systems as original equipment to new heavy duty diesel vehicles.

In contrast to the autocatalyst sector, the outlook for platinum demand in jewellery is mixed. On the positive side, sales of platinum jewellery to affluent consumers in all major regions have remained relatively robust in the face of much higher metal prices. In addition, this year is expected to see a substantial increase in the number of weddings conducted in China, as 2006 is considered to be a much more favourable year to get married than 2005.

In addition, Chinese retailers held back from replenishing stock as much as possible in late 2005 and early 2006 as the platinum price was rising steeply.

Emissions regulations in the USA will soon require the fitment of after-treatment as standard equipment on the majority of new heavy duty truck models, resulting in a significant boost to autocatalyst demand for platinum in 2006.

The result was that, following the New Year holiday in early February 2006, inventory levels were generally very low. Consequently, a substantial upturn in demand for platinum was seen from Chinese jewellery manufacturers in mid-February and March.

However, should the platinum price continue to strengthen during the year we would expect to see additional stock reductions and recycling throughout the global jewellery trade. Platinum could also lose further sales to white gold and to palladium.

Demand for platinum in industrial applications is projected to expand again this year. Another increase in consumption of the metal in hard disks is expected to outweigh a slight softening in demand from the glass industry.

The fundamentals of the platinum market, therefore, remain positive and any shortfall in the projected increase in supplies this year will lead to a tightening in availability of metal and higher lease rates. However, speculative activity across the metals markets is likely to exert a greater influence on the price of platinum in the short term than the supply-demand balance.With no end in sight to the current commodities bull market, and with the dollar widely expected to weaken this year, the price has further upside potential. We therefore forecast platinum could reach $1,250 within the next six months. Conversely, in the event of significant fund long liquidation, good end user demand is likely to limit the downside to $1,025.

PALLADIUM

Demand for palladium climbed above 7 million oz for the first time in five years in 2005, increasing by 480,000 oz to 7.04 million oz. This was primarily due to a marked increase in purchases by the Chinese jewellery sector, although autocatalyst demand edged higher and there was growth in some electronic and chemical applications. Supplies of palladium slipped lower but, at 8.39 million oz, remained well in excess of demand. The palladium market, therefore, was in a state of surplus for the fifth year in succession.

- **Demand** for palladium increased by 7 per cent to 7.04 million oz in 2005; the growth was almost entirely due to substantially higher use of the metal in jewellery.
- Purchases of palladium for the manufacture of **jewellery** jumped by 54 per cent to 1.43 million oz, driven by rapid development of the market in China.
- **Autocatalyst** demand for palladium increased marginally to 3.81 million oz. Although auto makers made greater use of palladium catalyst systems, average loadings in gasoline vehicles continued to decline.
- **Electronics** demand for palladium improved to 965,000 oz, an increase of 5 per cent, largely due to growth in use of the metal in plating applications.
- **Supplies** of palladium fell by 2 per cent to 8.39 million oz; growth in South African output did not offset lower production in North America and a drop in sales of Russian metal.
- The palladium market continued in surplus in 2005 and the easy availability of metal kept the **price** suppressed for much of the year. Speculative sentiment remained positive, however, and strong fund buying in the fourth quarter pushed the price to almost $300.

Purchases of palladium for **autocatalysts** increased by less than 1 per cent to 3.81 million oz in 2005. Substantially higher demand was seen in Asia, with auto makers in Japan, China and South Korea all increasing their use of the metal. These gains, however, were largely offset by lower demand in Europe and North America.

Demand for palladium from auto makers in Europe fell below 1 million oz for the first time since 1996 as production of gasoline light vehicles continued to decline. North American demand also slipped lower as a further reduction in average metal loadings countered the positive effects of switching from platinum to palladium in catalysts.

Jewellery demand for palladium, on the other hand, surged by 500,000 oz to 1.43 million oz, becoming the second largest application for the metal. The growth was almost entirely due to the rapid expansion of purchases by Chinese jewellery manufacturers, as orders for palladium products from wholesalers and retailers swelled.

Palladium Supply and Demand
'000 oz

		2004	2005
Supply			
South Africa		2,480	2,590
Russia		4,800	4,620
North America		1,035	905
Others		265	275
Total Supply		**8,580**	**8,390**
Demand			
Autocatalyst:	gross	3,790	3,810
	recovery	(530)	(630)
Dental		850	845
Electronics		920	965
Jewellery		930	1,430
Other		600	620
Total Demand		**6,560**	**7,040**
Movements in Stock		**2,020**	**1,350**

JM

Purchases of palladium for the **electronic** applications improved to 965,000 oz from 920,000 oz the year before. The growth was mainly due to greater use of the metal in plating; demand from multi-layer ceramic capacitor manufacturers slipped lower.

The mature market for palladium in **dental** alloys was relatively stable, demand softening slightly to 845,000 oz, whereas purchases of palladium for use in **other applications** rose by 3 per cent to 620,000 oz. Demand for the metal in chemical industry catalysts was moderately higher at 320,000 oz, and sales of palladium bars and coins to private investors in North America also grew.

At 8.39 million oz, **supplies** of palladium exceeded demand by 1.35 million oz. As in 2004, mine production was supplemented by a substantial volume of Russian metal sold from stocks. This included more than 1 million oz of palladium shipped from Russian state inventories, plus 439,000 oz of metal sold by Stillwater Mining Co. from the stock it received from Norilsk Nickel in 2003.

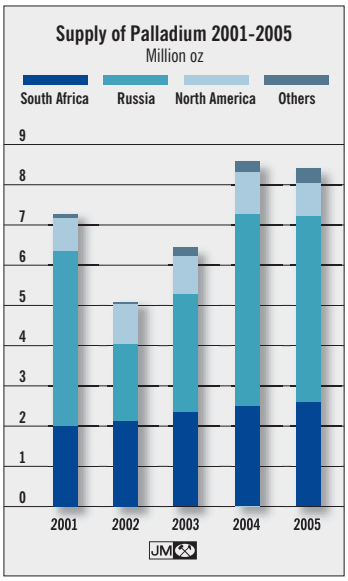
The **price** of palladium was capped at or just above $200 throughout the first nine months of 2005. Fund interest was strong during the first quarter, with speculative buying on NYMEX pushing the price from close to $180 to just over $200 in early March. However, substantial spot sales of metal prevented it from moving any higher and when funds subsequently reduced their long positions the price declined to a low of $172 in July.

Renewed speculative buying emerged from September onwards, and with other metals markets rallying strongly, the palladium price broke out of its previous range and surged to a peak of $297 in December. The lack of support from the fundamentals, however, meant that when funds started taking profits ahead of the year-end the price fell sharply, finishing 2005 at $253.

Supply

Russian supplies of palladium totalled an estimated 4.62 million oz in 2005. Norilsk Nickel produced just over 3.13 million oz of palladium during the year from its nickel-copper operations on the Taimyr and Kola peninsulas. The company was able to release details of its output for the first time following the relaxation of secrecy laws covering the Russian pgm industry. All of Norilsk's palladium output is understood to have been sold during the year, the majority under contract to end users.

The remaining Russian metal was supplied to the market from two sources: the Russian State Treasury (Gokhran) and Stillwater Mining Co. In recent years Gokhran has not received an annual pgm export quota until late in the year, leading to substantial exports of palladium in late 2004 and early 2005, and again in December 2005 and early 2006. We estimate that over 1 million oz of Russian state metal was sold into the market last year.



Our 2005 Russian supply figure for palladium also includes 439,000 oz of metal sold by Stillwater Mining. This came from the inventory of more than 877,000 oz that Stillwater received from Norilsk Nickel when the latter acquired a majority shareholding in the US company in 2003.

South African production of palladium climbed by 4 per cent to 2.59 million oz. Output increased from all of the major pgm mining groups with the exception of Anglo Platinum, where palladium production was disrupted by the problems at the company's Polokwane smelter.

Supplies of palladium from **North America**, however, dropped sharply, sliding by 130,000 oz to 905,000 oz. Although output from Stillwater, Inco and Falconbridge was stable, production at North American Palladium fell by 43 per cent due to a combination of a low grade ore zone in the mine, equipment failures at the mill, and lower pgm recoveries.

Demand

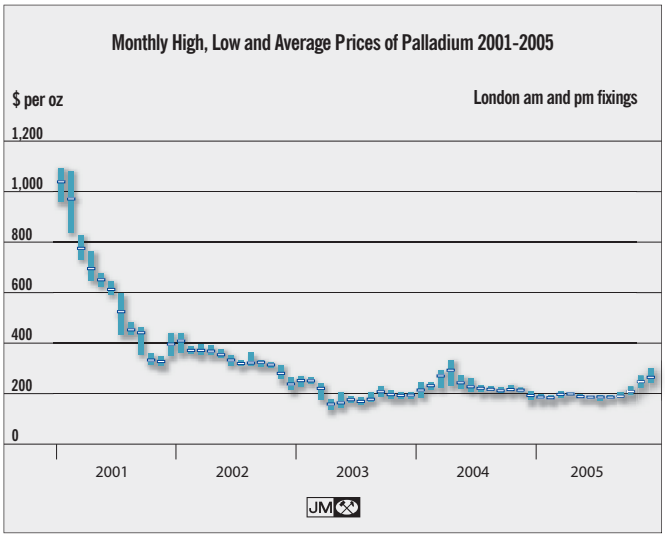
With palladium trading at less than a quarter of the price of platinum throughout most of 2005, auto makers continued to make greater use of the former on gasoline vehicle catalyst systems. This trend, coupled with higher light vehicle output and generally tightening emissions regulations, led to substantially higher demand for palladium from vehicle manufacturers in Asia. Purchases by the Japanese **autocatalyst** sector increased by 4 per cent to 660,000 oz, Chinese demand jumped by 43 per cent to 150,000 oz, and demand in the Rest of the World region grew by 16 per cent to 580,000 oz.

In North America, however, further progress was made on reducing the amount of palladium required per catalyst and average loading levels continued to fall. At the same time light vehicle output softened and foreign brands gained a greater share of the US market. Purchases of palladium by the North American auto industry consequently drifted down to 1.43 million oz, a fall of 1 per cent on the previous year.

European autocatalyst purchases of palladium dropped more markedly, sliding by 10 per cent to 990,000 oz. Demand was affected by the continuing decline in production and sales of gasoline light vehicles as diesels took further market share, as well as by the ongoing thrifting of palladium loading levels on catalysts. Although the first diesel after-treatment systems containing palladium were launched during the year, production volumes were small and palladium loading levels were relatively low.

The overall result of the changes above was that total demand for palladium in autocatalysts edged up by just 20,000 oz to 3.81 million oz in 2005.

The volume of palladium recovered from scrap autocatalysts continued to climb, rising by 19 per



cent to 630,000 oz. Increased recovery in Europe resulted from a greater number of catalysts entering the recycling chain with higher average palladium loadings. Palladium recovery also continued to rise in North America for the same reasons.

Purchases of palladium for use in **jewellery** surged to 1.43 million oz in 2005, up from 930,000 oz the year before. Chinese purchases of metal jumped by 71 per cent to 1.2 million oz as manufacturers increased production to meet strong orders from wholesalers and retailers. The latter continued to establish inventories of palladium jewellery last year, with more stores adding it to their range of products and others expanding the number of items stocked. The introduction and rapid acceptance of Pd990 jewellery (99 per cent palladium) was a significant factor in the increased demand for metal, as many retailers built up stocks alongside their existing displays of Pd950.

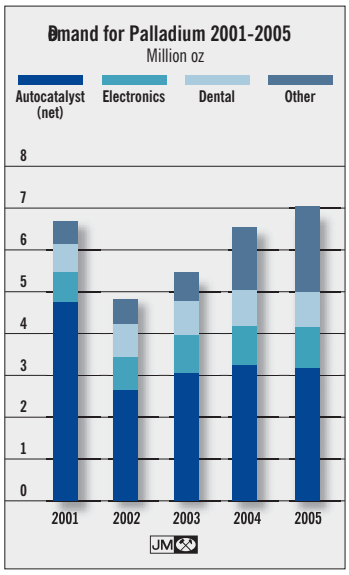
Palladium has proved attractive to the Chinese jewellery trade because of the low cost of financing metal compared with platinum. Traders are willing to fund manufacturers' inventories of work in progress, and wholesalers and retailers can establish and maintain inventories of product at much lower cost than for platinum. The lower density of palladium also helps in this regard, as roughly twice as many products of identical volume can be produced from a given weight of palladium compared with platinum.

For consumers, palladium offers an affordable entry point into the white precious metal jewellery market. Palladium's close association with platinum is also a factor in its favour, enabling it to be sold on the basis that it shares many of the same attributes, namely whiteness, rarity, purity and durability. Purity, in particular, gives palladium a significant advantage over white gold jewellery (which contains 75 per cent gold at most) as purity remains an important consideration for consumers in less affluent areas. The argument that palladium jewellery is a good investment is also commonly heard in China – a message that increased in credibility during the fourth quarter of last year when the price was rising.

The level of retail sales of palladium jewellery, however, is harder to determine than the scale of metal demand from manufacturers. Sales of palladium jewellery to consumers undoubtedly increased in 2005 compared with the previous year, but by less than the 71 per cent rise in metal purchases.

Outside China, most of the other demand for palladium in jewellery stems from use of the metal in platinum and white gold alloys. However, trade interest in palladium jewellery in North America increased last year and a few manufacturers began the production of a limited range of products.

Purchases of palladium for use in **electronic** applications advanced to 965,000 oz in 2005. The rise in demand came primarily from the plating sector, with increased use of palladium in place of gold on connectors and growth in use of the metal in applications such as printed circuit boards. Consumption of palladium in multi-layer ceramic capacitors, however, fell as a result of the ongoing thrifting of palladium in conductive pastes and the miniaturisation of capacitors.



Demand for palladium in **dental** alloys was slightly lower in 2005 at 845,000 oz, whilst purchases for industrial and **other applications** was up 20,000 oz at 620,000 oz. Sales of palladium coins and small bars to private investors in North America continued at a high level, with interest in precious metals in general boosted by the rising price of gold.

Outlook

After having risen strongly for the previous three years, total demand for palladium could flatten out in 2006. There will undoubtedly be stronger demand from the auto industry, with growth expected in all regions except Europe, but the outlook for the jewellery sector is less certain.

North American purchases of palladium for autocatalysts are forecast to grow significantly as the rate of thrifting slows and the growing substitution of platinum in gasoline vehicle catalysts finally has a noticeable impact on metal demand. Asian auto makers are also expected to purchase more palladium in 2006 than last year, again due to a combination of higher light vehicle production, switching from platinum to palladium catalysts for gasoline vehicles, and tightening emissions legislation.

In Europe, however, the continuing slide in gasoline vehicle production in the face of rising diesel sales is projected to result in a further fall in palladium demand. The decline will be countered to some extent by increasing use of palladium, in combination with platinum, in after-treatment systems for diesel vehicles.

In contrast to the autocatalyst sector, purchases of palladium for jewellery manufacture may not grow this year. A key issue for the Chinese jewellery trade and for the wider palladium market is how much of the jewellery that was manufactured in 2005 ended up in the hands of consumers, and how much remained in the display cases and strong-rooms of wholesalers and retailers.

Although retail sales might well strengthen further in 2006, with a greater range of products on display and plans for organised promotion and marketing of the metal, the size of the inventory built up through 2005 could stifle any growth in purchases of metal.

Supplies of palladium are also predicted to be flat or slightly lower in 2006 as Stillwater completed its sales of Russian metal during the first quarter. Without the sales of Russian metal from stocks the palladium market would have recorded a deficit last year. However, we estimate that the remaining palladium inventory in Russia could support sales in excess of 1 million oz per year for at least the next four to five years. More than 580,000 oz of palladium were imported by Switzerland from Russia in the first two months of 2006 alone, a large proportion of which we believe was State-owned metal.

The increased penetration of palladium jewellery throughout China, plus the introduction of Pd990 products, led to a strong rise in puchases of metal by Chinese jewellery manufacturers.

More pertinently, perhaps, if South African production of platinum expands as planned in 2006, palladium output will also rise substantially. In this event, mine supplies of metal would comfortably cover demand.

None of the above, however, is likely to have a major bearing on the price of the metal in the short term. The climb in the palladium price from less than $200 at the beginning of the fourth quarter of 2005 to $370 in April this year was driven by hedge funds, managed futures funds and other investors. Over the last two years, funds have amassed a speculative net long position in the metal equivalent to several million ounces, a significant proportion of which is in the form of physical metal.

In the current commodities bull market, it is quite possible for speculative buying to push the price of palladium even further above the level that would appear justified by the level of demand from end users. However, the collapse in the silver price from a fixing of $14.31 on the 20th of April 2006 to $12.185 the next day was a salutary reminder that, for relatively small metal markets lacking strong underlying fundamentals, the downside risks are substantial. We forecast that palladium could trade as high as $420 over the next six months but, in the event of a major fund sell-off, it could drop as low as $260.

SUPPLIES, MINING & EXPLORATION

SOUTH AFRICA

Platinum supplies from South Africa totalled 5.11 million oz in 2005, a rise of 2 per cent on the previous year. Although refined platinum production from Anglo Platinum was unchanged, most other producers reported increases in both output and sales. Shipments of palladium were up 4 per cent at 2.59 million oz, while rhodium supplies climbed 7 per cent to 627,000 oz.

Anglo Platinum

Refined production of platinum by Anglo Platinum was unchanged in 2005 at a little over 2.45 million oz; refined palladium output increased by 3 per cent to 1.353 million oz, whereas rhodium production jumped by almost 30 per cent to 328,000 oz. Fluctuations in the amount of metal in the group's processing pipeline had a significant influence on output. Around 72,000 oz of platinum were released during the first half of the year but an explosion at the Polokwane smelter in September resulted in an additional 120,000 oz of platinum accumulating in unprocessed stocks of concentrate. This metal was expected to be refined in the first half of 2006. Meanwhile, changes in the rhodium refining circuit at the group's precious metals refinery resulted in a substantial release of metal.

Anglo Platinum reports output from its individual mines as "equivalent refined production" (the amount of pgm produced in concentrate, adjusted for standard smelting and refining recoveries). In 2005, total equivalent refined platinum production increased by 2 per cent to just over 2.5 million oz, a record level for the group. This was principally due to the expansion of operations at Kroondal under the Pool & Share Agreement (P&SA) with Aquarius Platinum: a new 300,000 tonne per month (tpm) concentrator was commissioned in March 2005 and the output of this plant is supplied to Anglo Platinum's facilities for processing. Impala retains the right to treat concentrate from the original Kroondal concentrator until mid-2007. There were also modest increases in output from Modikwa, BRPM and PPRust. However, the gains were partly offset by significant falls in production at Rustenburg (lack of available Merensky reserves and lower productivity) and at Amandelbult (difficult ground conditions).

PGM Supplies: South Africa
'000 oz

	2004	2005
Platinum	5,010	5,110
Palladium	2,480	2,590
Rhodium	587	627

JM

In July 2005, Anglo Platinum announced a second P&SA with Aquarius Platinum, under which the two companies will pool reserves and assets near the latter's Marikana operation. The Marikana concentrator will be upgraded by retrofitting a dense media separation plant, increasing processing capacity to around 250,000 tpm of ore by late 2006. Concentrate produced at Marikana will be split between Anglo Platinum and Impala, with the former processing material derived from the orebodies it contributed to the P&SA and the latter continuing to refine the pgm from Aquarius's original Marikana orebody.

The Mototolo joint venture with Xstrata South Africa received the go-ahead in August 2005. This UG2 operation will use mechanised mining to extract 200,000 tpm of ore, yielding 132,000 oz of platinum per annum at full production. Commissioning of the concentrator is due to take place in the final quarter of 2006 and a small amount of metal from Mototolo may be refined before the year end.

Anglo Platinum has a number of potential new projects on the Bushveld, the most advanced of these being an expansion at PPRust. The development of a replacement pit at PPRust North to maintain output at around 200,000 oz of platinum per year has already been approved; it is likely that the scope of this project will soon be expanded to add a further 230,000 oz of platinum to annual production.

At BRPM, the extension of mining onto Styldrift will be the subject of a full feasibility study this year, while trial mining at the developing Twickenham mine is to be extended. It is also possible that the Pandora joint venture with Lonmin and Northam will enter production in 2006. Other projects, including the wholly-owned Der Brochen and the joint ventures at Ga-Phasha and Booysendal, should also advance to the pre-feasibility study stage.

Impala Platinum

At Impala Platinum, refined production from the company's original lease area rose strongly in 2005, up 6 per cent to a record 1.158 million oz. Palladium

The refurbished concentrator at Barplats produced only small volumes of pgm in concentrate in 2005. However, the compnay has since changed hands once again, with the new owners planning to expand pgm output to as much as 250,000 oz per year.

output was up 12 per cent at 548,000 oz, although that of rhodium was little changed at 130,000 oz.

The operations recorded a strong performance: a total of 16.5 million tonnes of ore were processed through the mill, a 7 per cent increase compared with 2004, while concentrator recoveries were up 2.5 per cent at 85.5 per cent. These gains were partly offset by a decline in head grade, reflecting an increase in dilution due to rising volumes of ore from mechanised mining and more difficult ground conditions at No.11 shaft.

Impala continues to invest heavily in new infrastructure which will provide access to deeper ore reserves on its western Bushveld lease area. Although the aim of the current programme of capital expenditure is to maintain production at around the current level, there is some scope for modest short-term expansion to around 1.2 million oz of platinum per annum.

The company's Marula Platinum mine on the eastern Bushveld had another difficult year in 2005, with mill throughput declining to just 772,000 tonnes. Planned as a mechanised operation, the mine is currently in the process of switching to conventional mining; as a result, full platinum production of 140,000 oz will not now be reached until 2009. However, the adoption of narrow stoping has resulted in an improvement in head grades, and production of platinum in concentrate was therefore unchanged at 31,000 oz last year.

A lack of available reserves and reduced productivity resulted in production from Anglo Platinum's Rustenburg operations slipping lower in 2005.

In addition to refining pgm from the above mines, Impala Refining Services (IRS) treats matte and concentrate respectively from Zimplats (in which Impala has an 86.9 per cent stake) and Mimosa (a 50:50 joint venture with Aquarius Platinum); production from these mines is discussed in the section on Zimbabwe on page 19.

IRS also purchases concentrates from a number of other producers, including Aquarius Platinum, Lonmin's Limpopo division and Barplats, as well as toll-treating substantial quantities of pgm contained in secondary materials. From 2006, it will begin to refine pgm from Aquarius's new mine at Everest South and from the Impala-ARM joint venture at Two Rivers; this will offset the loss of concentrate from Lonmin Limpopo in late 2006 (see section on Lonmin below) and from Kroondal in 2007. In order to ensure that sufficient capacity is available in future years, Impala's base and precious metals refineries are currently being upgraded to allow the treatment of 2 million oz of platinum per annum, and additional capital expenditure has been approved for the expansion of platinum refining capacity to 2.3 million oz.

Lonmin

Lonmin produced a record 963,000 oz of platinum in 2005, up 4 per cent compared with the previous year, as output from its western Bushveld mines (comprising the Western Platinum Mine, Eastern Platinum Mine and Karee Mine) was supplemented by small amounts of pgm from its new Limpopo division. The latter, formerly Messina Platinum, was acquired in June 2005 as part of Lonmin's $190 million purchase of Southern Platinum.

At the western Bushveld operations (also referred to as the Marikana division – not to be confused with the Aquarius Marikana mine) mill throughput declined by 4 per cent to 13.7 million tonnes in 2005, principally due to a 25 per cent fall in the amount of open pit ore that was processed. However, volumes of ore from underground were up, contributing to an improvement in overall head grades. As a result, platinum output rose by 2 per cent to 939,000 oz.

The Limpopo division milled 461,000 tonnes of ore between the completion of the Southern Platinum acquisition in mid-June and the end of 2005. The

resulting concentrate was sold to Impala under an amended concentrate off-take agreement, under which Limpopo will continue to supply a fixed amount of concentrate to IRS until late 2006. Platinum production during this period totalled 24,000 oz and we estimate that output for the full calendar year was around 40-45,000 oz.

Lonmin forecasts that its platinum output will reach the 1 million oz level for the first time in 2006. Beyond this year, the company expects further substantial growth: production at Marikana is scheduled to exceed 1.1 million oz of platinum annually by 2010, while Limpopo should reach full capacity of 75,000 oz by 2007. It is possible that output from the latter will be expanded by a further 125,000 oz per year, should a revised feasibility study yield positive results.

In March 2006, Lonmin announced that it was commissioning a feasibility study into an expansion of its smelting and refining capacity from the current 1.3 million oz up to 2 million oz of platinum per annum. This project would cost around $300-350 million, and would allow Lonmin to toll-treat concentrates from other producers as well as providing scope for further expansions at its own mines.

Northam

In 2005 Northam made a strong recovery from a fire late the previous year, which resulted in the loss of six weeks' output. A total of 2.35 million tonnes of ore was processed last year, an increase of 17 per cent, with most of the increased tonnage coming from the UG2 reef. Production of platinum in concentrate climbed to 225,000 oz (up 18 per cent on the previous year), palladium output reached 109,000 oz (up 17 per cent) and rhodium production increased to 109,000 oz (up 29 per cent, reflecting the higher proportion of this metal in UG2 ore).

New technology at the UG2 concentrator contributed to improved recoveries and also enabled Northam to reduce the chromite content of its UG2 concentrate (high chrome levels can be detrimental to smelter performance). As a result, the company was able to increase the proportion of UG2 ore milled to 36 per cent, up from 32 per cent the previous year, with no negative effect on overall recoveries. However, average grades declined slightly; UG2 ore at Northam typically contains around 4.5 grams of pgm per tonne, compared with over 6 grams per tonne for the Merensky.

Aquarius Platinum signed a Pool and Share Agreement covering its Marikana operation with Anglo Platinum during 2005. The plant is currently being expanded to process 250,000 tpm of ore.

It is likely that UG2 ore will account for an increasing proportion of total production in the near future. The Merensky Reef at Northam is geologically complex; the company has reported that mining conditions on the Merensky are particularly difficult at the moment, resulting in poor extraction ratios, loss of mining face, and lower grades.

Aquarius Platinum

With the commissioning of the Everest South concentrator in December 2005, Aquarius Platinum now operates three platinum mines in South Africa, which between them will have the capacity to produce over 550,000 oz of platinum per annum at full production. Two of these mines, Kroondal and Marikana, are subject to Pool & Share Agreements with Anglo Platinum and are discussed in the section on page 12.

Everest South, Aquarius's first operation on the eastern Bushveld, came on-stream slightly ahead of schedule and significantly under budget. Ore production last year was principally from open cast pits, supplemented in the final quarter by some 85,000 tonnes of underground material. At the end of 2005 the mine had a 472,000 tonne ore stockpile which

will be drawn upon during the build-up to full production this year.

Hot commissioning of the concentrator began at the end of November 2005, and the following month the plant treated 129,000 tonnes of ore at a head grade of 3.12 grams of pgm per tonne. However, the metal in this concentrate was not refined until early 2006 and is therefore not included in our supplies estimates for last year. Production is expected to ramp up rapidly during the first half of 2006.

In addition to its three South African mines, Aquarius also has 50 per cent stakes in two joint ventures: the Mimosa mine *(see section on Zimbabwe on page 19)* and the Chromite Tailings Retreatment Plant, which is located at the Kroondal platinum mine and treats pgm-rich tailings from two local chrome mines. The plant began operating in early 2005, and last year treated 154,000 tonnes at a grade of just under 3 grams of pgm per tonne. However, recoveries were poor and production last year totalled just 5,000 oz of pgm in concentrate. The venture will need to install additional processing equipment if the planned production rate of 28,000 oz of pgm in concentrate is to be achieved.

ARM Platinum

ARM's Platinum division has interests in two pgm-producing mines in South Africa, the Modikwa joint venture with Anglo Platinum (ARM: 41.5 per cent) and the Nkomati Nickel mine which is jointly owned with the Australian company LionOre (ARM: 50 per cent). It also has a 55 per cent share of the Two Rivers platinum project, a joint venture with Impala.

Modikwa's pgm output is refined by Anglo Platinum and is reported in that company's production figures. Last year, the mine milled 2.61 million tonnes of UG2 ore at a grade of 4.14 grams of pgm per tonne; this contributed a total of 128,000 oz each of platinum and palladium and 30,000 oz of rhodium to Anglo Platinum's refined production.

In 2005, Nkomati Nickel processed 344,000 tonnes of ore, most of which came from the small but high grade Massive Sulphide Body (MSB); however, some lower-grade ore is now being mined from the much larger deposit known as the Main Mineralised Zone (MMZ). This shift in ore types contributed to lower sales of pgm in concentrate: 34,000 oz in 2005, down from 38,000 oz the previous year.

At planned rates of mining, the MSB at Nkomati will be exhausted in 2008. In February 2006, ARM and LionOre announced their intention to spend R384 million on a new concentrator and associated infrastructure, enabling the mine to increase ore production from the MMZ to around 100,000 tpm, and thus maintain nickel and pgm output close to current levels. The joint venture partners are continuing to evaluate a major proposed expansion, which would more than quadruple nickel production to over 20,000 tonnes per annum and lift annual pgm output to 100,000 oz.

The R1.3bn Two Rivers project, will come on stream in 2006. Trial mining has been underway since mid-2004, contributing to a substantial ore stockpile and enabling the joint venture partners to assess the chosen mining method and confirm assumptions regarding grade and stoping width. The ore stockpile should enable a rapid ramp-up towards full production of 220,000 oz of pgm per annum once the concentrator is commissioned in the second half of 2006.

Other

Sales of pgm from **Barplats'** Crocodile River mine amounted to 46,000 oz in 2005. Mill throughput totalled 806,000 tonnes, of which about 260,000 tonnes came from the re-opened Maroelabult and Zandfontein sections. The remaining mill feed comprised reclaimed tailings from previous attempts to operate the Crocodile River mine, and also ore purchased from small open pits nearby.

In February 2006, the Canadian company Eastern Platinum Ltd (Eastplats) agreed to buy a 69 per cent stake in Barplats from a consortium of investors. As a condition of the acquisition, Eastplats subsequently raised more than C$100 million in equity financing to fund Barplats' proposed expansion programme, which envisages pgm output eventually rising to 250,000 oz annually.

In November 2005, **Ridge Mining** confirmed its intention to proceed with the development of its Blue Ridge project, subject to financing negotiations. A revised feasibility study envisages a milling rate of 120,000 tpm of ore yielding 75,000 oz of platinum annually at full production.

The converter aisle at Norilsk Nickel's Nadezhda Metallurgical Plant in Siberia. Improvements at its metallurgical operations led to the release of pgm from Norilsk's process pipeline during the second half of 2005.

RUSSIA

Sales of Russian palladium are estimated to have reached 4.62 million oz in 2005, with some 480,000 oz of this metal being shipped in December. The total includes 439,000 oz that was sold from stocks held by Stillwater Mining in the USA. Shipments of platinum and rhodium in 2005 from Russia are estimated to have been 890,000 oz and 90,000 oz respectively.

Following the lifting of secrecy on Russian production of pgm, Norilsk Nickel has been able to reveal its output of platinum and palladium for the first time. In 2005 the company produced 3.133 million oz of palladium and 751,000 oz of platinum.

Although output of Norilsk's main products, nickel and copper, was flat throughout 2005, the production of pgm in the third and fourth quarters of the year was particularly strong — the company reaped the benefits of process changes that led to reductions in the amounts of precious metals tied up in its metallurgical operations.

In April 2006 Norilsk was due to announce the conclusions of a review of its operating plan to 2015 and these were expected to result in an expansion in the volumes of ore produced in the Taimyr Peninsula operations. However, as mining there is gradually moving from rich ores to copper and disseminated ores, the amounts of pgm produced may not increase to the same degree as any increases in ore production might suggest.

Production of platinum from the alluvial mines of the Far East of Russia, primarily Kondyor (Khabarovsk) and Koryak (Kamchatka) is believed to have been slightly down on the level of 2004, but no firm data on output is presently available.

It appears that the State Fund (Gokhran) did not receive its 2005 quota for exports of pgm until very late in the year, but around 1.3 million oz of palladium were then shipped and arrived in the USA and Switzerland in December 2005

PGM Supplies: Russia
'000 oz

	2004	2005
Platinum	845	890
Palladium	4,800	4,620
Rhodium	100	90

JM

and January 2006. We have also reassessed a similar pattern of exports of palladium in late 2004 and early 2005 and, as a result, increased our estimate of Russian supplies in 2004 to 4.8 million oz.

The 2005 Russian supply figure for palladium includes 439,000 oz of metal sold by Stillwater Mining from the 877,169 oz transferred in 2003 by Norilsk Nickel in part payment for a majority shareholding in the company. Although the metal was exported from Russia in 2003, none was sold during that year and so it was not then included in our supply data. Early in 2004, Stillwater entered into sales agreements to sell palladium at a rate of approximately 36,500 oz per month from this stock. The last of the inventory was sold during the first quarter of 2006.

NORTH AMERICA

Supplies of palladium from North America declined by 130,000 oz to 905,000 oz in 2005, as production at North American Palladium dropped by more than 40 per cent. Platinum supplies, in contrast, were down only modestly compared with the previous year; a reduction in output in Canada was partly offset by a slight increase in sales by Stillwater Mining Company in the USA.

Canada

Last year was an exceptionally difficult one for Canada's only primary pgm miner, North American Palladium. A 30 per cent decline in grade (to just 1.66 grams of palladium per tonne), poor mill availability and a sharp drop in recoveries all contributed to a plunge in palladium production to just 177,000 oz, down 43 per cent from the peak of 309,000 oz in 2004.

The fall in grade, due to the mining of a lower grade area of the open pit, was largely anticipated by the company, which intended to compensate by increasing mill throughput. Unfortunately, a series of component failures combined with power cuts caused by severe weather caused mill throughput to decline by 10 per cent to 4.78 million tonnes. The lower grades, combined with metallurgical problems and fluctuations in mill throughput, all had a serious impact on recoveries, which averaged less than 70 per cent for the year.

PGM Supplies: North America
'000 oz

	2004	2005
Platinum	385	360
Palladium	1,035	905
Rhodium	17	20

JM

North American Palladium experienced further difficulties in early 2006, including problems with its crusher and a minor leak in a tailings dam. However, the company expects to see an improvement in production this year, with a new underground section due to come on stream during the first half. This should improve the average head grade, contribute to higher recoveries and lead to an increase in palladium output.

Inco's pgm production (as a by-product of nickel mining in the Sudbury basin) was almost unchanged in 2005 at 419,000 oz. With the company continuing to focus on pgm-rich ores at its Sudbury operations, output should be maintained above 400,000 oz this year, and there is potential for further increases in future years. A major constraint on pgm production at Sudbury is the high copper content of the pgm-rich ores; Inco is installing a copper removal circuit at its Clarabelle mill which will be commissioned in late 2006.

Falconbridge's by-product pgm output comes mainly from its nickel mines in the Sudbury area, and from the Raglan nickel operation in northern Quebec. Mine production of nickel from the Sudbury operations was down 14 per cent in 2005, largely as a result of lower ore grades and ore pass repairs at the Thayer Lindsley mine. Nickel production at Raglan also fell, down 16 per cent to 22,224 tonnes.

Falconbridge is currently undertaking a modest expansion at Raglan; this will lift milling capacity to 1.3 million tonnes of ore per annum from early 2008, and raise annual nickel production to over 30,000 tonnes. In the Sudbury area, shaft sinking at Nickel Rim South began in early 2005; the mine will replace declining production at the company's older shafts when it enters production in 2009. The project will exploit copper-nickel reserves with an average pgm grade in excess of 4 grams per tonne.

In October 2005, Inco announced an offer to acquire Falconbridge for a combination of cash and shares. The necessary approvals have been received from regulatory bodies in Canada, but the verdict of US and European competition authorities had not been delivered as of mid-March 2006. Inco consequently exteded its offer to Falconbridge shareholders to the end of June 2006.

USA

In 2005, production from Stillwater Mining's two pgm mines in Montana was marginally down compared with the previous year. Palladium output slipped by 2.5 per cent to 428,000 oz and platinum fell by 3 per cent to 126,000 oz. This was a direct consequence of a slight decline in the average head grade. Sales last year of 431,000 oz palladium and 135,000 oz platinum were slightly above the level of production.

Stillwater continues to enjoy above-market prices for its palladium under long-term sales contracts that expire in 2010. Under its current cost structure, and assuming 2005 average pgm prices, Stillwater would face difficulties without that price protection. The company is therefore undertaking a series of operating initiatives to improve the cost efficiency of its mines. These include a shift towards selective mining methods to improve grades and extraction ratios; an increase in underground development; and higher pgm production. Output of pgm this year is planned to total in the region of 595-625,000 oz, representing an increase of 7-13 per cent compared with 2005.

ZIMBABWE

In 2005, supplies of platinum from Zimbabwe grew by 7 per cent to reach 156,000 oz, while shipments of palladium and rhodium reached 123,000 oz and 13,000 oz respectively. Further modest upgrades to capacity are being undertaken, but the fate of more substantial investment is once again in the balance, following government proposals of March 2006 that could result in the government of Zimbabwe taking a substantial stake in foreign-owned mining operations.

During 2005 the Mimosa mine processed 1.514 million tonnes of ore, a 15 per cent increase compared with 2004. Grades also increased modestly, and as a result, output of pgm in concentrate was up 19 per cent. Production of the individual metals totalled 72,000 oz of platinum, 54,000 oz of palladium and 5,500 oz of rhodium.

In September 2005, Aquarius Platinum and Impala Platinum, the joint venture partners in Mimosa, announced an expansion which will take annual output to at least 86,500 oz of platinum in concentrate. Known as Wedza Phase IV, the project will involve a 25 per cent upgrade in concentrator capacity to 150,000 tpm, with commissioning expected to take place by mid-2006.

PGM Supplies: Zimbabwe and Others
'000 oz

	2004	2005
Platinum	250	270
Palladium	265	275
Rhodium	16	17

The Zimplats operation (in which Impala holds an 86.9 per cent stake) is in the process of switching from open-cast to primarily underground mining, which the company estimates will be a more cost-effective method of exploiting the orebody. Underground tonnage almost doubled last year, rising to around 20 per cent of the total compared with 12 per cent in 2004.

The total quantity of ore processed through the mill fell slightly to 2.03 million tonnes, but there was an increase in pgm content, largely because the grade of ore extracted from underground workings is generally higher than that of open pit ore. Sales of pgm in matte totalled 87,000 oz of platinum, 73,000 oz of palladium and 8,000 oz of rhodium in 2005.

Capital spending on the development of the underground mine will total around $46 million; although the project as it stands is not intended to result in any significant increase in output, it will include the development of some of the infrastructure required for future expansions. A feasibility study of an expansion to 145,000 oz of platinum per annum has now been completed, and will be submitted to the Impala and Zimplats boards in May 2006.

An incremental expansion of the Mimosa plant in Zimbabwe to a capacity of 150,000 tpm is expected to be complete by mid-2006

PLATINUM

AUTOCATALYST

Demand for platinum in autocatalysts increased by 9 per cent in 2005 to 3.82 million oz, a record high. Once again, much of the growth was generated in Europe, where diesels continued to increase their share of passenger vehicle sales. At the same time, the advent of Euro IV emissions limits plus the introduction of catalysed soot filters (CSF) led to an overall rise in platinum loadings. Platinum demand in China and the Rest of the World region rose on the back of higher vehicle output, and demand in North America increased marginally. Japanese purchases, however, fell following stock building the previous year.

Europe

European demand for platinum in autocatalysts increased by 17 per cent to 1.96 million oz in 2005 – the eighth successive year of growth.

The rising demand for platinum continued to be influenced by expanding production and sales of light duty diesel vehicles, although the rate of growth slowed significantly compared with the previous year. In 2005 diesels accounted for 49.5 per cent of new light duty vehicle registrations in Western Europe (up from 48.3 per cent in 2004) .

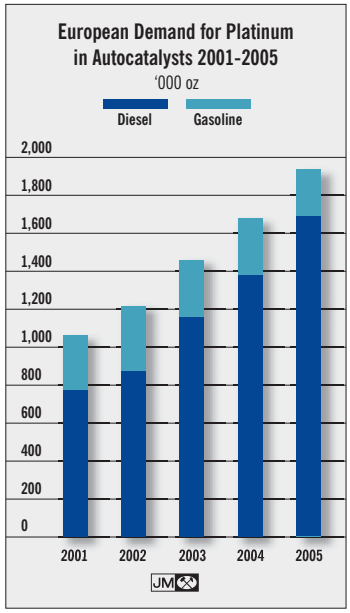
The slowing growth in the diesel sector was partly a reflection of a tough year for car sales in Europe overall, total new vehicle registrations edging lower. It was also a result of a relatively poor year for diesel sales in Germany, the largest market in the region. Uncertainty there over whether government subsidies or tax incentives for purchasers of cars fitted with CSF might be forthcoming in 2006, plus a lack of availability of particulate filters in the fourth quarter, dampened sales.

Platinum Demand: Autocatalyst
'000 oz

	2004	2005
Europe	1,680	1,960
Japan	615	595
North America	800	820
Rest of the World		
China	75	110
Other	320	335
Total	**3,490**	**3,820**

JM

However, average platinum loading levels for light duty diesels continued on an upward trend in 2005 as a greater proportion of vehicles were produced to Euro IV emissions standards. The Euro IV standard (which has applied to new models introduced after 1st January 2005) required a 50 per cent cut in oxides of nitrogen (NOx) emissions from light duty diesels compared with Euro III. One means of reducing NOx emissions from a diesel engine is to lower the temperature of combustion. This, however, results in greater emissions of carbon monoxide (CO) and a lower temperature exhaust flowing through the catalyst. In some instances catalyst platinum loadings have been increased to compensate.



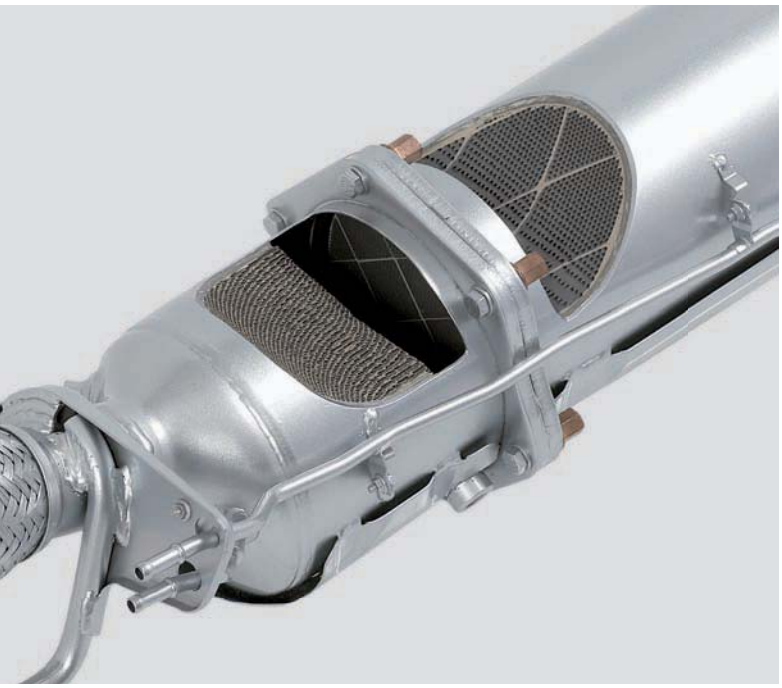
The Euro IV legislation also introduced stricter limits on emissions of particulate matter. Auto manufacturers have been able to meet these limits on the majority of new light vehicle models without using CSF. However, increased media attention and public concern about particulate emissions has helped drive sales of CSF as optional extras and has led manufacturers to increasingly fit them as standard equipment.

Japan

Purchases of platinum by auto makers in Japan dropped to 595,000 oz in 2005, down 3 per cent from the previous year. The year-on-year comparison of demand, however, is not representative of underlying use of the metal on catalysts as the 2004 figure was boosted by the purchase of metal for inventories.

In contrast, the use of platinum by the Japanese autocatalyst sector increased for the seventh year in succession in 2005, rising by around 7 per cent. In part this reflected greater production of cars and light trucks, vehicle output rising by almost 3 per cent to just under 10.5 million. Sales in Japan were lifted by the strengthening of the local economy, whilst the weakening of the yen over the course of the year contributed to an increase in vehicle exports. At the same time an increasing proportion of light vehicles for the domestic market was manufactured to tighter emissions limits. In 2005 the majority of cars and light trucks met Japanese Low Emissions Vehicle (J-LEV)

The construction of new furnaces in Asia for the manufacture of high-purity LCD glass generated substantial additional demand for platinum in 2005.



Increasing fitment of catalysed soot filters to light duty diesel vehicles contributed to strong growth in autocatalyst demand for platinum in Europe last year.

standards, with a growing number meeting the stricter J-ULEV rules.

Greater use of platinum in autocatalysts in Japan was also stimulated by the introduction of new national emissions regulations covering heavy duty diesel vehicles, which came into effect in October 2005. The legislation substantially reduced the permissible emissions of NOx, CO and PM from new trucks and buses, resulting in the fitment of oxidation catalysts and / or CSF to the majority of new models.

North America

Autocatalyst demand for platinum in North America rose by a modest 20,000 oz to 820,000 oz in 2005, despite the fact that light vehicle production in the region edged down to 15.7 million units.

Platinum use by the big three US-based auto companies slipped lower as several leading US light vehicle brands lost market share and recorded year-on-year declines in sales. Conversely, overseas manufacturers, notably some of the Japanese car companies, produced and sold greater numbers of vehicles within North America. The overall impact of these changes in the pattern of light vehicle production was a small rise in platinum demand. A slow but steady increase in retrofitting of after-treatment systems to heavy duty diesel vehicles contributed to the increase in North American platinum demand last year.

There was little change in total average loading levels in 2005 but switching from platinum to palladium will accelerate during 2006. The adverse effect of this on platinum demand, however, will be more than offset by the widespread introduction of diesel oxidation catalysts (DOC) and CSF on new heavy duty truck models to comply with new federal emissions regulations.

China

Demand for platinum from the autocatalyst sector in China climbed from 75,000 oz in 2004 to 110,000 oz in 2005, annual growth of 47 per cent. This was the result of a combination of higher vehicle production and ongoing tightening of vehicle emissions limits.

The rate of growth in Chinese vehicle production accelerated in 2005 compared with the previous year, when a deliberate tightening of the availability of consumer credit slowed growth in new car sales. Last year, production of light vehicles in China climbed by 14 per cent to more than 5 million units.

All new light vehicles produced in China have had to meet Euro II emissions standards since mid-2004, which necessitate the use of catalysts on gasoline cars and light trucks but not on diesels. Given that virtually all cars and a majority of light trucks in China are gasoline powered, more than three-quarters of new light vehicles sold are now catalysed.

Rest of the World

Autocatalyst demand for platinum in the Rest of the World region (excluding China) grew by just under 5 per cent to 335,000 oz in 2005. Demand increased on the back of much stronger light vehicle production in Asia and South America.

The South Korean auto industry in particular enjoyed a good year, with light vehicle output rising by 12 per cent to more than 3.8 million cars and light trucks. Vehicle production expanded in response to a rapid turn-around in the domestic market (sales of cars rising by 6 per cent after having fallen for the previous two years) and to meet strong demand from overseas markets in Europe and North America.

The impact on platinum demand, however, was dampened somewhat by an acceleration of switching from platinum-based catalysts to palladium after-treatment systems on both new and existing models.

Increased light vehicle production in India and much of South East Asia contributed to the overall rise in platinum demand last year, as did strong growth in sales in the major South American auto markets of Brazil and Argentina.

Autocatalyst Recovery

The total volume of platinum recovered from scrapped autocatalysts increased by 12 per cent in 2005, reaching 770,000 oz. Once again, substantial increases in recovery occurred in North America and Europe, but Japanese recovery fell as exports of used vehicles increased.

Platinum Demand: Autocatalyst Recovery
'000 oz

	2004	2005
Europe	(145)	(170)
Japan	(55)	(35)
North America	(435)	(505)
Rest of the World	(55)	(60)
Total	**(690)**	**(770)**

JM

Recovery of platinum from scrapped autocatalysts in North America surpassed half a million ounces for the first time in 2005, the total reaching 505,000 oz. Scrap yards and collectors continued to maximise the recovery of catalysts from vehicles, spurred by higher platinum prices. The increase in metal recovery, however, also reflected the changing mix of vehicles (and therefore catalyst systems) entering scrap yards.

In Europe, higher metal recovery from old catalysts reflected an increase in vehicle recycling rates, which in turn was driven by the introduction of new European legislation covering the disposal of end of life vehicles.

In Japan, however, recovery of platinum from autocatalysts fell. The adjustment to our 2005 number reflects in part a downwards revision in Japanese estimates of the number of end of life vehicles generated each year (a new vehicle disposal certification scheme introduced in 2005 allowed the collation of accurate data for the first time). In addition, the fall in platinum recovery last year was also a consequence of a growing export trade in second hand vehicles from Japan to markets in South East Asia, China and Russia.

JEWELLERY

In 2005 jewellery demand slipped below 2 million oz for the first time since 1996, dropping by 9 per cent year-on-year to 1.96 million oz. Purchases of metal by jewellery manufacturers fell in the three largest markets, China, Japan and North America, as the rising price of platinum encouraged destocking and recycling of old jewellery. Platinum jewellery also faced increased competition from alternative precious metal alloys. Jewellery demand for platinum in Europe was static.

Europe

Total European demand for platinum in jewellery was unchanged at 195,000 oz in 2005. Throughout the region sales of platinum bridal jewellery and luxury pieces continued to fare better than fashion products, which faced tough competition from white gold in lower price brackets.

The UK bridal market for platinum jewellery continued to develop positively at the retail level but concern about the rising price led some jewellers to stock fewer platinum pieces. This was reflected in hallmarking statistics, the number of platinum pieces hallmarked during the year falling by 11 per cent. However, the total weight of pieces marked actually increased marginally to almost 94,000 oz, reflecting a consumer preference for heavier rings.

Platinum Demand: Jewellery
'000 oz

	2004	2005
Europe	195	195
Japan	560	510
North America	290	275
Rest of the World		
China	1,010	875
Other	105	105
Total	**2,160**	**1,960**

JM

In Germany the rising price of the metal added to the pressure on sales of platinum jewellery from alternative white metals. Some manufacturers, however, reported improved sales of large luxury pieces in the domestic market, and German exports of bridal products to the UK increased. The net result was little change in purchases of metal by German manufacturers. The picture was similar in Italy, with manufacturers facing a difficult domestic market but managing to make modest gains in exports.

Platinum demand from the Swiss jewellery sector was also fairly stable in 2005. The number of platinum

watchcases manufactured slipped lower, following strong production the previous year, but this was compensated for by higher output of Swiss-made bridal jewellery and products for the upper end of the fashion market.

Japan

Jewellery manufacturers in Japan purchased 510,000 oz of platinum in 2005, a fall of 9 per cent compared with the previous year. The continuing rise in the platinum price had a number of adverse effects on manufacturers' purchases of metal. In particular, scrap collection increased, with greater volumes of metal being recycled from trade inventories and from consumers selling back old jewellery. Some smaller manufacturers and wholesalers, facing rising metal financing costs, reduced the proportion of platinum produced and stocked, whilst an increase in the number and type of retail outlets that purchase old jewellery for cash contributed to a rise in returns from the public.

In addition, the average weight per piece of platinum jewellery continued to decline as manufacturers sought to meet key price points by producing lighter designs. In the bridal sector, total sales of platinum rings edged downwards once again, reflecting the long-term decline in marriages, a trend of fewer couples purchasing engagement rings, and increasing competition from white gold for wedding rings.

In the fashion sector, platinum did well at the upper end of the market, although overseas brands rather than Japanese manufacturers were the main beneficiaries. At the lower end, the pressure on platinum sales from white gold remained high.

North America

Demand for platinum from the North American jewellery sector slipped by 5 per cent to 275,000 oz in 2005 – a smaller decline than we had forecast at the time of our Interim Review last November. In particular, luxury jewellery marketed under international brand-names continued to sell well, both domestically and abroad. Several of the leading manufacturers of products for the upper end of the market experienced a very good level of orders leading up to Christmas, regardless of the strength of the platinum price.

In contrast, however, the rise in the platinum price made it increasingly difficult for the metal to compete in lower-priced segments of the market, with sales of both fashion and bridal products suffering from increased competition from white gold. At the same time, the high price led to an increase in scrap returns and recycling of out-dated platinum jewellery throughout the trade, reducing demand for new metal.

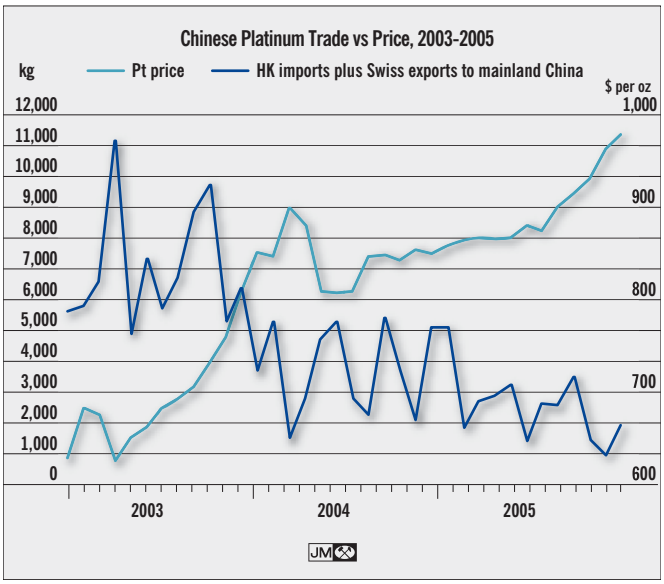
China

Purchases of platinum by jewellery manufacturers in China fell by 13 per cent to 875,000 oz in 2005, the lowest level of demand for new metal since 1998. In our Interim Review, published last November, we forecast Chinese demand for the year at 920,000 oz. However, the rate of fabrication and metal purchasing by Chinese manufacturers fell to very low levels during November and early December when the platinum price soared from $930 to over $1,000. Activity did pick up during the second half of December when the price fell back, but not by enough to offset the poor performance of the preceding few weeks.

The effects of the rising platinum price on the jewellery trade in China were similar in many respects to those seen in Japan and North America; specifically, a reduction of inventories and greater recycling throughout the business.

The increasing and unpredictable costs of financing metal resulted in manufacturers cutting back on production and stocks of platinum products, with the majority only producing new items to fill firm orders from retailers. To overcome the reluctance of manufacturers to take on metal price risk some leading retail chains purchased metal themselves from the Shanghai Gold Exchange and provided it to their suppliers on consignment.

Wholesalers reduced their holdings of platinum, being able to stock considerably more white gold or palladium jewellery for the same level of investment. Outside of Shanghai and Beijing the mix of jewellery stocked by retailers followed a similar pattern, with the proportion of counter space devoted to platinum declining. The volume of old platinum jewellery traded-in for new pieces by consumers also increased. These factors all contributed to a marked rise in the volume



The relationship between the platinum price and Chinese jewellery demand for the metal is apparent from trade data.

of metal returned to manufacturers for recycling into new platinum products.

At the same time, retailers tended to re-order platinum less frequently and in smaller quantities. Many recorded lower sales of platinum jewellery, which was partly a consequence of stocking fewer products, but 2005 was widely considered to be an inauspicious year to get married and sales of bridal jewellery suffered as a result. Despite all of the above, in the largest cities, where development of the platinum brand has been focussed, consumer demand remained relatively robust. In Beijing and Shanghai in particular, buyers of platinum jewellery were largely undeterred by higher prices, which for many reinforced the metal's exclusive image and attractiveness as an investment.

Trade statistics are not an accurate guide to the actual level of platinum demand in China, but the trend in Chinese imports clearly reflects the underlying fall in purchases of metal by the jewellery sector.

Rest of the World

Demand for platinum from jewellery manufacturers in the Rest of the World was unchanged at 105,000 oz in 2005. Some markets in Asia, notably Taiwan, India and South Korea, continued to show promise but gains within these countries were offset by lower exports to North America and Japan. The nascent South African platinum jewellery manufacturing sector consumed increasing volumes of metal but remained small.

CHEMICAL

Consumption of platinum by the chemicals sector grew by 3 per cent to 335,000 oz in 2005. Thrifting affected demand from the nitric acid industry but this was outweighed by increased purchases of platinum for process catalysts.

Platinum's single largest application in the chemicals sector is as a catalyst for the manufacture of silicones, which are widely used by the construction and automotive industries.

Strong economic growth in parts of Asia, particularly China, continued to support investment in new capacity for silicones production in 2005. However, the recent rise in the platinum price has encouraged a certain degree of thrifting, with manufacturers reducing the amount of platinum catalyst used in the process. Since the platinum from the catalyst ends up in the final product and (unlike most process catalysts) cannot subsequently be recovered, this represents a direct and substantial cost saving for the manufacturer. Overall, usage of platinum in silicones was up moderately in 2005.

The most significant other chemical catalyst application for platinum is in the production of paraxylene. Investment in the latter has been stimulated by rising demand from the purified terephthalic acid (PTA) sector, for which paraxylene is a precursor. PTA is in turn a feedstock for the production of the plastic polyethylene terephthalate. Purchases of platinum for new paraxylene plants softened slightly in 2005, reflecting a slightly lower rate of expansion in the sector than in 2004, but demand was still relatively strong by historical standards.

Platinum Demand: Chemical
'000 oz

	2004	2005
Europe	115	110
Japan	40	55
North America	90	100
Rest of the World	80	70
Total	**325**	**335**

JM

The declining trend in demand for platinum from the nitric acid industry continued in 2005. Thrifting is having a negative impact on consumption, especially in Europe; nitric acid manufacturers are now using fewer catalyst gauzes per burner and the metal content of individual gauzes is also decreasing. At the same time, the rate of expansion of the nitric acid industry in Asia slowed compared with the previous year, and there were fewer additions to existing capacity.

ELECTRICAL

Soaring demand for personal computers and consumer products containing hard disks was the driving force behind a 20 per cent increase in platinum demand from the electrical industry in 2005. Use of the metal in fuel cells also increased. Total worldwide consumption in electrical products reached 360,000 oz, up from 300,000 oz in 2004.

The hard disk industry enjoyed another year of rapid expansion in 2005, with worldwide disk output estimated to have risen by more than 30 per cent and platinum consumption increasing at a similar rate. Both private consumers and businesses appear to be replacing personal computers (PCs) more rapidly than in the past, due to lower prices and a shift in consumer preferences towards less durable notebook computers. This helped to drive PC sales upward by around 16 per cent last year. In addition, there has been strong growth in the use of hard drives in a range of consumer electronic devices, particularly personal video recorders and MP3 music players.

Platinum Demand: Electrical
'000 oz

	2004	2005
Europe	40	40
Japan	50	65
North America	90	95
Rest of the World	120	160
Total	**300**	**360**

JM

In recent years, the average number of disks required in each hard drive has fallen, as increases in data storage capacity have been offset by improvements in the quantity of data that can be stored on a given area of disk (the areal density). However, improvements in areal density have now slowed, while data storage requirements are still growing rapidly; as a result, the disk per drive ratio has begun to increase again, further boosting overall demand for hard disks.

Sales of platinum for use in fuel cells increased in 2005 but demand in terms of ounces was still not significant. Most of the metal was destined for the manufacture of proton exchange membrane (PEMFC) and direct methanol (DMFC) fuel cells, used in prototypes for automotive, electronic and stationary power applications.

Work on commercialising PEMFC and DMFC technology in portable electronic devices has accelerated recently, with the first products expected to be on sale within the next two years.

Demand for platinum wire for use in thermocouples remained strong in 2005, supported by increased production capacity and output in the glass and semiconductor industries. Both sectors are important users of high-temperature platinum-wire thermocouples.

GLASS

Sales of platinum to the glass industry rose by over 20 per cent in 2005, reaching a new record of 355,000 oz. Demand was driven by substantial investment in the production of glass for liquid crystal displays (LCDs) in Japan and other Asian countries, while the North American fibre glass industry recorded positive demand for the first time in three years.

Industry estimates suggest that production of LCD glass substrates rose by around 60 per cent in 2005. This reflects rapid expansion in consumer demand for flat screen computer monitors and LCD televisions. The latter accounted for an estimated 15 per cent of the total world market for televisions by the end of last year, up from 6 per cent at the end of 2004. With further strong growth expected, glass manufacturers continue to invest heavily in new facilities for the production of large-size glass substrates used in LCD screens.

In 2004 and 2005, capacity increases were concentrated in Japan and the Rest of the World region, with large new LCD glass plants being developed in Japan, South Korea and Taiwan. Since a single new LCD glass furnace requires several thousand ounces of platinum, recent investment activity in this sector has driven world-wide demand from the glass industry to all-time record levels.

Platinum Demand: Glass
'000 oz

	2004	2005
Europe	5	10
Japan	90	95
North America	(10)	5
Rest of the World	205	245
Total	**290**	**355**

JM

In North America, glass companies made substantial sales of pgm back to the market in 2003 and 2004, following the closure of the remaining US plants producing cathode ray tubes used in conventional television screens. There is no longer any production of traditional television glass in the USA. In 2005 demand was positive, with the North American fibre glass industry needing to procure small amounts of platinum for capacity additions and to replace metal lost in the manufacturing process.

There was also a modest increase in platinum consumption in China, reflecting strong demand for glass fibre from the booming construction industry.

PETROLEUM REFINING

The petroleum refining industry consumed 155,000 oz of platinum in 2005, an increase of 5,000 oz compared with the previous year. Demand was once again supported by investment in new reforming and isomerisation capacity in the Rest of the World region; elsewhere, only small additions to capacity are being made, and growth in platinum demand is being limited by thrifting.

Given the tightness in the global petroleum markets in 2005, the majority of refineries were run at very high operating rates throughout the year. In this environment, plant operators aim to minimise downtime and maximise output, delaying full catalyst change-outs for as long as possible. Conversely, however, higher operating rates tend to lead to greater losses during service and so increased volumes of top-up catalyst are required. The net result last year was a modest increase in demand for platinum.

Platinum Demand: Petroleum Refining
'000 oz

	2004	2005
Europe	15	15
Japan	5	5
North America	35	35
Rest of the World	95	100
Total	**150**	**155**

JM

Average loadings on platinum reforming catalysts are trending slowly downwards over the long term. In the Rest of the World region, however, thrifting has been more than offset by the construction of new reforming and isomerisation units. In 2005, metal was purchased in advance of planned increases in capacity which will occur this year and next in the Middle East and Asia.

OTHER

Demand for platinum in other applications was stable at 470,000 oz in 2005. Lower offtake from the dental sector was offset by greater consumption of the metal in biomedical devices and turbine blades for aircraft engines.

The use of platinum in its four principal other applications – dental alloys; automotive (spark plugs and oxygen sensors); biomedical components and drugs; and turbine blades – is discussed in detail in a special feature on pages 28 to 31. Most of platinum's remaining applications consume only small amounts of metal; the exception to this is pollution control for off-road vehicles (such as mining equipment) and stationary sources, which accounts for approximately 20,000 oz of platinum demand annually.

Platinum Demand: Other
'000 oz

	2004	2005
Europe	190	180
Japan	40	40
North America	205	210
Rest of the World	35	40
Total	**470**	**470**

JM

INVESTMENT

Net demand for large platinum bars was negative in 2005, in line with lower purchases by Japanese private investors and a price-driven increase in sales of old bars back to the market at the year end. In contrast, interest in platinum among US investors surged in late 2005, and this compensated for weak sales of bullion coins earlier in the year.

Sales of US Mint's Platinum Eagle bullion coins totalled 20,000 oz in 2005, almost unchanged compared with the previous year. In addition, the US Mint also produces proof-quality platinum Eagle coins for collectors. Demand for bullion coins was weak in the first 11 months of the year, with sales down 26 per cent on 2004. However, December was an exceptionally good month with 6,900 oz of coins being shipped, the upturn clearly linked to a resurgence of investor interest in precious metals as the gold price moved above $500.

Other platinum coins struck in 2005 included 30,000 one tenth ounce Panda coins issued by the People's Bank of China.

Demand for large platinum bars from Japanese private investors was negative in 2005, with a net 15,000 oz being returned to the market. Gross sales of large bars were down about 15 per cent as higher prices deterred investors, while returns of old bars to the market were up by a similar percentage. Most returns to the market occurred in June, as the yen-denominated platinum price moved decisively over ¥3,000, and December, when the price surged towards ¥4,000.

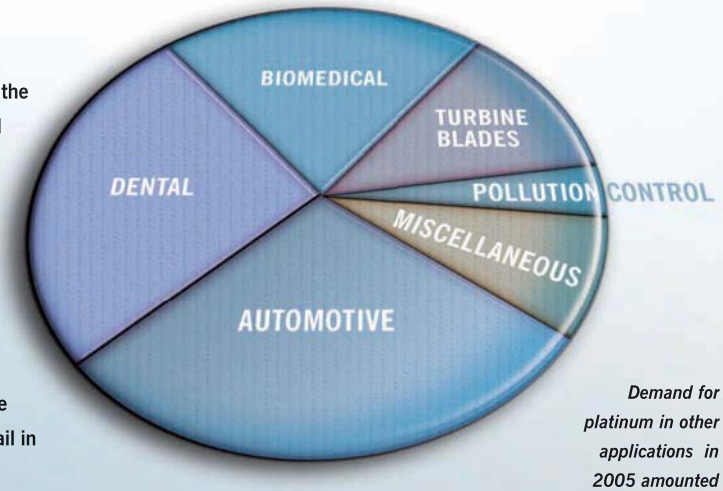
Platinum Demand: Investment
'000 oz

	2004	2005
Coins and small bars		
Europe	0	0
Japan	0	0
North America	25	25
Rest of the World	5	5
Large bars in Japan	**15**	**(15)**
Total	**45**	**15**

JM

Other Applications for Platinum

In addition to its well known applications in the autocatalyst, jewellery, chemical, electrical and glass sectors, platinum has a wide variety of other uses. These vary from automotive and medical applications for platinum consuming over 100,000 oz of metal annually, to many small end uses such as stationary source pollution control, catalytic heaters, gas safety sensors and cathodic protection which individually require just a few thousand ounces. The largest sectors of the market (tabulated below) are discussed in more detail in the following sections.



Demand for platinum in other applications in 2005 amounted to 470,000 oz

Main sectors of demand for other applications for platinum in 2005	
non-catalytic automotive	>130,000 oz
dental alloys	>120,000 oz
biomedical	>100,000 oz
turbine blades	> 50,000 oz

Combined demand for these four sectors in 2005 amounted to almost 90 per cent of the total demand of 470,000 oz

Dental Alloys

Platinum has a long and varied history of use in the dental industry, dating back to at least the early 19th century. In modern dentistry, however, platinum's use is confined to alloys used in bridges and crowns (prosthetic teeth). The latter can either be made entirely of precious metal alloy or from a porcelain crown bonded to an alloy core.

There are two principal types of precious metal alloy used in dental restorations: low gold and high gold alloys. The latter have been used in restorative dentistry for many decades, and are typically at least 75 per cent gold (as high as 99 per cent in some cases). Most contain platinum as an alloying element: the platinum content can vary from 1 per cent to as much as 20 per cent. These alloys may also contain small amounts of silver, palladium and base metals.

The use of platinum in high gold alloys is principally to improve the strength and stiffness of the alloy, enabling the crown or bridge to withstand the forces generated during biting and chewing. Its high melting point is advantageous as this helps to minimise the risk of deformation when firing porcelain bonded crowns, while its resistance to corrosion and tarnishing are also beneficial.

The low gold category encompasses a much wider range of alloy types. These generally contain gold, palladium and silver in varying quantities, but do not incorporate platinum. Palladium is usually a significant component, accounting for up to 80 per cent of the alloy by weight.

The choice of alloy is partly based on its technical characteristics such as melting point, strength and ductility, ability to retain fine details when cast, bonding performance with porcelain, and resistance to corrosion and tarnishing. However, the preferences of dentists and their patients also play an important role, resulting in great variations between patterns of alloy consumption in different parts of the world.

Finally, cost is an important factor; in recent years demand for dental alloys has been heavily influenced by fluctuations in the prices of gold, platinum and palladium.

Europe is currently the world's principal market for high gold alloys, accounting for around two-thirds of platinum demand in the global dental industry. Most of this demand occurs in Germany, where dental practitioners and consumers have tended to be rather less price-sensitive than in other European countries.

The North American dental

Platinum has a long history of use in dentistry but demand has diminished in recent years as use of lower cost alloys and ceramic alternatives has risen.

sector uses only modest amounts of platinum in high gold alloys; products with a high palladium content have a dominant share of this market.

In both regions, the trend of platinum demand is downwards. Full ceramic crown and bridge systems (which do not have a metal core) are now starting to encroach upon the market for high gold alloys. At the same time, the price differentials between gold, platinum and palladium are encouraging a shift towards low gold alloys, which do not normally contain platinum.

Outside Germany and North America, consumption of platinum-containing dental alloys is minimal. The Japanese market is dominated by the Kinpala alloy, which contains 20 per cent palladium but no platinum, while in China and the Rest of the World region, the relatively high cost of restorative dental treatment means that the use of precious metal dental alloys remains small.

Automotive

The automotive industry is the single largest consumer of platinum, accounting for nearly half of all demand in 2005. Although most of this metal was used in autocatalysts, two other automotive applications, spark plugs and oxygen sensors, together consumed more than 130,000 oz of platinum in 2005.

SPARK PLUGS

In a gasoline engine, power is generated by mixing air and fuel inside a combustion chamber (cylinder) and igniting this mixture with a spark generated by a spark plug. The plug also has an important secondary function - that of removing excess heat from the combustion chamber. A correctly functioning plug helps to ensure clean and efficient combustion, thereby playing a significant role in meeting emissions limits.

Traditionally, most spark plugs had base metal electrodes. However, these electrodes are gradually eroded by the repeated cycles of firing, which widens the gap between them. Ultimately, this can lead to misfires, which increase pollution and can damage the catalytic converter.

The use of platinum-tipped electrodes largely eliminates this problem because platinum resists chemical and electrical erosion much better than base metal alloys. As a result, a platinum-tipped plug generally has an effective life of 100,000 miles or more, compared with around 30,000 miles for a typical base metal plug. This in turn allows for longer intervals between servicing and reduces costs: on many modern engines, replacing plugs is a difficult and time-consuming job.

Platinum plugs are now fitted as original equipment on all new vehicles in North America, where strict on-board diagnostic (OBD) and catalyst durability requirements have caused manufacturers to abandon the use of base metal plugs.

In Europe and Japan the use of platinum plugs is increasing: we estimate that currently around 25 per cent of new gasoline cars in Europe and around half of Japanese vehicles are fitted with platinum plugs. Diesel vehicles, which currently account for more than half of the European market, utilise glow plugs, which do not use platinum. The aftermarket has tended to lag behind, such that only around a third of all replacement plugs are platinum-tipped, but here too sales are increasing.

Platinum-tipped spark plugs are increasingly fitted as original equipment as they last several times longer than their base metal predecessors.

OXYGEN SENSORS

Oxygen sensors are less familiar to motorists than spark plugs, but the role they play in ensuring optimal engine performance and reducing emissions is no less vital. An oxygen sensor is an indispensable part of a modern vehicle's closed-loop engine management system, which controls the air-fuel mixture that is fed to the combustion chambers.

In the majority of oxygen sensors the sensing element consists of a ceramic bulb coated on both sides with a thin layer of platinum, the outside of which is exposed to the exhaust gases. The voltage generated by the sensor is determined by the

amount of oxygen in the exhaust: a high voltage indicates that the air-fuel mixture is too rich (there is too much fuel and not enough air), a low one that the engine is running too lean. This voltage is monitored by the onboard engine management computer, which adjusts the proportion of air to fuel to ensure that the average is close to the optimal ratio of 14.7:1. The sensor ensures that the autocatalyst works efficiently and that emissions leaving the engine are minimised.

All catalyst-equipped cars have at least one sensor mounted in the exhaust system upstream of the catalytic converter; in countries where strict OBD legislation is in place (such as the USA), vehicles are also fitted with one or more sensors downstream of the autocatalyst in order to monitor emissions. A large vehicle may therefore have as many as four sensors. The average number of sensors per car has grown steadily in recent years as a result of tightening OBD legislation, and this has generated proportionate increases in platinum demand.

Biomedical Uses

Biomedical, the third largest of platinum's other application categories, encompasses uses varying from anti-cancer drugs to devices used in cutting-edge treatments for heart and brain disease. We estimate that a little over 100,000 oz of platinum was consumed by this sector in 2005.

ANTI-CANCER DRUGS

The first platinum-based anti-cancer drug, cisplatin, has been in use for nearly three decades and has revolutionised the treatment of certain diseases, particularly testicular cancer. The chemical compound itself had been known since the mid-nineteenth century but its ability to inhibit cell division (and thus its potential utility in the fight against cancer) was discovered by chance in 1965; the development and approval of the drug took over 10 years, and cisplatin was first approved in 1978. Despite the subsequent development of other platinum compounds with less severe side-effects, the drug is still in widespread use, especially in the treatment of testicular, ovarian, bladder and lung cancers.

More recently, two other platinum-based drugs have come onto the market. The first, carboplatin, was approved in the late 1980s and is currently the most widely used of all the platinum anti-cancer compounds. It indicated for the treatment of a similar range of cancers to cisplatin but is considerably less toxic. A second drug, oxaliplatin, was first approved in Europe in 1996 and in the USA in 2004 and is principally used to treat advanced colorectal cancer. In the last two years oxaliplatin has been rapidly adopted by oncologists and its use has now overtaken that of cisplatin.

Other platinum compounds with anti-cancer activity have been discovered, but most are still in the very early stages of development. However one potential new drug, satraplatin, is currently in Phase 3 trials (the final stage of clinical evaluation which, if successful, may lead to the approval of the drug). It is thought that an application for European approval could be made as early as 2007.

MEDICAL COMPONENTS

Platinum components are a critical element of many biomedical devices, particularly those which are implanted permanently into the body or used in minimally-invasive surgical procedures. The metal has many qualities which make it an ideal choice for medical applications: it is among the most biocompatible of all metals; it conducts electricity well; it is hard and resistant to corrosion, yet workable enough to permit the machining of tiny, complex components; and it is radiopaque (visible under x-ray).

The two largest uses for platinum components are in angioplasty, a treatment for blocked arteries, and

Micro-machined platinum components have numerous surgical applications, whilst platinum-based drugs are widely used in the treatment of cancers.

in devices such as pacemakers and implantable cardioverter defibrillators (ICD) that are used in the treatment of cardiac arrhythmias (irregularities in the beating of the heart). Platinum marker bands enable surgeons to track the position of guidewires and catheters within the body, whilst pacemakers and ICD are usually connected to the heart by platinum-tipped electrodes.

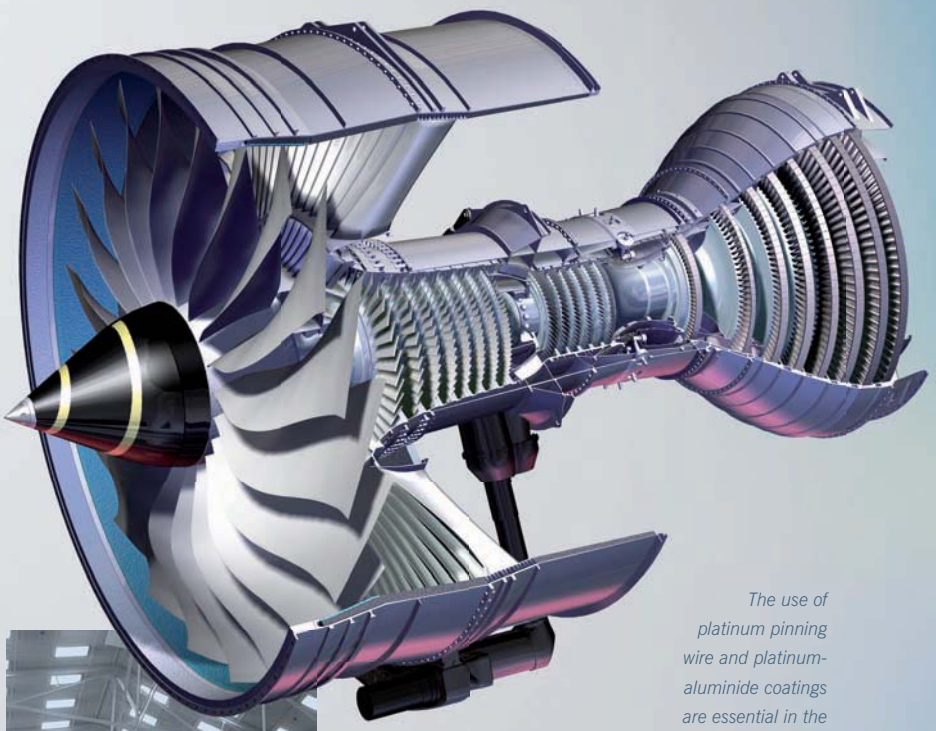
Recent medical trials have improved doctors' ability to identify people at risk of fatal arrhythmias. As a result, there has been rapid growth in the number of patients implanted with an ICD – up by around 20 per cent in 2005. This application has consequently been the largest single contributor to recent growth in biomedical demand for platinum.

Turbine Blades

In 2005, more than 50,000 oz of platinum were used in the manufacture of turbine blades, making this the fourth largest of the metal's other applications. Platinum is used both in the casting of blades and in coatings required to increase their longevity in the very harsh operating conditions of a modern gas turbine engine.

Turbine blades are manufactured via investment casting, which enables the production of very complex cast shapes with, in some cases, hollow cores. The process involves the creation of a disposable wax mould or form that is subsequently coated with a ceramic material. The wax is then removed by melting and the ceramic shell is fired. Molten metal (often a titanium-based superalloy) is then cast into the shell.

Blades destined for use in the hottest part of a turbine engine often have a hollow core, which functions as an internal cooling vent. This is formed by fixing a ceramic core inside the ceramic shell using platinum "pinning wire". The pinning wire holds the core in place while the blade is cast, before melting into the alloy and thus remaining permanently within the blade.



The use of platinum pinning wire and platinum-aluminide coatings are essential in the production of blades used in modern high-temperature turbines.

Platinum is universally used for pinning wire as its high strength and rigidity ensures that cores are held securely during casting, and it does not adversely affect the structure and integrity of the blade.

The efficiency of a gas turbine is related to its running temperature. In the quest for ever greater fuel efficiency, turbines are becoming hotter: the gases from the combustion chamber in a modern aero-engine may enter the high pressure section of the turbine at temperatures of over 1,500ºC. In order to extend the life of the blades used in the high pressure section of the engine, a platinum aluminide coating is usually applied. This provides protection from oxidation and allows the blade to operate continuously for as long as 20,000 hours before it requires repair or replacement. It is usually possible to strip and reapply the platinum coating once, after which the blade must be changed.

Demand for platinum in turbine blades is expected to rise steadily over the next few years as increasing demand for air travel stimulates sales of new aircraft. Not only will additional platinum be required for new engines, but the expansion of the world air fleet will also boost the recoating and replacement blade markets.

PALLADIUM

AUTOCATALYST

Autocatalyst demand for palladium edged up by just 20,000 oz to 3.81 million oz in 2005. Given the metal's persistent and substantial discount to platinum, such a slow rate of growth might appear surprising. However, although North America auto manufacturers increasingly phased out platinum-based catalysts in favour of palladium-based systems, average palladium loading levels continued to decline. European demand for palladium was also adversely affected by thrifting, as well as by a further fall in sales of gasoline light vehicles. It was only in Asia that auto industry purchases of palladium increased, notably in South Korea and China.

Europe

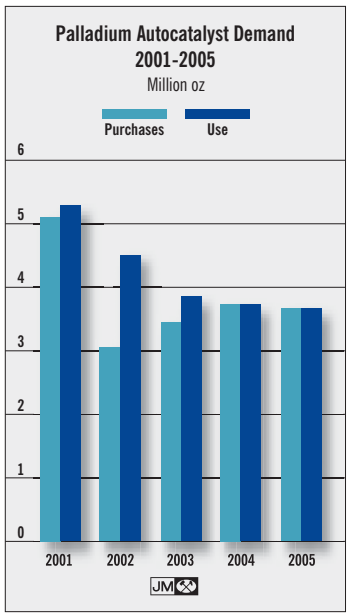
In 2005 European auto industry purchases of palladium fell below 1 million oz for the first time since 1996, dropping 10 per cent year-on-year to 990,000 oz. Demand was affected by the continuing decline in production and sales of gasoline light vehicles and by the ongoing thrifting of palladium loading levels on catalysts. The introduction of the first diesel after-treatment systems containing palladium had a negligible effect on metal demand last year.

Car companies and catalyst manufacturers made further progress in reducing the average palladium content of gasoline vehicle catalysts in 2005. This was achieved despite the advent of Euro IV emissions legislation, which applied to all new light vehicle models from the beginning of the year. Technical advances in catalyst design and manufacture, together with increased use of close-coupled catalysts, have enabled substantial reductions in metal use over the last few years.

Close-coupled catalysts are fitted near to the engine manifold and so very quickly reach their effective operating temperature after the vehicle is started. The rapid 'light-off' of the catalyst enables more effective control of emissions at lower metal loadings.

The Western European light vehicle market was relatively flat in 2005, with total new vehicle sales little changed from the year before. However, sales of diesels continued to rise, accounting for almost one out of every two new light vehicles purchased. Production and sales of gasoline vehicles consequently declined, which had a direct effect on demand for palladium.

The first catalyst systems for light duty diesel vehicles containing a proportion of palladium in place of platinum entered production during the second half of 2005. Although platinum-palladium after-treatment systems for diesel vehicles are expected to become more widely adopted over the next few years, their intr oduction did not have a material impact on demand for either metal last year.



Purchases of palladium by auto manufacturers now closely reflect use of the metal on catalysts, excess industry stocks having been eliminated.

Palladium Demand: Autocatalyst
'000 oz

	2004	2005
Europe	1,105	990
Japan	635	660
North America	1,445	1,430
Rest of the World		
China	105	150
Other	500	580
Total	**3,790**	**3,810**
Autocatalyst recovery	**(530)**	**(630)**

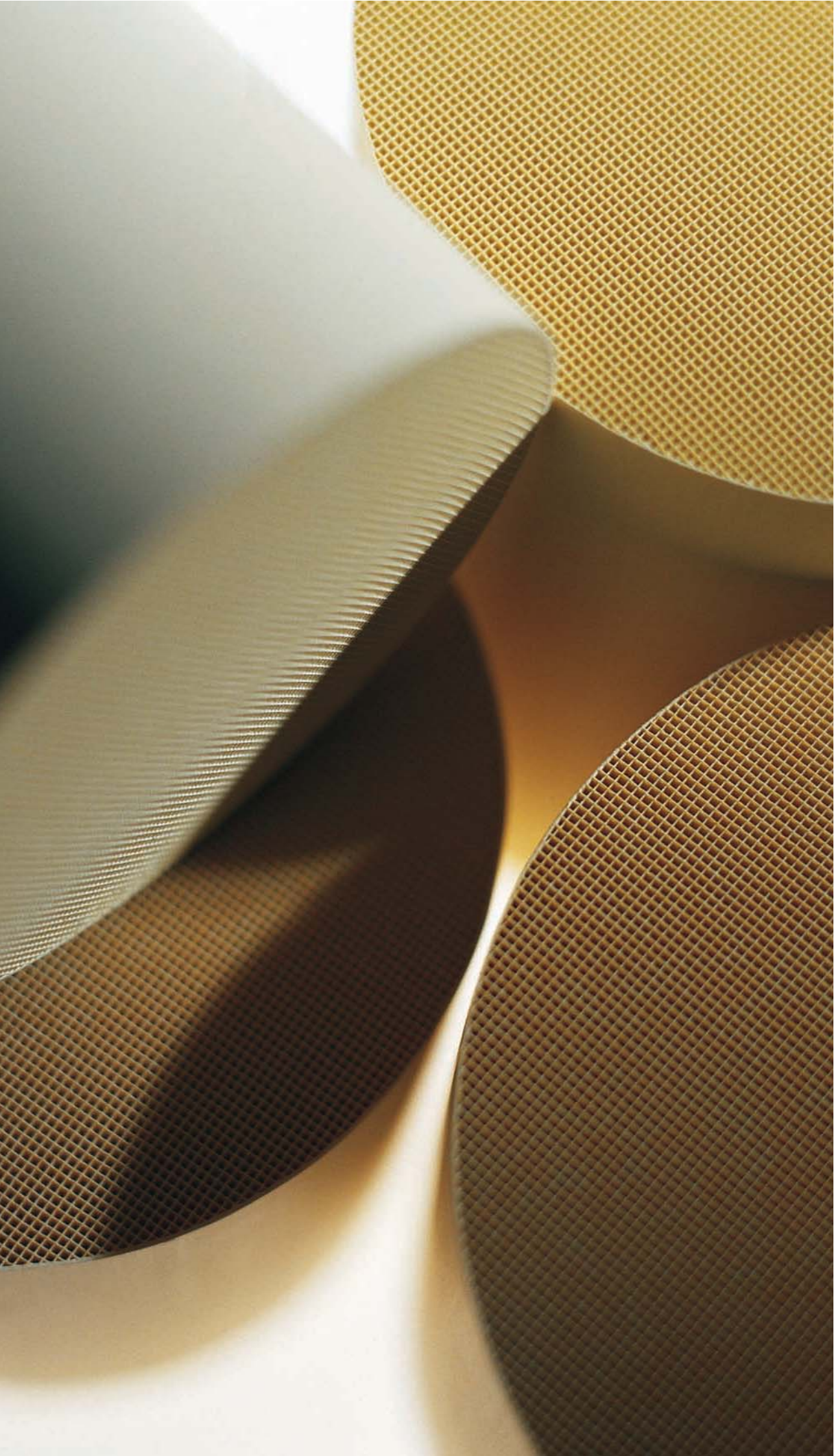
JM

Japan

Japanese autocatalyst demand for palladium expanded by 4 per cent to 660,000 oz in 2005. This was largely a result of a 3 per cent rise in light vehicle production as the Japanese auto industry benefited from both increased domestic and export sales.

Palladium demand was also supported by the rising proportion of vehicles manufactured to increasingly stringent emissions standards. Within Japan a growing number of cars and light trucks were produced to ultra-low emissions vehicle standards, and legislation in the major Japanese export markets of Europe and North America continued to tighten.

Japanese auto makers have not, in general, made very significant changes to their use of platinum and palladium in response to movements in the prices of the two metals. Some have initiated a gradual change in favour of palladium-based formulations on new models but to date the impact on metal demand has been relatively minor.



Autocatalyst demand for palladium edged up by less than 1 per cent in 2005 as thrifting continued to reduce average loading levels in both North America and Europe.

North America

The North American auto industry purchased 1.43 million oz of palladium in 2005, a fall of 1 per cent compared with the previous year. The decline was less than we had previously forecast as switching from platinum to palladium catalysts by US auto manufacturers began to increase, a consequence of the persistently large disparity between the prices of the two metals.

Although an increasing proportion of vehicles manufactured were fitted with palladium-based catalysts, the average metal loading per catalyst continued to fall. The negative consequences of this thrifting on the consumption of palladium by the US auto industry once again outweighed the positive effects of switching.

The changing pattern of vehicle sales was also detrimental to palladium demand in North America last year. Record high gasoline prices (which exceeded $3.00 per gallon in some states during the year) resulted in lower than anticipated sales of some of the largest SUVs and pick-up trucks, vehicles which tend to have large catalysts containing significant amounts of pgm.

Although total light vehicle sales edged upwards in 2005, North American vehicle production slipped as imports gained market share. Furthermore, foreign brands accounted for a greater proportion of vehicle output within the region. Both factors had an adverse effect on demand for palladium as the best-selling transplant models had, on average, lower palladium loadings than their US counterparts.

China

Purchases of palladium for use in the Chinese autocatalyst sector jumped by 43 per cent to 150,000 oz in 2005, broadly in line with the growth in platinum consumption. The surge in pgm demand was a result of higher light vehicle production, tightening emissions limits, and an increase in the proportion of light vehicles fitted with catalysts.

The Chinese auto industry grew robustly in 2005, with production of light vehicles rising by 14 per cent to 5 million units, in line with strong growth in sales of both passenger cars and light trucks.

Emissions standards equivalent to Euro II were introduced nationwide in China in mid-2004, requiring the fitment of catalysts to all new gasoline light vehicle models. The phasing out of the manufacture and sale of older, Euro I compliant models was complete by mid 2005. The combined effect of these changes was a significant rise in palladium demand.

Record high gasoline prices during 2005 hit US sales of many of the larger SUV models and pick-up trucks, which had a knock-on effect on palladium demand.

Recovery of palladium from scrapped autocatalysts climbed by 19 per cent to 630,000 oz last year.

Rest of the World

Autocatalyst demand for palladium in the Rest of the World climbed to 580,000 oz in 2005, annual growth of 16 per cent. This resulted in part from higher light vehicle production, notably in South Korea (up 12 per cent), India (up 8 per cent), South East Asia and South America. It was also a function of generally rising emissions standards, both in these regions and, in the case of South Korea, in the export markets of Europe and North America. There was also a noticeable acceleration in the switching from platinum-based catalyst systems to palladium products on gasoline vehicles by a number of Asian auto manufacturers.

Autocatalyst Recovery

The weight of palladium recovered from scrap autocatalysts climbed by 19 per cent to 630,000 oz in 2005. The biggest year-on-year increase occurred in Europe; a combination of greater volumes of catalysts entering the recycling chain plus higher average palladium loadings on those catalysts led to a 50 per cent rise in palladium recovery to 165,000 oz.

Palladium recovery also continued to grow in North America, increasing to 390,000 oz. This was primarily a function of a rise in the number of vehicles manufactured in the mid-1990s, fitted with palladium-rich catalysts, coming to the end of their lives. Recovery of the metal from scrapped catalysts in the Rest of the World region also increased but remained small in comparison.

In contrast, Japanese recovery of palladium from autocatalysts fell to just 30,000 oz last year. As with falling platinum recovery, this was a result of fewer end of life vehicles being recycled within Japan as the export trade in second hand vehicles and parts expanded.

JEWELLERY

Purchases of palladium for use in jewellery soared by 54 per cent to 1.43 million oz in 2005. This was almost entirely as a result of the rapid expansion of palladium jewellery manufacturing in China, which accounted for 1.2 million oz of total jewellery demand last year. The majority of the remaining 230,000 oz was consumed in the production of platinum jewellery alloys in Japan and some white gold alloys, although small volumes of palladium jewellery were also produced in North America.

The Chinese jewellery sector purchased 1.2 million oz of palladium in 2005, an increase of half a million ounces on the year before. Although retail sales of palladium jewellery grew, the surge in purchases of metal was driven primarily by companies throughout

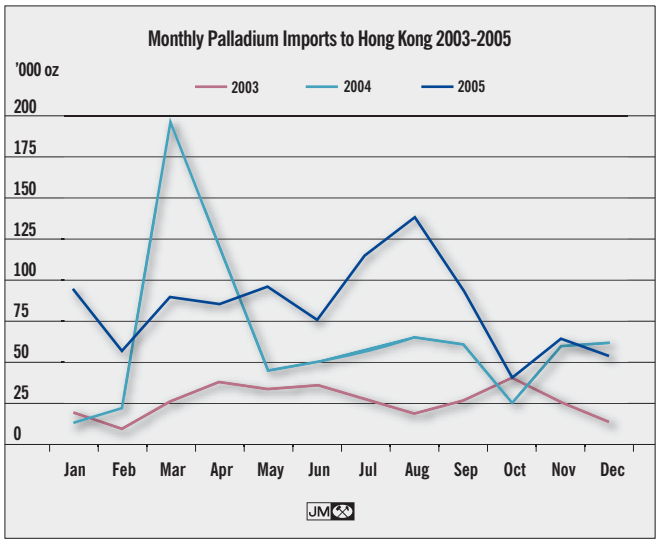
the trade establishing and expanding stocks of finished jewellery. The majority of jewellery manufacturers had started production of palladium products the previous year, and most stepped up output markedly in 2005 to fulfil orders from a growing number of wholesalers and retailers across the country. The spread of palladium jewellery to stores throughout China last year was remarkably rapid; Shanghai and Beijing are now the only major cities where a significant proportion of retail outlets still do not stock palladium.

The concept of purity is a strong selling point for the jewellery buying public in China, especially in rural areas. Last year, 99 per cent pure palladium jewellery (Pd990) was introduced in addition to 95 per cent pure palladium products (Pd950). This made a significant contribution to the growth in metal demand as stores began building inventories of Pd990 items alongside their existing ranges of Pd950.

One of the primary attractions of palladium to the jewellery trade was the fact that it cost considerably less to finance metal inventories compared with platinum. This was a function of both the substantial price differential between the two metals and (given the large, readily available stocks) the very low lease rates for palladium.

Palladium holds a further advantage relative to platinum for jewellery manufacturers in the form of its much lower density, which means that almost twice the number of identical items can be manufactured from the same weight of metal. Assuming metal prices of $900 for platinum (approximately the average price in 2005) and $225 for palladium, for a given level of investment a jeweller would be able to buy (or borrow) four times as much palladium and produce around eight times as many rings from it. Consequently, for many manufacturers output of palladium jewellery overtook platinum in terms of the number of pieces produced, and for some, palladium also overtook platinum in terms of the weight of metal used.

Imports of palladium to Hong Kong averaged almost 85,000 oz per month in 2005, up by more than 29 per cent on the previous year, whilst exports of metal direct to mainland China also increased significantly.



Some North American jewellery manufacturers became increasingly interested in palladium during 2005, although demand for metal was modest.

For the jewellery-buying public, palladium is seen to share many of the attributes that have made platinum so attractive: whiteness, rarity, purity, durability, and a good potential investment. It also offers less affluent consumers the opportunity to participate in the trend for white precious metal jewellery at a relatively affordable price. Its relative purity also gives palladium an important competitive edge over white gold, which contains at most 75 per cent gold.

The rally in the price of palladium from less than $200 in September to almost $300 in December was, in some respects, supportive of the expansion of retail sales of palladium jewellery, giving credence to the argument that it would be a sound investment and an appreciating store of value.

Nevertheless, the level of sales completed from manufacturer through retailer to consumer was

uneven last year, palladium doing well in some areas but being received less enthusiastically in others. Where it sold best, typically in second and third tier cities in the central and western provinces, palladium appeared both to expand the overall level of precious metal jewellery sales and to take market share from yellow gold, white gold and platinum.

The relative absence of palladium jewellery in stores in Shanghai and Beijing relates in part to the strong position that platinum has established in those cities. Platinum remains the jewellery metal to which young, middle-class consumers aspire, and leading retailers are wary of undermining the investments that they have made in promoting it.

Palladium Demand: Jewellery
'000 oz

	2004	2005
Europe	35	35
Japan	155	145
North America	10	20
Rest of the World		
China	700	1,200
Other	30	30
Total	**930**	**1,430**

JM

Outside of China the main application for palladium in jewellery is as a component of platinum jewellery alloys in Japan and, to a lesser extent, white gold alloys in Europe, where the use of nickel in jewellery is limited by legislation. In 2005, however, growing interest was seen in North America in Pd950 palladium jewellery and a number of manufacturers began trialling the production of limited ranges of products.

CHEMICAL

Investment in new chemicals plants in the Rest of the World region continued to generate strong sales of palladium in 2005, supporting demand at the historically high level of 320,000 oz. The construction of new production facilities for purified terephthalic acid in Asia remained one of the most important components of demand. In the mature markets of Europe, Japan and North America, little new plant construction was undertaken and palladium demand was therefore primarily replacement metal to cover losses in the production of various chemicals and pharmaceuticals.

One of the main applications for palladium-based catalysts in the chemicals industry is in the production of purified terephthalic acid (PTA), a feedstock used in the production of polyester fibre and polyethylene terephthalate (PET). During 2005 construction of significant new PTA capacity continued in several countries including India, Brazil, Mexico and especially China, where a number of new plants were either under construction or entered the planning stages. This reflected a shortage of local manufacturing capacity; China, for example, sourced less than half its PTA requirement from domestic production. The lack of captive PTA production has in turn resulted from the rapid growth in demand for polyester resin in those countries from their expanding textile industries.

Palladium is also a key catalyst in the production of vinyl acetate monomer (VAM), an intermediate product in the manufacture of a wide range of polymers used in industrial and consumer products such as paints, adhesives, coatings, textiles, acrylic fibres and packaging.

As with PTA, the market for VAM was strong in 2005, supported by robust economic growth in North America and Asia. Consequently demand for palladium-based catalysts from this sector increased on the back of high operating rates at existing plants and the construction of new capacity in China.

Purchases of palladium for use in gauzes for the nitric acid industry were broadly flat in 2005. Increased demand for palladium catchment gauze from North American nitric acid producers was offset by metal returned following the closure of plants elsewhere.

Palladium Demand: Chemical
'000 oz

	2004	2005
Europe	70	70
Japan	25	25
North America	85	85
Rest of the World	130	140
Total	**310**	**320**

JM

DENTAL

Demand for palladium from the dental sector edged down to 845,000 oz in 2005, marginally lower than the year before. High gold prices encouraged a switch towards palladium-containing alloys in North America, but this was offset by an increase in the recycling of production scrap in Japan.

Japan is the world's largest market for palladium-based dental materials. The Kinpala alloy (which has a palladium content of 20 per cent) dominates the market for reconstructive dentistry; the market is mature and there were no fundamental changes in alloy use in 2005. However, net palladium demand fell by 15,000 oz to 505,000 oz due to an increase in the

Palladium Demand: Dental '000 oz		
	2004	2005
Europe	80	75
Japan	520	505
North America	235	250
Rest of the World	15	15
Total	**850**	**845**

JM

reprocessing of scrap. Japanese dental alloy companies have traditionally been slow to return production scrap for recycling. Recently, collectors have become much more active in this market, resulting in a shortening of the time between the sale of alloy and the return of scrap, and a consequent increase in the amount of metal recovered.

In North America, high gold prices have had a positive influence on demand for palladium in the dental industry. With gold prices averaging almost $450 in 2005, there was a shift away from high gold alloys (which usually contain platinum rather than palladium) towards lower-gold content alloys which generally incorporate palladium and silver in varying proportions. As a result, North American dental demand rose by 15,000 oz to 250,000 oz.

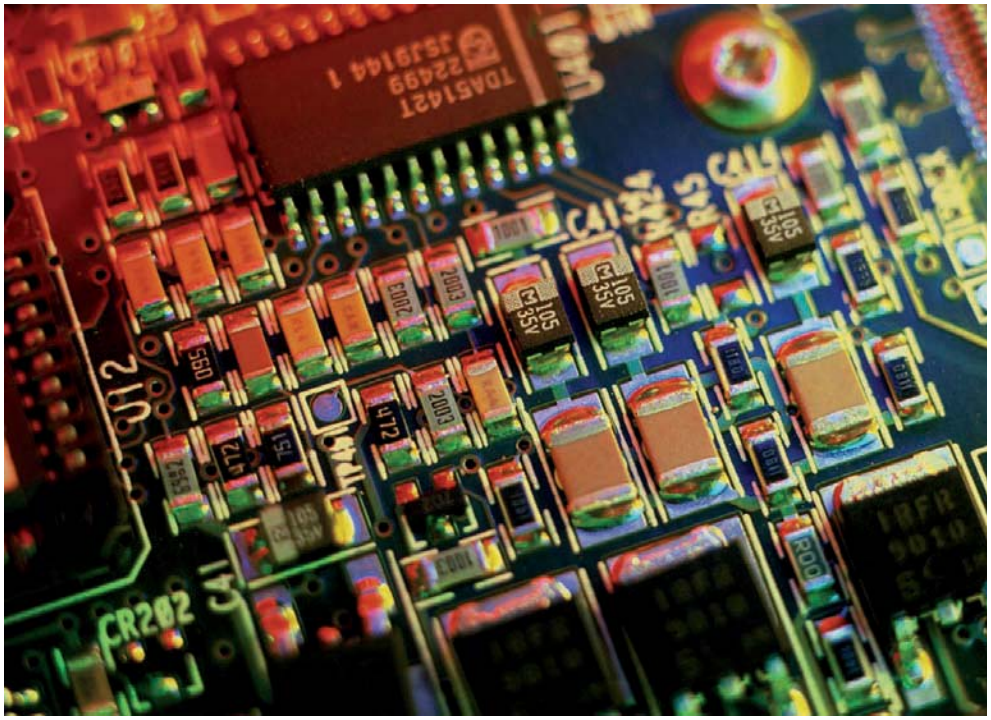
European demand for palladium-based dental alloys occurs principally in Italy. This market tends to be price sensitive, and high prices for palladium and gold therefore had a negative impact on the use of dental alloys containing these metals. Total European purchasers of palladium softened to 75,000 oz.

ELECTRONICS

Palladium usage in electronics rose by 5 per cent to 965,000 oz in 2005, supported by strong demand for consumer electronic devices and the increased adoption of palladium in the plating sector. This was partly offset by further substitution and thrifting of palladium in multi-layer ceramic capacitors (MLCC), the metal's largest single application in the electronics sector.

World output of MLCC rose by an estimated 16 per cent in 2005, in line with strong sales of personal computers and mobile phones (especially those with an in-built digital camera) and greater use of electronic components in vehicles. On a geographical basis, the largest increases in production occurred in the Rest of the World region: China is now an important MLCC manufacturer (partly due to the relocation of production capacity from Europe and North America), and is the world's largest consumer of palladium for this application.

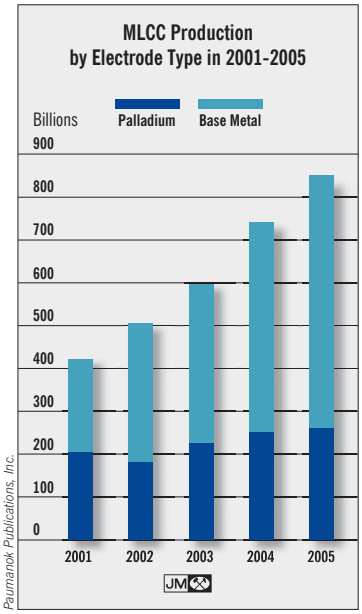
Demand for palladium in MLCC, however, dropped by around 4 per cent. Conductive pastes based on nickel rather than palladium were used in an estimated 70 per cent of all MLCC produced in 2005, up slightly compared with the previous year. In addition,



MLCC production jumped by an estimated 16 per cent in 2005 but thrifting and miniaturisation continued to adversely affect demand for palladium.

there was further thrifting of the palladium content of the palladium-silver pastes used in the remaining 30 per cent of capacitors. Furthermore, the ongoing miniaturisation of electronic components continued to adversely affect metal demand from the capacitor industry as the average size of MLCC declined.

Despite higher palladium prices there is no evidence that the pace of substitution increased in 2005. Although manufacturers adopted nickel technology for new production lines, most continued to operate their existing production facilities based on palladium. In particular, palladium has been retained for MLCC with a low layer count (where it is not generally economic to shift to nickel) and in speciality high-performance applications (which are not price sensitive).



However, there are sharp variations between regions, with the adoption of nickel by the Japanese industry now approaching 90 per cent while in other regions nickel accounts for little more than half of capacitor production. In the latter areas, the uptake of nickel is likely to progress gradually, with almost all new production capacity using this technology.

Consumption of palladium by the plating sector rose by almost 30 per cent in 2005, outweighing the decline in demand from MLCC. There was increased substitution of gold by palladium in the plating of connectors, while there was also growth in other applications including the plating of palladium on circuit boards. In addition, there was further progress in the replacement of lead with palladium in copper lead frames .

Additional growth in demand for palladium in 2005 resulted from increased production of resistor chips and related components, particularly for use in automotive electronics. Use of palladium in hybrid integrated circuits was relatively stable.

As with all our demand numbers (with the exception of the autocatalyst sector) our estimates of palladium demand in electronics are net figures – that is they account for the recovery of substantial quantities of metal from scrap. In 2005, we calculate that the amount of palladium recovered from electronic scrap was down around 6 per cent compared with the previous year. This decline reflects the impact of component miniaturisation and the thrifting and substitution of palladium that has occurred in recent years.

Palladium Demand: Electronics
'000 oz

	2004	2005
Europe	115	80
Japan	235	260
North America	185	195
Rest of the World	385	430
Total	**920**	**965**

JM

OTHER

Private investors' enthusiasm for palladium coins and bars helped to maintain other demand for palladium at the historically high level of 300,000 oz in 2005, marginally up compared with the previous year. Consumption in a wide range of small applications, including catalysts for stationary-source pollution control, automotive oxygen sensors and brazing alloys, was little changed.

Private investors in the USA again bought significant quantities of palladium in 2005, motivated by the perception that the palladium price has the potential to appreciate significantly in the wake of gold and platinum. Demand for investment products reached 220,000 oz, up 5 per cent on the previous year. Substantial quantities of palladium bullion products of all forms were purchased, including coins and one and ten ounce bars from a variety of sources. In November 2005, the Royal Canadian Mint began offering one ounce Maple Leaf bullion coins, of which 40,000 were produced and sold last year. A 2006 version of the bullion coin has also been issued, and this year no mintage limit has been announced.

The only other legal-tender palladium coin to be struck in 2005 was a half-ounce Panda from China, of which 8,000 were minted.

Demand for palladium in other industrial aplications edged higher in 2005, with consumption of the metal in catalysts for contol of stationary source emissions and in platinum alloys used in oxygen sensors increasing.

Palladium Demand: Other
'000 oz

	2004	2005
Europe	25	20
Japan	10	10
North America	230	250
Rest of the World	25	20
Total	**290**	**300**

JM

OTHER PLATINUM GROUP METALS

RHODIUM

Purchases of rhodium expanded by 11 per cent to 812,000 oz in 2005, equalling the previous high recorded in 2000. Use of the metal in autocatalyst, glass and chemical applications increased, but year-to-year changes in inventory levels within the auto industry continued to distort the overall pattern of demand.

Autocatalyst

The use of rhodium in the manufacture of autocatalysts increased only marginally in 2005. In contrast, purchases of metal by auto companies increased by 8 per cent to 821,000 oz. The apparent disparity reflects the fact that there was a significant draw down of inventories of rhodium in 2004, which meant that purchases of metal in the market lagged behind consumption. With stocks maintained at relatively stable levels in 2005, demand climbed to more closely match the underlying use of rhodium in catalysts.

Rhodium Supply and Demand
'000 oz

	2004	2005
Supply		
South Africa	587	627
Russia	100	90
North America	17	20
Others	16	17
Total Supply	**720**	**754**
Demand		
Autocatalyst: gross	758	821
recovery	(140)	(137)
Chemical	43	47
Electrical	8	9
Glass	46	55
Other	14	17
Total Demand	**729**	**812**
Movements in Stocks	**(9)**	**(58)**

JM

The US auto industry accounted for much of the year-to-year changes in inventories with demand jumping by 31 per cent to 292,000 oz. The use of rhodium on catalysts, however, increased by a more sedate 3 per cent – this being indicative of the longer-term trend of slowly rising rhodium loadings on gasoline light vehicles which is a result of increasingly stringent limits on NOx emissions.

Rhodium is very effective at catalysing the conversion of NOx to nitrogen, and average loading levels edged upwards in the US in 2005 as the phase-in of Tier II federal emissions standards continued. The Tier II regulations require auto manufacturers to meet an average NOx emissions limit of 0.07 grams per mile across their light vehicle fleets, a reduction of more than 75 per cent from the preceding National Low Emissions Vehicle standards.

However, the rise in the price of rhodium gave auto manufacturers cause for concern during 2005, and is expected to lead to an increased emphasis on thrifting the metal in future catalyst formulations.

European auto industry demand for rhodium was stable in 2005 at 180,000 oz. The combined effect of lower production of gasoline vehicles, an increased proportion of cars produced to Euro IV emissions standards, and thrifting of rhodium on some vehicle models was neutral for metal demand.

Japanese auto manufacturers purchased 216,000 oz of rhodium in 2005, down around 8 per cent compared with the previous year. As in North America, the year-to-year change in demand for metal was a function of additions to inventories made in 2004. The use of metal on catalysts in Japan last year was broadly stable.

Demand for rhodium in autocatalysts in China and the Rest of the World region, increased by 11 per cent to 133,000 oz, reflecting strong growth in production of light vehicles in Asia and South America.

At 137,000 oz, the total volume of rhodium recovered from scrapped autocatalysts edged slightly lower in 2005. Recovery continued to grow in North America and Europe, reflecting changes in the mix of vehicle models reaching the end of their lives and, in Europe, increased vehicle recycling rates due to new legislation. In Japan, however, recovery slipped lower as second-hand vehicles were increasingly exported rather than being scrapped.

Other Demand

Purchases of rhodium for use in the glass industry climbed to a new record high of 55,000 oz in 2005, an annual increase of 20 per cent. The majority of this additional demand stemmed from the ongoing and rapid expansion of LCD glass manufacturing capacity in Asia. Glass producers invested heavily in the construction of new furnaces in order to meet burgeoning orders from manufacturers of LCD and other flat panel displays. Increased rhodium demand was also seen from the fibreglass industry in Asia.

Demand for rhodium for use in catalysts for the chemicals industry was also robust last year, rising by 9 per cent to 47,000 oz. Much of this growth was generated by the construction of new plants for the production of oxo-alcohols and acetic acid.

RUTHENIUM & IRIDIUM

Strong demand from the electronics sector was the driving force behind a substantial increase in ruthenium demand, up 17 per cent to 788,000 oz in 2005. Sales to the chemicals industry softened but remained above the long-term average. Iridium demand recorded a more modest increase, up 3 per cent to 124,000 oz, with growth spread across a range of applications.

Ruthenium Demand by Application
'000 oz

	2004	2005
Chemical	123	117
Electrochemical	96	96
Electronics	388	506
Other	65	69
Total Supply	**672**	**788**

JM

Purchases of ruthenium for use in electronic applications rose sharply in 2005, surging to 506,000 oz. Consumption of the metal in the manufacture of hard disks climbed substantially, driven by strong growth in sales of consumer electronics. The addition of ruthenium to the structure of the disk has enabled manufacturers to overcome previous limits on storage capacity. There was also a significant rise in inventories of ruthenium held within the industry as hard disk producers, anticipating further growth in consumption, took advantage of relatively low and stable prices to build stocks.

Electronics demand for ruthenium was also boosted by use of the metal in plasma display panels (PDP), which compete with LCD displays in the market for large flat-screen televisions. Manufacturers have been able to enhance the image quality of PDP by incorporating ruthenium into the conductive paste applied to the inner surface of the screen.

Elsewhere in the electronics sector, there was also significant expansion in the consumption of ruthenium in conductive pastes used in resistor components.

Sales of ruthenium to the chemicals industry eased slightly to 117,000 oz in 2005, following two years of very strong demand. Purchases of ruthenium-based catalysts for use in the production of bulk chemicals such as acetic acid edged downwards as less new capacity was brought on stream than in the year before.

Iridium Demand by Application
'000 oz

	2004	2005
Chemical	25	26
Electrochemical	27	28
Electronics	30	31
Other	38	39
Total Supply	**120**	**124**

JM

Use of ruthenium in the electrochemical sector was unchanged in 2005 at 96,000 oz whereas demand for iridium moved up to 28,000 oz. This reflected the gradual long-term move towards the use of iridium-ruthenium anode coatings rather than ruthenium-only coatings in the chlor-alkali industry.

Electronics demand for iridium totalled 31,000 oz in 2005, slightly higher than the year before. Iridium's principal electronic use is for the manufacture of crucibles required for the production of high quality single crystals. Demand is concentrated in North America, where expanding sales of positron emission topography (PET) scanners to the medical profession has generated strong growth in production of scintillator crystals.

There were also modest increases in sales of iridium to the chemical and automotive sectors. Iridium, together with ruthenium, is used in a catalyst for the production of acetic acid, and is increasingly used for spark plug electrodes.

RHODIUM SUPPLIES

Supplies of rhodium increased by 5 per cent to 754,000 oz in 2005. South African output climbed by 7 per cent to 627,000 oz as total production of pgm expanded. Anglo Platinum's output of rhodium was also boosted by the release of a significant volume of metal from its process pipeline.

Russian sales of rhodium, however, fell by 10,000 oz to an estimated 90,000 oz in 2005. Norilsk Nickel sold all of its output but only limited quantities of rhodium from state stocks entered the market during the year.

With demand for rhodium growing by more than twice the rate of increase in supplies, the market moved to a deficit of 58,000 oz.

Ruthenium & Iridium

South African output of ruthenium and iridium continued to rise in line with increased production of platinum. The availability of refined metal, however, was insufficient to prevent the price of both metals from strengthening from the second quarter of 2005 onwards, in the face of rising demand and occasional bids for metal from speculators.

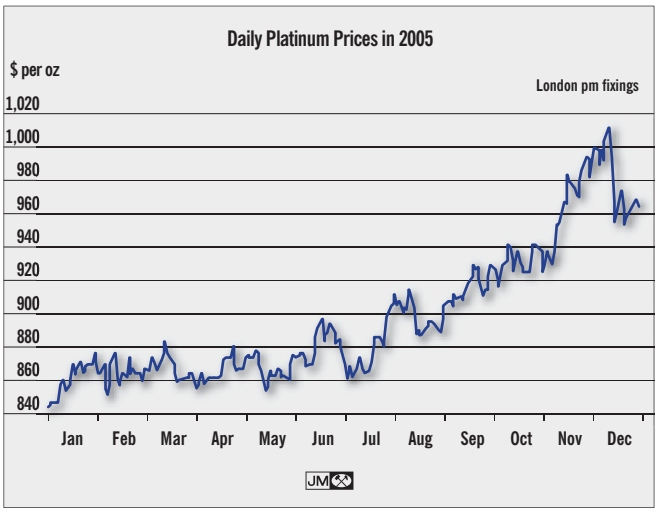
PRICES & FUTURES MARKETS

PLATINUM

A sharp increase in the flow of investment and speculative capital into the platinum market during the second half of 2005 propelled the price to a 25-year high of $1,012 in December. Similar patterns were seen in other metal markets, with gold, copper, zinc and aluminium all rising to multi-year peaks on the back of fund buying. This was partly a function of macro-economic factors (as reflected in US dollar and yen exchange rates) and the heightened interest in commodities as an asset class. However, it was also founded upon strong fundamentals, with supplies struggling to keep pace with growth in demand for several metals.

Platinum spent much of January through to June trading relatively quietly between $860 and $880. Good physical demand and steady fund buying provided support at the bottom of the range, whilst speculative selling tended to cap the market at or just above $880. This continued a pattern of largely sideways trading dating back to August 2004.

The price broke through the resistance around the middle of the year, moving upwards in a succession of rallies that culminated in a sprint from $925 in early November to a peak fixing of $1,012 in December. Much of the impetus came from a substantial increase in fund and general public long positions on the Tokyo Commodities Exchange (TOCOM) as investors reacted to a significant weakening of the yen by moving cash into dollar-denominated commodities. However, the introduction in mid-December of extraordinary trading margins on TOCOM triggered a rush of long liquidation. The price of platinum slumped to $942 as a result before recovering somewhat to end 2005 with a fixing of $964.



Platinum traded between $860 and $880 for much of the first six months of 2005; from July onwards speculative buying drove a strong rally that peaked at $1,012 in December

Average PGM Prices in $ per oz

	2004	2005	Change
Platinum	845.75	897.02	6%
Palladium	230.03	201.47	-12%
Rhodium	981.73	2,056.18	109%
Ruthenium	64.68	74.59	15%
Iridium	186.32	169.49	-9%

Platinum and palladium prices are averages of London am and pm fixings. Other pgm prices are averages of Johnson Matthey European base prices

JM

In early **January** 2005 the platinum price came under pressure from light fund selling in New York and Tokyo, slipping from around $860 on the 3rd to a fixing of $848 on the 4th when the London market opened. The price bottomed out at $843 on the 5th and this proved to be the low point of the entire year. An upturn in demand for metal from Chinese jewellery manufacturers and other end users then provided support, and from mid-month onwards funds turned net buyers of commodities as the dollar weakened. The platinum price consequently rallied and ended January firmly at $869.

A short-covering rally on TOCOM pushed the platinum price up to $881 on the 1st of **February** but this was swiftly followed by fund selling as the dollar regained strength. With Chinese buyers absent due to the Lunar New Year holiday, platinum slid to $847 on the 9th. The price then moved erratically for several weeks, reflecting fluctuations in the oil, gold and foreign exchange markets. Platinum regained the $870 level on the 11th of February; fell back under $860 the following week; then climbed to reach $883 on the 16th of **March** as funds increased their long positions on both NYMEX and TOCOM. However, when the price of oil fell sharply and the dollar rebounded yet again, long liquidation forced precious metals prices downwards, platinum dropping to $858 on the 23rd.

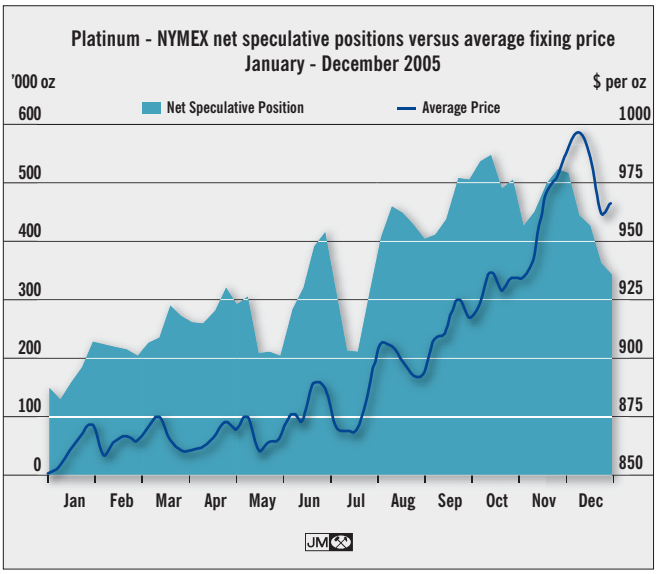
The fall below $860 led to a substantial rise in purchasing by Chinese jewellery manufacturers. Funds, however, were content to maintain rather than increase their long positions in platinum and it traded in a narrow band either side of $860 through to the 19th of **April**. The price then embarked on another brief rally, moving back up to $880 on the 26th as renewed fund buying flowed through NYMEX. Once again, however, the price lost momentum above $880 and subsequently fell back below $870.

Funds had another go at pushing platinum convincingly above $880 during the first half of **May**, but after fixing at $881 on the 11th long liquidation and short selling capped the rally and platinum fell quickly, dropping to $853 on the 16th. The repeated pattern of rallies breaking down around $880 was suggestive of option-related selling, although on this occasion fund selling was also seen in the crude oil, gold and copper markets as the dollar strengthened markedly. As before, the fall in the platinum price below $860 triggered an upturn in demand for metal from end users and the price stabilised, trading between $855 and $868 for the remainder of May.

During **June** increasing volumes of fund buying were seen in both the precious and base metal markets as the dollar reversed direction once more. The platinum price climbed to $878 on the 7th, dipped back under $870 over the course of the next few days, but then accelerated upwards from the 15th. This time the fund buying had sufficient vigour to drive the price through the previous level of resistance and platinum jumped to hit $900 on the 20th. At that point the net long position on NYMEX had climbed to around 400,000 oz, almost doubling in the space of two weeks.

The price of platinum then subsided through the remainder of June and into **July** as investors took profits, the speculative position on NYMEX falling back as quickly as it had grown. The second half of July, however, saw another rally develop as speculative positions on the New York and Tokyo exchanges increased. The generally bullish sentiment in the platinum market was helped by news of wage disputes within the South African mining industry, by the rand strengthening against the dollar, and by the Chinese government's decision to revalue the renminbi. Platinum moved swiftly back above $880 and offers had almost reached $900 again by the close of business on the 29th.

The rally continued in early **August** as fund buying and short covering pushed the net speculative position on NYMEX up over 450,000 oz and the estimated position on TOCOM towards 400,000 oz. The platinum price surged in response, fixing at $914 on the 4th then jumping to $924 on the morning of the 12th. At that level very little physical trade was concluded and the price began to fall back later that day as funds started taking profits. By the 16th platinum had dropped to $887 and it then fluctuated between $887 and $897 through to the end of the month.



The net fund long position on NYMEX climbed over 500.000 oz during the second half of 2005. This, plus a sharp rise in speculative long positions on TOCOM, pushed the price upwards.

Over the first two days of **September**, the after-effects of Hurricane Katrina caused oil prices to jump to almost $70 per barrel and the dollar to weaken sharply. This triggered increased speculative buying across the precious metals markets, gold climbing above $445, silver pushing over $7.00 and platinum striding back over $900 to fix at $909 on the 2nd. The price remained well supported above $900 by on-going fund buying for the next few days before advancing to a new high for the year of $930 on the 20th, tracking a very strong rally in gold. Both metals then eased off the highs as the dollar recovered some ground but then firmed again towards the end of the month, platinum fixing at $929 and gold setting a new 17-year high of $473.40 on the 30th.

Platinum began **October** by drifting down to $914 on the 5th; Chinese buyers were absent due to the National Day holiday and interest from other end users was subdued. From then on, however, speculative interest began to pick up again and the price rebounded to reach $941 on the 11th as the net fund position on NYMEX neared 550,000 oz.

After softening to $920 on the 20th on profit-taking, renewed speculative buying on TOCOM was responsible for propelling the price up to $944 on the morning of the 27th – the highest fixing for almost 25 years. On NYMEX, however, funds began unwinding long positions and the price subsequently dropped

to $924 on the 1st of **November**. Not surprisingly, the correction triggered an increase in orders of metal from end users, with good volumes being traded across the Shanghai Gold Exchange.

The rest of November saw a dramatic rally develop in platinum, the price soaring by more than $70 to peak just shy of $1,000.

The acceleration in the price began in earnest on the 9th, the furthest dated contract on TOCOM rising sharply on speculative buying and short-covering, and the morning fixing in London settling at $955, up from $937 the previous afternoon. The market then steadied for a couple of days before jumping to $969 on the 14th, then to $983 on the 16th. After another pause the price made a final run higher, peaking at $997 on the morning of the 28th. At that point funds and investors held net long positions in excess of 500,000 oz on both TOCOM and NYMEX.

The flood of speculative buying by Japanese based funds and investors on TOCOM was a result of a substantial fall in the value of the yen, which sparked a movement of cash into dollar denominated assets. However, the rise in the platinum price also reflected the overall bullishness of sentiment towards all the precious metals, with investor buying propelling the gold price rapidly towards $500 and driving silver well above $8.00.

After a brief reversal to $979 on the 30th on fund profit-taking, platinum turned upwards again in early **December** as the yen continued its downward track against the dollar. As Japanese investors resumed buying on TOCOM, platinum was quickly pushed over the $1,000 mark, fixing at $1,001 on the 2nd. US based funds, however, continued to unwind long positions and this selling capped the market for several days.

The market moved higher again from the 9th and peaked with fixings of $1,011 and $1,012 in London on the 12th following further very strong sessions on TOCOM. At that point the net long position held by funds and private investors on the Tokyo exchange was estimated to be in the region of 850-900,000 oz.

However, after the close of trading on the 12th the Precious Metals Management Committee of TOCOM announced that, in light of the high levels of open interest and volatility, extraordinary margins would be introduced for both platinum and gold. This resulted in a scramble by Japanese investors to liquidate long positions when trading began on the 13th, in turn causing the price of both metals to drop sharply. Platinum slumped to $942 on the morning of the 15th, losing $70 (7 per cent) in less than three days.

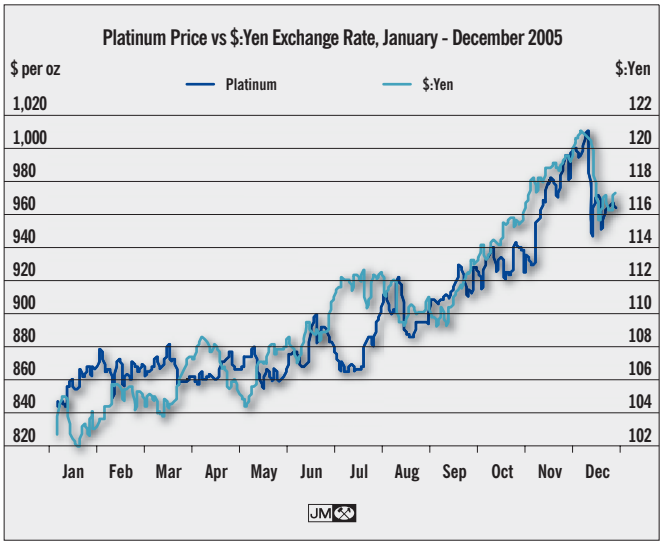
The price began to recover later that day, gaining support from buying by end users. By the 19th platinum had bounced back to fix at $974 but then softened a little to trade either side of $960 for the remainder of the month. The metal closed 2005 with a fixing of $964, a gain of $116 or almost 14 per cent over the opening fixing of the year.

Platinum Prices in 2005
London am and pm fixings, $ per oz

	High	Low	Average
January	871.00	843.00	857.00
February	881.00	847.00	864.00
March	883.00	858.00	870.50
April	880.00	855.00	867.50
May	881.00	853.00	867.00
June	900.00	867.00	883.50
July	896.00	864.00	880.00
August	924.00	887.00	905.50
September	930.00	893.00	911.50
October	944.00	914.00	929.00
November	997.00	924.00	960.50
December	1,012.00	942.00	977.00

JM

Foreign exchange markets exert a strong influence on metal prices; in 2005 a marked weakening of the yen spurrred substantial Japanese investment in precious metals from September onwards.



PALLADIUM

Palladium broadly followed the direction of the other precious metals markets in 2005: a long period of trading within in a narrow range was followed by a strong rally towards the end of the year. During the fourth quarter speculative buying was able to overcome the unfavourable fundamentals of palladium and propel the price from less than $200 in October to a peak of $297 in early December, before it eased back to end the year at $253.

After having closed out a significant volume of long positions on NYMEX during the previous December, funds turned net buyers of palladium futures during **January** 2005. As a result, the palladium price moved up from an opening fixing of $180 to $192 on the 11th. Overall, however, the tone of the market was weak, with plenty of metal available to satisfy continuing demand from the Chinese jewellery sector. The price consequently slipped back to trade below $190 for much of the rest of the month.

Palladium weakened further in early **February**, dropping to $178 on the 8th as Chinese buying tailed off ahead of the New Year holiday and as the platinum and gold markets fell. From then on palladium traded quietly between $179 and $186 through to the 28th.

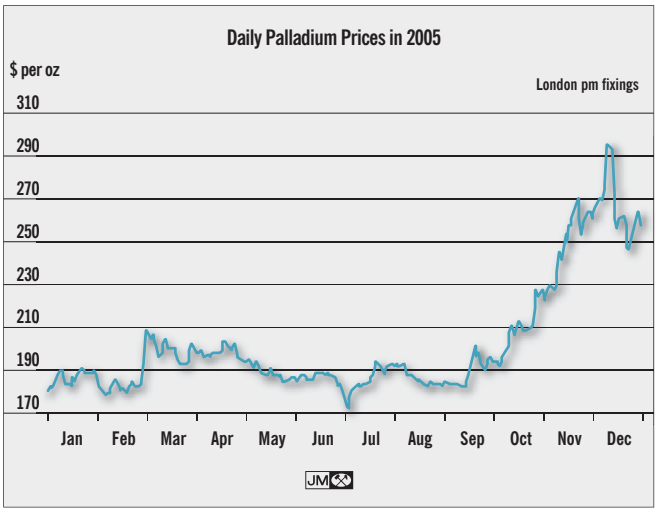
Strong speculative buying and short-covering of palladium positions on NYMEX at the beginning of **March** had the effect of propelling the price from $182 on the 1st to $208 on the 4th. The fund buying continued for the next two weeks, the net speculative position nearing 1 million oz by the 22nd, up from 714,000 oz at the start of the month. However, with increased offers of physical metal coming into the market the price was unable to make further gains and palladium ended March at $198.50.

The surge of fund buying in March was followed by steady long liquidation on NYMEX throughout **April** and much of **May**. The price of palladium traded very quietly around the $200 level until the final week of April. At that point the fund selling began to have an impact and the price drifted down from $202 on the 27th to reach $185 by the end of May. By then the fund long position on NYMEX had been cut by almost half from the peak in March, falling to just over 500,000 oz. Given the scale of the fund long liquidation, the reaction of the price was relatively muted. This in part reflected good demand for metal from the Chinese jewellery sector, although there were also suggestions that substantial option positions below the market were generating support.

Palladium Prices in 2005
London am and pm fixings, $ per oz

	High	Low	Average
January	192.00	180.00	186.00
February	190.00	178.00	184.00
March	208.00	182.00	195.00
April	203.00	196.00	199.50
May	195.00	184.00	189.50
June	190.50	182.50	186.50
July	192.00	172.00	182.00
August	192.50	182.50	187.50
September	202.00	182.50	192.25
October	227.00	192.00	209.50
November	270.00	221.00	245.50
December	297.00	246.00	271.50

JM



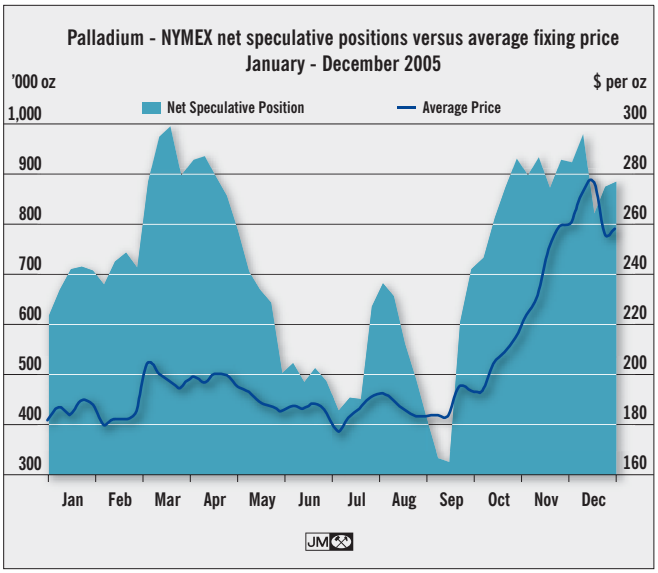
The palladium price traded in a narrow range either side of $190 for the first nine months of 2005, before rallying strongly in line with the other precious metals during the fourth quarter.

The palladium price settled into a new, narrow range in **June**, trading either side of $185 for the duration of the month. The fund selling had largely abated and bids and offers for spot metal were well matched. **July**, however, saw activity pick up, initially in the form of fund long liquidation across the precious metal markets in reaction to the strengthening dollar. The price slipped below $180 on the morning of the 4th, triggering stop-loss sell orders. The afternoon fixing was settled at $173 and palladium edged down another dollar to $172 the following morning – the lowest fixing for almost two years.

However, fund buying then re-emerged across the precious metals sector as the dollar changed direction and the palladium price staged a recovery. The speculative long position on NYMEX climbed from around 430,000 oz on the 5th to almost 640,000 oz on the 26th, with the price climbing back above $190 as a result.

Palladium held above $190 in early **August** on continuing speculative investment but as the month progressed significant new short positions were opened on NYMEX, which weighed on the price. By the 22nd palladium had drifted down to $182 and remained close to that level through to the 31st. The spot market was quiet for the most part, with several days of very thin trade on the London fixings.

During the first half of **September**, palladium remained locked in a tight $182-185 trading range, unaffected by rising gold and platinum prices. From around the 16th onwards, however, speculative sentiment towards the metal quickly became bullish.



Fund buying on NYMEX failed to have much impact on the palladium price until the fourth quarter of 2005, when substantial speculative buying via over-the-counter deals was also seen.

Those funds that had opened new short positions during August were caught out as the market turned upwards, and as those positions were covered the price climbed back over $200, palladium fixing at $202 on the 20th. The price then softened as the platinum and gold markets fell but palladium held above $190 and ended September at $194.

Palladium continued to fluctuate between $190 and $200 throughout the first week of **October** but then rallied again from the 10th as further short covering was followed by a substantial increase in new long positions. The price climbed to $213 on the 17th, edged back under $210 for several days, then accelerated upwards towards the end of the month, reaching $227 on the 27th. Fund activity on NYMEX remained the key driver behind the rally, the net speculative position increasing by 200,000 oz to 930,000 oz, but daily volumes on TOCOM also picked up as Japanese investors sought to hedge the effect of the weakening yen by buying dollar-denominated assets.

After a quiet start to **November** the rally in palladium accelerated again during the second week of the month, following other precious and base metal prices upwards. Fresh speculative buying, both on the New York and Tokyo futures exchanges and via over-the-counter transactions, propelled the price up to $243 on the 10th, to $260 by the close of trade on the 18th, and to $268 on the 21st. Palladium ended November at $258, still strongly supported by fund interest. At that stage the net speculative long position on NYMEX was just over 920,000 oz, whilst the equivalent position on TOCOM had climbed to around 250,000 oz, up from an estimated 175,000 oz at the beginning of the month.

The rally became something of a spike during **December**: palladium moved above $270 on the 2nd as platinum pushed up to hit $1,000, then after pausing for a week the price jumped by more than $20 to fix in London at $297 on the morning of the 9th. However, the market had moved well ahead of the fundamentals, there being plenty of metal available to cover demand from end users. Consequently, when long liquidation hit the precious metal markets between the 13th and 15th the correction in the palladium price was steep, the metal plunging to $249. After slipping further to $246 on the 22nd the price recovered a little, fixing at $264 on the 28th in thin trade before softening to end 2005 at $253. This represented a gain of 41 per cent ($73) from the opening fixing of the year.

OTHER PGM

The price of rhodium appreciated substantially in 2005, rising from $1,330 in January to a peak of $3,100 in November – a 14-year high. This marked the continuation of a rally that began in early 2004, when rhodium was trading at around $500.

The performance of the price was primarily a function of the declining availability of metal. This in turn was a result of growth in supplies of rhodium being insufficient to meet strong demand from the auto, glass and chemical sectors. There was a notable drop in the volume of Russian rhodium offered, suggesting that state-owned stocks had been depleted. The tightness of the market was exacerbated by speculative buying and by the preference of some of these longs to hold rather than lend metal.

After an initial period of weakness, the prices of ruthenium and iridium were also pushed higher by strengthening industrial demand, ruthenium climbing from a low of $55 to $87 and iridium rising from $145 to $195.

The rhodium market was quiet in early January 2005, the Johnson Matthey base price holding steady at $1,330. On the 11th, however, the price began moving upwards in response to tightness in the lending market. As short term lease rates climbed above 20

per cent some industrial users sought to buy rhodium and close out leases. With speculators competing for the limited volumes of metal on offer, the Johnson Matthey base price strengthened to $1,500 by the 21st and had reached $1,665 by the middle of February.

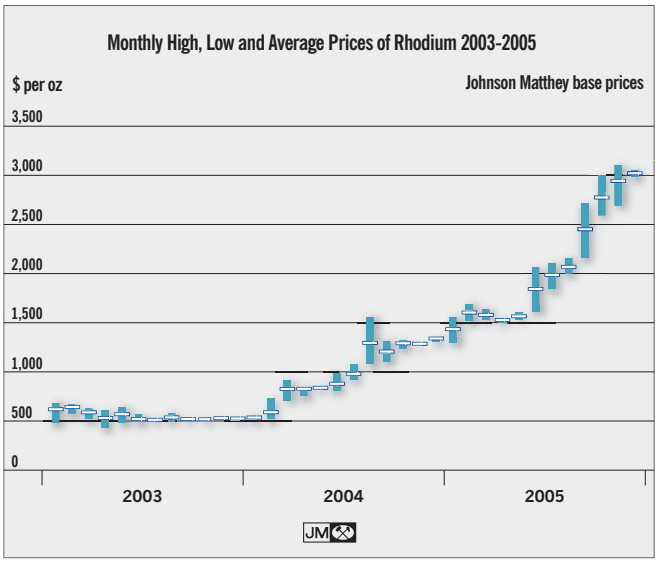
The availability of metal then improved and the price fell back to trade between $1,500 and $1,600 all the way through to the end of May. Good physical demand, including some forward buying by the auto industry, provided solid support at the lower end of the price range.

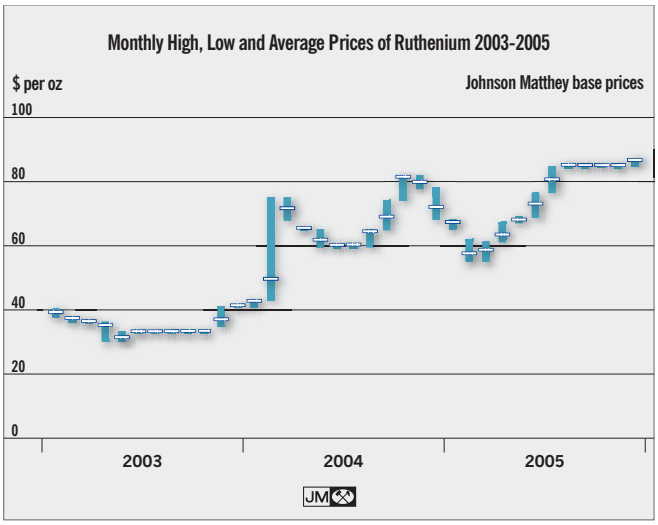
In June demand began to outweigh the amount of rhodium on offer once again. As the price began to move up out of its previous range, the scramble to cover near-term requirements intensified. With forward buying contributing to the pressure the price climbed above $2,000.

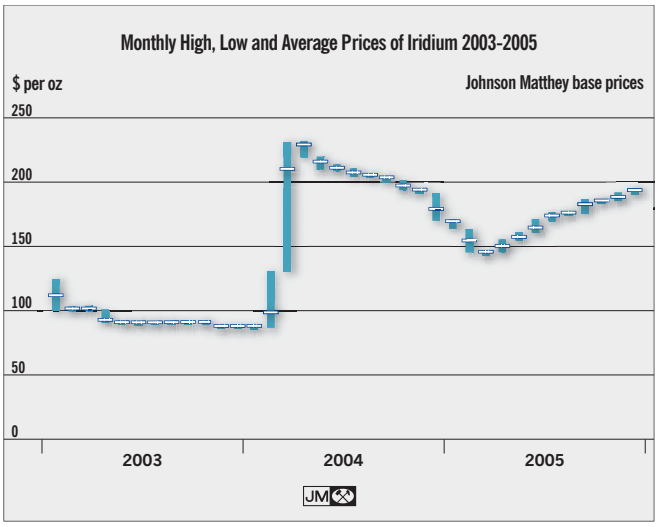
The market then quietened down, briefly dipping to $1,850 before trading between $2,000 and $2,150 from mid-July to the end of August. However, when more buyers returned to the market in early September the price gained renewed upwards momentum. With very few offers of any significant size to be found, and with speculators competing with end users for metal, the JM base price climbed rapidly: rhodium touched $2,500 on the 16th, reached $2,700 by the end of the month, and hit $3,000 on the 7th of October.

The move to $3,000 drew out some speculative profit-taking and the price fell back to $2,600 but the respite for consumers of metal was brief. By early November rhodium was moving higher again, reaching $3,100 on the 17th and trading either side of $3,000 for the remainder of the year.

The ruthenium market began 2005 weakly: the JM base price slid from $68 in January to $55 by the middle of February as offers of metal outweighed buying interest. However, good industrial demand emerged from March onwards, particularly from the electronics sector. As a result the price moved steadily upwards, reaching $85 in late July. The price held that level all the way through to December before ticking up to end the year at $87. The iridium market followed a similar path, the price edged down from $170 at the start of the year to $145 in February but then climbed from early April onwards as demand strengthened. The JM base price climbed to $175 in July, $185 in September, and hit $195 in December.

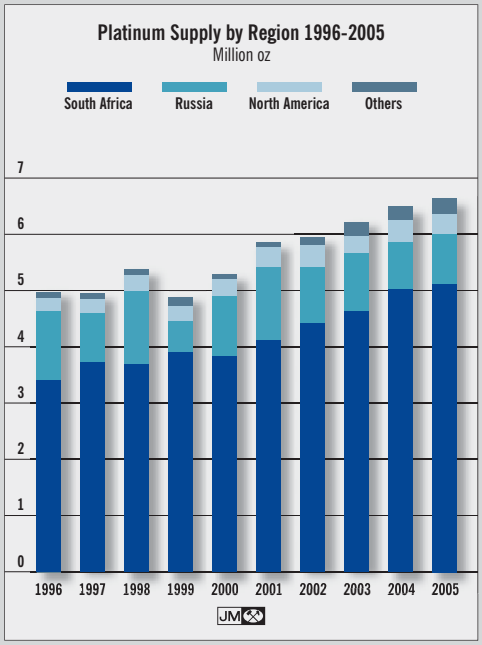


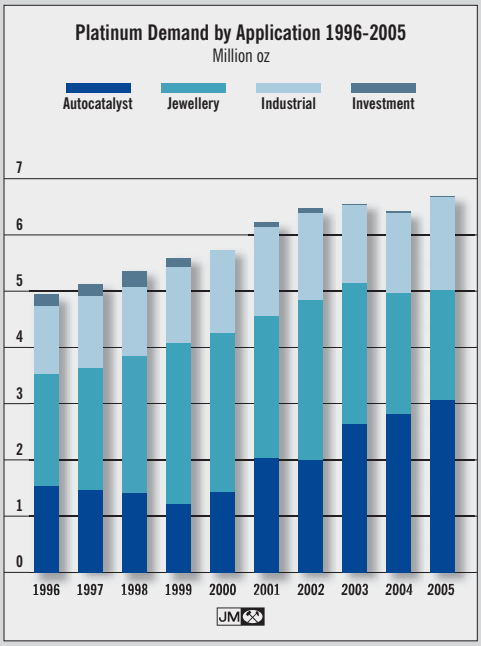




Platinum Supply and Demand

'000 oz	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Supply										
South Africa	3,390	3,700	3,680	3,900	3,800	4,100	4,450	4,630	5,010	**5,110**
Russia	1,220	900	1,300	540	1,100	1,300	980	1,050	845	**890**
North America	240	240	285	270	285	360	390	295	385	**360**
Others	130	120	135	160	105	100	150	225	250	**270**
Total Supply	**4,980**	**4,960**	**5,400**	**4,870**	**5,290**	**5,860**	**5,970**	**6,200**	**6,490**	**6,630**
Demand by Application										
Autocatalyst: gross	1,880	1,830	1,800	1,610	1,890	2,520	2,590	3,270	3,490	**3,820**
recovery	(350)	(370)	(405)	(420)	(470)	(530)	(565)	(645)	(690)	**(770)**
Chemical	230	235	280	320	295	290	325	320	325	**335**
Electrical	275	305	300	370	455	385	315	260	300	**360**
Glass	255	265	220	200	255	290	235	210	290	**355**
Investment: small	110	180	210	90	40	50	45	30	30	**30**
large	130	60	105	90	(100)	40	35	(15)	15	**(15)**
Jewellery	1,990	2,160	2,430	2,880	2,830	2,590	2,820	2,510	2,160	**1,960**
Petroleum	185	170	125	115	110	130	130	120	150	**155**
Other	255	295	305	335	375	465	540	470	470	**470**
Total Demand	**4,960**	**5,130**	**5,370**	**5,590**	**5,680**	**6,230**	**6,470**	**6,530**	**6,540**	**6,700**
Movements in Stocks	**20**	**(170)**	**30**	**(720)**	**(390)**	**(370)**	**(500)**	**(330)**	**(50)**	**(70)**



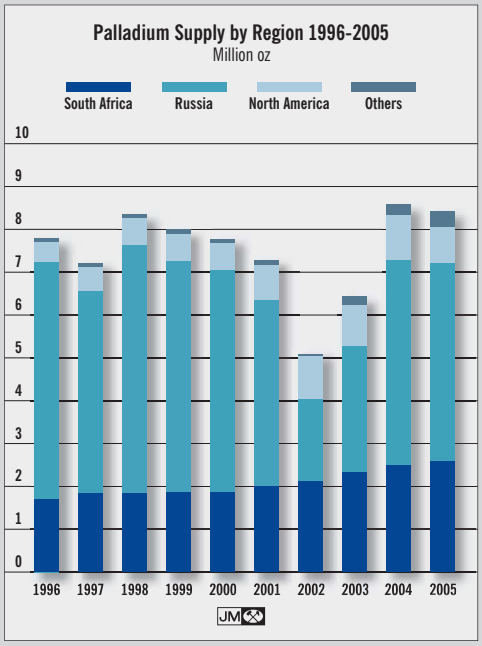


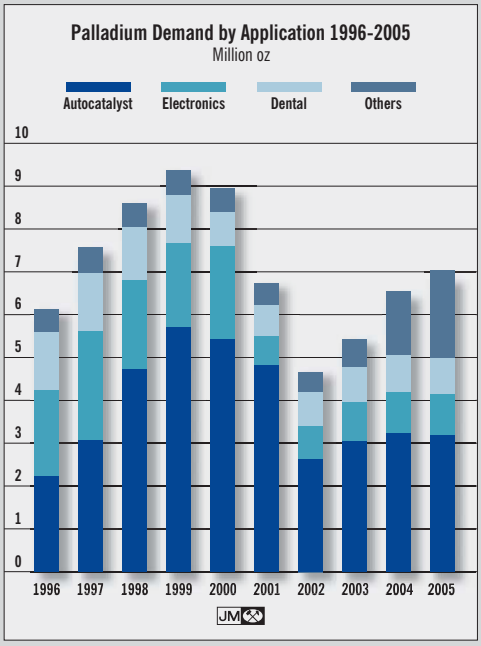
Platinum Demand by Application: Regions

'000 oz	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Europe										
Autocatalyst: gross	515	510	545	560	680	1,060	1,210	1,455	1,680	**1,960**
recovery	(20)	(25)	(30)	(30)	(40)	(70)	(90)	(115)	(145)	**(170)**
Chemical	60	70	60	80	100	105	115	105	115	**110**
Electrical	25	45	45	70	80	65	40	35	40	**40**
Glass	40	20	25	20	20	10	10	10	5	**10**
Investment: small	5	5	5	5	0	0	0	0	0	**0**
Jewellery	125	150	160	185	190	170	160	190	195	**195**
Petroleum	15	15	15	15	15	15	15	15	15	**15**
Other	75	85	85	90	105	155	190	190	190	**180**
Total	**840**	**875**	**910**	**995**	**1,150**	**1,510**	**1,650**	**1,880**	**2,095**	**2,340**
Japan										
Autocatalyst: gross	245	255	240	250	290	340	430	500	615	**595**
recovery	(50)	(50)	(55)	(60)	(60)	(55)	(55)	(60)	(55)	**(35)**
Chemical	20	20	20	20	20	25	30	40	40	**55**
Electrical	45	65	55	75	90	80	55	40	50	**65**
Glass	80	85	80	65	65	85	60	85	90	**95**
Investment: small	25	25	25	20	5	5	5	5	0	**0**
large	130	60	105	90	(100)	40	35	(15)	15	**(15)**
Jewellery	1,480	1,390	1,290	1,320	1,060	750	780	660	560	**510**
Petroleum	5	5	5	5	5	5	5	5	5	**5**
Other	25	30	30	35	35	35	55	40	40	**40**
Total	**2,005**	**1,885**	**1,795**	**1,820**	**1,410**	**1,310**	**1,400**	**1,300**	**1,360**	**1,315**
North America										
Autocatalyst: gross	850	800	775	535	620	795	570	885	800	**820**
recovery	(275)	(290)	(310)	(315)	(350)	(370)	(380)	(420)	(435)	**(505)**
Chemical	80	80	80	95	100	100	100	95	90	**100**
Electrical	130	100	105	120	145	120	100	85	90	**95**
Glass	30	45	20	25	50	35	30	(30)	(10)	**5**
Investment: small	75	145	175	60	35	45	40	25	25	**25**
Jewellery	90	160	270	330	380	280	310	310	290	**275**
Petroleum	60	50	40	40	35	40	45	40	35	**35**
Other	140	160	170	190	210	250	265	215	205	**210**
Total	**1,180**	**1,250**	**1,325**	**1,080**	**1,225**	**1,295**	**1,080**	**1,205**	**1,090**	**1,060**
Rest of the World (inc. China)										
Autocatalyst: gross	270	265	240	265	300	325	380	430	395	**445**
recovery	(5)	(5)	(10)	(15)	(20)	(35)	(40)	(50)	(55)	**(60)**
Chemical	70	65	120	125	75	60	80	80	80	**70**
Electrical	75	95	95	105	140	120	120	100	120	**160**
Glass	105	115	95	90	120	160	135	145	205	**245**
Investment: small	5	5	5	5	0	0	0	0	5	**5**
Jewellery	295	460	710	1,045	1,200	1,390	1,570	1,350	1,115	**980**
Petroleum	105	100	65	55	55	70	65	60	95	**100**
Other	15	20	20	20	25	25	30	30	35	**40**
Total	**935**	**1,120**	**1,340**	**1,695**	**1,895**	**2,115**	**2,340**	**2,145**	**1,995**	**1,985**

Palladium Supply and Demand

'000 oz	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Supply										
South Africa	1,690	1,810	1,820	1,870	1,860	2,010	2,160	2,320	2,480	**2,590**
Russia	5,600	4,800	5,800	5,400	5,200	4,340	1,930	2,950	4,800	**4,620**
North America	455	545	660	630	635	850	990	935	1,035	**905**
Others	95	95	120	160	105	120	170	245	265	**275**
Total Supply	**7,840**	**7,250**	**8,400**	**8,060**	**7,800**	**7,320**	**5,250**	**6,450**	**8,580**	**8,390**
Demand by Application										
Autocatalyst: gross	2,360	3,200	4,890	5,880	5,640	5,090	3,050	3,450	3,790	**3,810**
recovery	(145)	(160)	(175)	(195)	(230)	(280)	(370)	(410)	(530)	**(630)**
Chemical	240	240	230	240	255	250	255	265	310	**320**
Dental	1,320	1,350	1,230	1,110	820	725	785	825	850	**845**
Electronics	2,020	2,550	2,075	1,990	2,160	670	760	900	920	**965**
Jewellery	215	260	235	235	255	240	270	260	930	**1,430**
Other	140	140	115	110	60	65	90	140	290	**300**
Total Demand	**6,150**	**7,580**	**8,600**	**9,370**	**8,960**	**6,760**	**4,840**	**5,430**	**6,560**	**7,040**
Movements in Stocks	**1,690**	**(330)**	**(200)**	**(1,310)**	**(1,160)**	**560**	**410**	**1,020**	**2,020**	**1, 350**





Palladium Demand by Application: Regions

'000 oz	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Europe										
Autocatalyst: gross	860	1,100	1,370	1,530	1,900	1,730	1,370	1,220	1,105	**990**
recovery	(5)	(5)	(5)	(10)	(15)	(30)	(45)	(70)	(110)	**(165)**
Chemical	65	70	65	65	95	65	70	65	70	**70**
Dental	255	260	210	180	100	50	55	70	80	**75**
Electronics	300	340	270	255	265	35	85	85	115	**80**
Jewellery	30	50	50	50	45	35	35	35	35	**35**
Other	20	25	25	25	20	20	15	20	25	**20**
Total	**1,525**	**1,840**	**1,985**	**2,095**	**2,410**	**1,905**	**1,585**	**1,425**	**1,320**	**1,105**
Japan										
Autocatalyst: gross	180	245	480	600	510	505	520	550	635	**660**
recovery	(30)	(45)	(50)	(55)	(50)	(40)	(40)	(40)	(40)	**(30)**
Chemical	20	20	20	20	20	20	20	25	25	**25**
Dental	600	620	590	545	470	475	505	515	520	**505**
Electronics	990	1,390	1,060	980	990	260	140	225	235	**260**
Jewellery	115	110	105	105	150	140	165	160	155	**145**
Other	10	10	10	10	15	10	10	5	10	**10**
Total	**1,885**	**2,350**	**2,215**	**2,205**	**2,105**	**1,370**	**1,320**	**1,440**	**1,540**	**1,575**
North America										
Autocatalyst: gross	1,230	1,680	2,820	3,490	2,805	2,375	640	1,205	1,445	**1,430**
recovery	(110)	(105)	(115)	(125)	(155)	(200)	(260)	(270)	(345)	**(390)**
Chemical	70	70	70	75	65	75	75	70	85	**85**
Dental	410	415	390	350	230	190	215	225	235	**250**
Electronics	490	550	460	405	485	250	210	215	185	**195**
Jewellery	5	10	10	10	10	10	10	10	10	**20**
Other	90	55	55	50	5	15	45	95	230	**250**
Total	**2,185**	**2,675**	**3,690**	**4,255**	**3,445**	**2,705**	**925**	**1,540**	**1,845**	**1,840**
Rest of the World (inc. China)										
Autocatalyst: gross	90	175	220	260	425	480	520	475	605	**730**
recovery	0	(5)	(5)	(5)	(10)	(10)	(25)	(30)	(35)	**(45)**
Chemical	85	80	75	80	75	90	90	105	130	**140**
Dental	55	55	40	35	20	10	10	15	15	**15**
Electronics	240	270	285	350	420	125	325	375	385	**430**
Jewellery	65	90	70	70	50	55	60	55	730	**1,230**
Other	20	50	25	25	20	20	20	20	25	**20**
Total	**555**	**715**	**710**	**815**	**1,000**	**770**	**1,000**	**1,015**	**1,855**	**2,520**

Rhodium Supply and Demand

'000 oz	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Supply										
South Africa	359	377	400	410	457	452	490	544	587	**627**
Russia	110	240	110	65	290	125	90	140	100	**90**
North America	5	16	16	18	17	23	25	26	17	**20**
Others	2	3	4	8	3	4	10	14	16	**17**
Total Supply	**476**	**636**	**530**	**501**	**767**	**604**	**615**	**724**	**720**	**754**
Demand by Application										
Autocatalyst: gross	424	418	483	509	793	566	599	660	758	**821**
recovery	(45)	(49)	(57)	(65)	(79)	(88)	(99)	(124)	(140)	**(137)**
Chemical	21	36	31	34	39	44	39	39	43	**47**
Electrical	9	9	6	6	7	6	6	6	8	**9**
Glass	53	43	34	35	42	41	37	26	46	**55**
Other	9	10	10	9	10	10	10	13	14	**17**
Total Demand	**471**	**467**	**507**	**528**	**812**	**579**	**592**	**620**	**729**	**812**
Movements in Stocks	**5**	**169**	**23**	**(27)**	**(45)**	**25**	**23**	**104**	**(9)**	**(58)**

NOTES TO TABLES

Supply figures are estimates of sales by the mines of primary pgm.

With the exception of the autocatalyst sector, **demand** estimates are net figures, demand in each sector being total purchases by consuming industries less any sales back to the market. Thus, annual totals represent the amount of primary metal that is acquired by consumers in a particular year. We continue to exclude the CIS from our demand estimates.

Movements in stocks in a 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 indicates an increase in stocks; a negative figure indicates a rundown in stocks.

Gross autocatalyst demand is purchases of pgm by the auto industry for manufacture of catalytic converters. **Autocatalyst recovery** is pgm recovered from scrapped catalytic converters and is allocated to the region in which the converter was scrapped.

Investment: small refers to the long-term holding of metal in the form of coins, and bars weighing 10 oz or less. **Investment: large** is in the form of 500 g and 1 kg bars in Japan and includes platinum held on account for subscribers to accumulation plans.

GLOSSARY

g	grams
kg	kilograms
tonne	1,000 kg
tons	short tons (2,000 pounds or 907 kg)
oz	ounces troy
pgm	platinum group metals
ppt	parts per thousand
prices	all prices quoted are per oz unless otherwise stated
R	South African rand
$	US dollars
¥	Japanese yen

BEE	black economic empowerment
CO	carbon monoxide
CSF	catalysed soot filter
DMFC	direct methanol fuel cell
DOC	diesel oxidation catalyst
DPF	diesel particulate filter
HC	hydrocarbons
HIC	hybrid integrated circuit
LCD	liquid crystal display
Merensky, Platreef, UG2	platiniferous orebodies in South Africa
PEMFC	proton exchange membrane fuel cell
MLCC	multi-layer ceramic capacitor
NOx	oxides of nitrogen
NYMEX	New York Mercantile Exchange
PM	particulate matter
TOCOM	Tokyo Commodity Exchange
ULEV	Ultra Low Emissions Vehicle

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