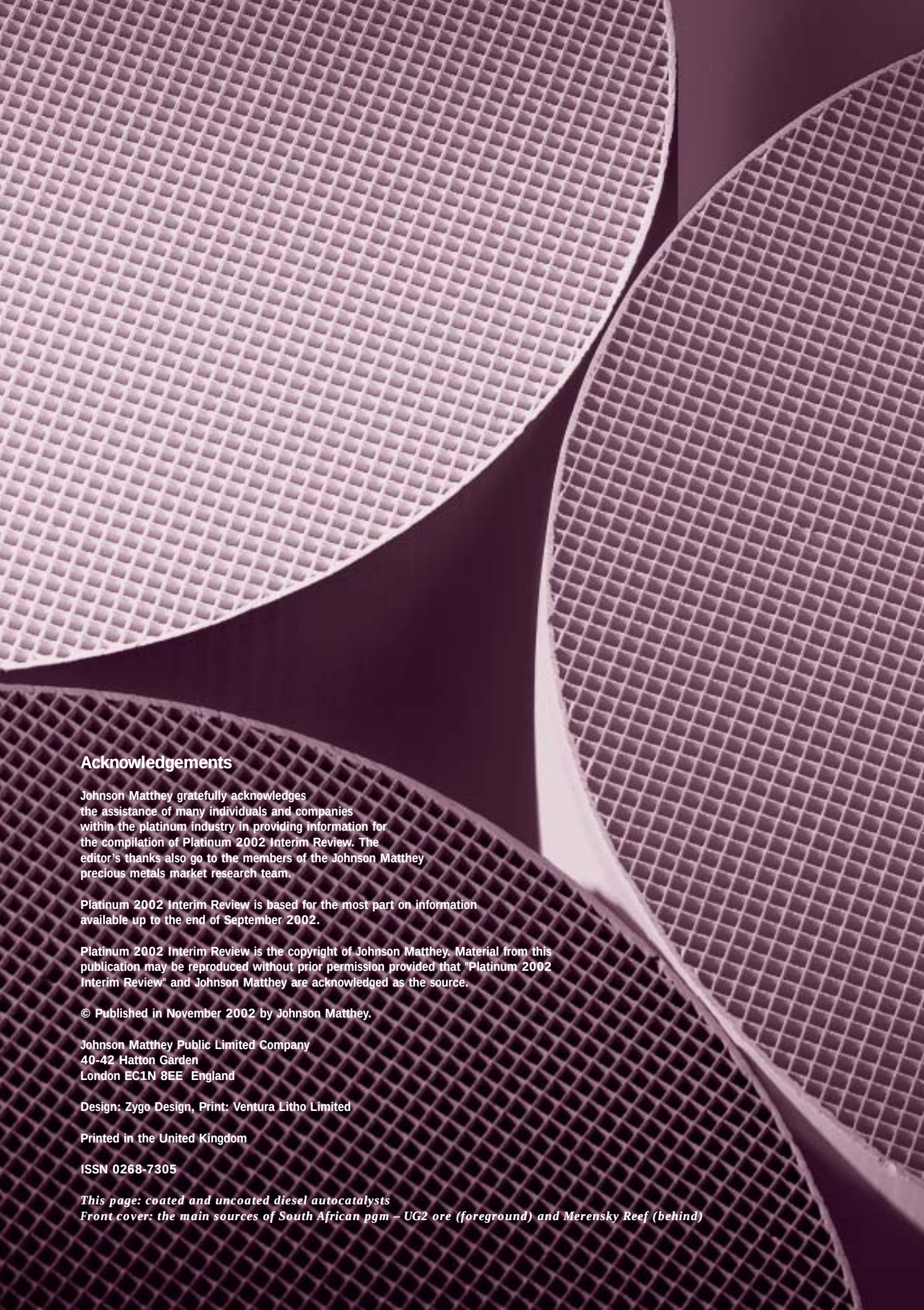
Platinum 2002

Johnson Matthey

Interim Review



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This page: coated and uncoated diesel autocatalysts
Front cover: the main sources of South African pgm – UG2 ore (foreground) and Merensky Reef (behind)

Platinum 2002

edited by Tom Kendall

Johnson Matthey

Interim Review

Summary and Outlook

Platinum

- Demand for platinum is forecast to climb to a new high of 6.37 million oz in 2002.
- Consumption of platinum in autocatalysts will grow but purchases of the metal will be largely unchanged at 2.52 million oz as some US manufacturers utilise inventories.
- Jewellery demand is expected to rebound to 2.78 million oz, although the rise will nearly all be due to continued growth in the Chinese market.
- Industrial demand will be stable at 1.55 million oz. Purchases from the glass industry will recede from the high level of 2001 but use of platinum-based catalysts by the chemical industry will increase.
- Supplies of platinum are forecast to grow marginally to 5.88 million oz. Shipments from Russia will fall towards the level of mine production, offsetting a substantial rise in South African output.
- With the market in deficit for the fourth year in a row, the platinum price strengthened from $455 in January to $560 by the end of September.

Platinum Supply and Demand
'000 oz

	2001	2002
Supply		
South Africa	4,100	4,440
Russia	1,300	950
North America	340	355
Others	110	135
Total Supply	**5,850**	**5,880**
Demand		
Autocatalyst: gross	2,530	2,520
recovery	(530)	(570)
Jewellery	2,550	2,780
Industrial	1,550	1,550
Investment	90	90
Total Demand	**6,190**	**6,370**
Movements in Stocks	(340)	(490)

Overview

Demand for platinum is forecast to climb by 2.9 per cent to 6.37 million oz in 2002. Chinese purchases of platinum for jewellery will rise strongly for the seventh year in succession. The use of platinum in autocatalysts continues to grow but purchases of metal by the auto industry will be stable owing to the use of stocks. Demand from industrial users will be broadly similar to 2001.

Supplies of platinum are expected to grow only marginally to 5.88 million oz. Increasing South African output will be offset by a large drop in Russian sales. Consequently, the deficit in the platinum market is expected to widen to 490,000 oz. This deficit has been evident in tightening physical liquidity and the strengthening platinum price. Substantial volumes of metal were withdrawn from market stocks held in Switzerland during the first nine months of 2002 to help satisfy demand.

Autocatalyst demand for platinum is forecast to remain stable at 2.52 million oz in 2002, despite growth in underlying use of the metal. This paradox is accounted for by the significant use of inventories of platinum by some US auto manufacturers, who had built up stocks over the previous two years.

In all the major vehicle manufacturing regions, the shift from palladium towards greater use of platinum in autocatalyst systems has noticeably increased consumption of the latter metal this year. In Europe, platinum demand has been boosted by the continued growth in sales of diesel cars (which only utilise platinum-based autocatalysts) at the expense of gasoline vehicles. Platinum consumption in 2002 will also increase as auto companies certify new models to tighter emissions standards.

After falling in 2001, **jewellery** demand for platinum is expected to rebound by 230,000 oz to 2.78 million oz in 2002. Chinese demand will again experience double-digit growth and is forecast to reach 1.47 million oz. In contrast, Japanese retail sales of platinum jewellery declined between January and September.

Demand for platinum in **industrial** applications is forecast to be stable at 1.55 million oz. New chemical manufacturing capacity in the Middle East and Asia will generate a modest increase in demand for platinum-based process catalysts, but glass industry demand for platinum will slip as expansions are proceeding at a lower rate than in 2001. Electrical demand is also expected to be flat – the more widespread use of hard disks containing platinum in non-computing applications will be offset by weak computer sales.

Purchases of platinum **investment** products were relatively strong in the first

quarter of the year but sales have fallen back as the price has risen. Overall investment demand, at 90,000 oz, is expected to be the same as 2001.

Supplies are forecast to reach 5.88 million oz this year, a marginal increase of 30,000 oz over 2001. New projects and expansions of existing operations in South Africa will deliver substantially higher volumes of metal in 2002. Russian sales, on the other hand, are likely to drop close to the level of production.

The liquidation of long futures positions in January caused the platinum **price** to slide from $481 to $455. Since then the price has strengthened in several rallies, each successive rise peaking higher than the last. Rising supplies have not been able to keep pace with the growth in physical demand and market liquidity has tightened. By the end of September platinum was trading close to $560 and strengthened further in early October.

Supply

Sales of platinum from **South Africa** are forecast to reach a new high of 4.44 million oz in 2002. The largest increase in output will come from Anglo Platinum but production from all the established producers will grow.

Anglo Platinum plans to supply 2.25 million oz of platinum this year, an increase of approximately 140,000 oz. Production will be lower than the company's initial 2002 forecast due to delays to the ramp up of production at the Bafokeng Rasimone Platinum Mine (BRPM) and a decline in head grade at PPRust due to a low-grade intrusion. On the positive side, output from the Waterval expansion has been building rapidly following commissioning of a new concentrator in February. The new Modikwa mine, a joint venture with African Rainbow Minerals, will also make its first contribution to refined production this year, although output will be small.

Impala's operations have benefited from increased concentrator throughput, due in part to processing of an ore stockpile, while Lonmin is substantially expanding its mining and milling operations. Northam's production will recover from the dip in 2001, caused by a prolonged strike, and output from Aquarius's Kroondal mine is nearing planned capacity.

We predict that supplies from **Russia** in 2002 will fall to 950,000 oz, significantly down from 2001 when 1.3 million oz of metal were sold. Central government stocks of platinum are now relatively low, so shipments are expected to be close to the level of production at Norilsk Nickel and the alluvial operations in the Far East of Russia. Although Norilsk is keen to sign contracts for the majority of its palladium production, the company has said that it will continue to sell platinum on the spot market.

Supplies of platinum from **North America** are forecast to rise by 15,000 oz in 2002, primarily due to increasing pgm output from Stillwater Mining Company. Output is also increasing in Zimbabwe: Zimplats will get a maiden contribution from its Ngezi mine this year, while an expansion programme at Mimosa is underway.

Firm platinum prices continue to stimulate a high level of exploration, both in South Africa and elsewhere. However, the drop in the palladium price from over $1,000 in January 2001 to $320 by June 2002 has weakened the economics of most projects outside Southern Africa as the great majority of them are significantly richer in palladium than platinum.

Demand

Autocatalyst demand for platinum is forecast to be virtually unchanged at 2.52 million oz this year, despite continued growth in underlying consumption. North American purchases are expected to fall by 40 per cent to 480,000 oz as some auto companies reduce their metal inventories. US car manufacturers are having to manage heavy pressure on their balance sheets, not least from healthcare and pension liabilities, while at the same time consumer finance deals and cash rebates on car sales have cut profit margins. The already strong focus on cost reduction has therefore intensified. After making net additions to their platinum inventories in previous years, several US auto makers have been using stocks to supplement purchases during 2002.

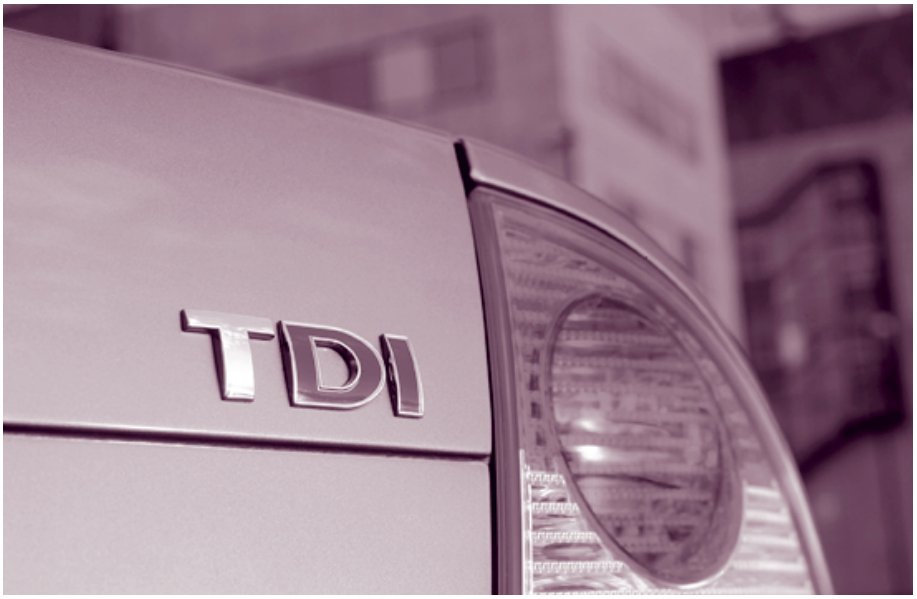
The greater use of platinum-based catalysts for gasoline vehicles, at the expense of palladium dominant systems, will have a positive impact on platinum consumption this year. Technical programmes that were initiated in 2000 and 2001, when the palladium price was at

its highest, have resulted in increased platinum consumption in all major manufacturing regions.

European autocatalyst platinum demand is forecast to expand by 185,000 oz to 1.25 million oz. Growing production of diesel cars will again be an important factor as they only utilise platinum-based catalytic converters. Two out of every five cars sold in western Europe are now diesels and use of platinum in diesel autocatalysts will account for almost 900,000 oz of demand in 2002.

Tighter vehicle emissions regulations will be introduced in Europe in 2005, and new standards are also likely to come into force in Japan the same year. These will necessitate higher pgm loadings on some models. Manufacturers in Europe are already producing cars that comply with the tougher standards because tax incentives in several countries make them attractive to consumers. Japanese manufacturers are also producing new models that will meet proposed new emission limits. The improved environmental credentials of these vehicles give auto companies a significant marketing advantage in Japan.

After falling for two consecutive years,



Supply and Demand for Platinum 1998-2002

Million oz

jewellery demand for platinum is forecast to rebound by 9 per cent in 2002 to 2.78 million oz. The Chinese jewellery industry will again purchase record volumes of platinum – demand is expected to rise 13 per cent to 1.47 million oz this year.

There have been no signs that the rise in the platinum price over the first nine months of this year affected the growth in the manufacture of platinum jewellery in China. However, in several other markets, the price has been something of a deterrent to both the trade and consumers.

In addition, the poor state of the economy in Japan, and weak consumer confidence in the USA and continental Europe have held back retail sales of platinum jewellery in these regions. Japanese demand, however, will rise to 735,000 oz because fabricators have been liquidating lower volumes of stock than in 2001. The European market, with the exception of the UK, was subdued during the first nine months of 2002 and demand is expected to be flat at 170,000 oz.

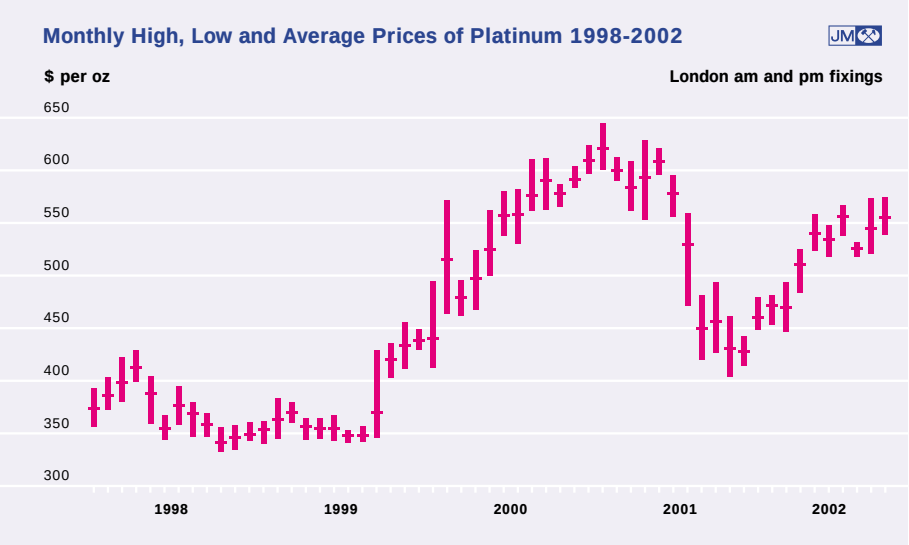
Industrial demand for platinum is predicted to be unchanged from 2001 this year at 1.55 million oz. Overall electrical demand will be stable at 385,000 oz – the spread of hard disks to non-computing applications will be tempered by weaker sales of personal computers and increasing storage capacity (which reduces the average number of disks required per product). Thermocouple demand has been hit by the slump in the semiconductor industry – although semiconductor orders have shown tentative signs of picking up, overcapacity remains substantial and investment in manufacturing equipment will be low in 2002.

Use of platinum-based catalysts by the chemical industry is forecast to rise 5 per cent to 300,000 oz. Growth in demand will stem from increases in paraxylene manufacturing capacity in the Middle East and Asia, plus a small increase in nitric acid capacity in Asia. Glass industry demand for platinum will fall from the high level of 2001 as the rate of capacity expansion in Asia has slowed. However, substantial investment in LCD glass manufacturing facilities in China and South Korea continues.

Dental demand is expected to be static after increasing by 20 per cent in 2001, when many dentists switched from palladium to high-gold alloys containing 10 per cent platinum. The fall in the palladium price has not so far encouraged a significant reversal of the substitution, many dental practices having made considerable investment in alternative materials.

Net **investment** demand for platinum is expected to be similar to 2001. Strong

purchases were made by Japanese investors in the first few months of the year when the platinum price was relatively low. Demand fell from April onwards as the price rallied, although a sharp rise in the value of the yen versus the dollar plus a slide in the gold price boosted Japanese purchases of precious metals in July.



Outlook

The economic outlook in most major regions of platinum consumption is uncertain. US consumer confidence is fragile in light of the stock market slump, corporate accounting scandals and political tensions. Countries in western Europe that have adopted the euro have found their ability to stimulate domestic demand constrained by the fact that interest rates are set centrally. In Japan, the huge level of debt overhanging the banking sector means that the economy may get worse before it gets better.

Although this global economic uncertainty places a caveat on any forecast, the fundamentals for platinum demand are good and we remain positive about the outlook for demand in 2003.

Growth in the autocatalyst sector is likely to be led by a rebound in North American purchases. Following the recent erosion of platinum inventories in the USA, demand next year will be more closely aligned with the underlying use of platinum in autocatalysts. However, while sales of light vehicles have held up remarkably well during the first nine months of 2002, there is unease about the resilience of the market. Preliminary data for the first two weeks of October suggested that sales might be starting to weaken, and figures over the remainder of the year will be closely watched.

European autocatalyst demand for platinum is forecast to grow solidly in 2003; diesels will continue to take market share from gasoline cars and an increasing number of vehicles will be certified to the tighter Euro Stage IV standards. The move away from palladium to platinum-based autocatalysts, however, will have less of an impact in 2003 – the fall in the price of the former metal has removed much of the rationale for further switching.

Jewellery demand in Europe, Japan and North America will remain sensitive to the sense of financial well-being felt by consumers. Retailers in the USA in particular are hoping for a strong Christmas season but are unwilling to make predictions about 2003.

Japanese retail sales of all jewellery will fall in 2002 and it is too early to speculate about 2003. That said, there will be less old jewellery stock available for recycling and this should provide another modest boost to platinum demand next year. Platinum also retains a strong hold on the Japanese bridal market and consumers' preference for white metal jewellery continues to grow, white gold having taken market share from yellow gold this year.

Chinese jewellery demand has the potential to grow further in 2003 – platinum jewellery is now well established in most major cities and the number of sales outlets continues to expand.

Profit margins throughout the Chinese platinum jewellery industry, however, are small. If platinum prices continue to climb during the remainder of 2002 and into 2003, margins will be further squeezed unless retail prices are also increased. The extent to which Chinese retail sales are independent of price may then start to be tested.

In the industrial sector, if sales of personal computers recover as manufacturers predict in 2003 then we would expect to see a rise in platinum demand for hard disks. However, as storage capacity increases, fewer disks are required per drive and this will moderate growth in metal demand. Demand for platinum-based catalysts for petroleum cracking and chemical processes is forecast to be largely stable next year.

Platinum supplies from South Africa are expected to increase substantially again in 2003 but the production targets are challenging. Russian sales are likely to continue at or close to the level of production, as we believe that the central government inventories are at relatively low levels.

After a substantial net outflow of platinum from Switzerland in 2002, it is unlikely that the heavy rate of withdrawals from market stocks can continue into 2003. The physical market, therefore, should remain tight and we expect platinum to trade between $550 and $650 during the next six months. The possibility of further squeezes on short-term liquidity and lease rates is high, which could result in short sharp jumps in the spot price above our forecast upper level.

Palladium

- Palladium demand is forecast to slump by almost 2 million oz to 4.88 million oz in 2002, slipping below the level of mine production.
- Heavy use of inventories by some US auto companies will greatly reduce the amount of palladium purchased for autocatalyst manufacture.
- Electronic component fabricators have continued to run down their palladium stocks at the expense of purchases, albeit at a reduced rate. Nickel has taken further market share in multi-layer ceramic capacitors.
- Total supplies of palladium are expected to plunge to 4.91 million oz. Russian shipments are forecast to drop by 63 per cent to 1.6 million oz in response to the weak market.
- South African supplies of palladium will rise to 2.19 million oz, while expansions in North America will see sales climb to 970,000 oz.
- The palladium price subsided from $440 at the start of 2002 to $320 by June, but stabilised close to this level through to the end of September.

Palladium Supply and Demand
'000 oz

	2001	2002
Supply		
South Africa	2,010	2,190
Russia	4,340	1,600
North America	830	970
Others	120	150
Total Supply	**7,300**	**4,910**
Demand		
Autocatalyst: gross	5,090	3,160
recovery	(280)	(370)
Dental	720	730
Electronics	710	750
Other	550	610
Total Demand	**6,790**	**4,880**
Movements in Stocks	510	30

Overview

Palladium demand is forecast to plunge by 28 per cent to 4.88 million oz in 2002 – the first time demand has been below 5 million oz since 1994. Some auto companies in the USA have been working off inventories of metal, while electronic component manufacturers have also drawn heavily on stocks. Supply is also expected to slump, falling by over 2.3 million oz to 4.91 million oz as Russia continues to stay out of the spot market.

The net result should be a weak, but finely balanced market. Although demand is expected to be only slightly below supply from primary sources, sales of over 300,000 oz of palladium by the US Defense National Stockpile Center during the first 10 months of the year have added to the surplus.

The palladium spot price retreated from $440 in January to $320 in June and has stabilised around that level since. The slide was partly in response to announcements by Ford that it had written down $1 billion of precious metal inventories and forward contracts.

The **autocatalyst** sector has seen a substantial fall in palladium demand. The big three US-owned car companies accrued substantial stocks of palladium between the late 1990s and 2001. Concerns about supply disruptions and rising and volatile prices have since receded, and we estimate that they have satisfied a large proportion of their production needs from inventories this year. In addition, some metal has been sold back to the market. Net autocatalyst demand, therefore, is forecast to fall to 3.16 million oz, down from over 5 million oz in 2001.

In the **electronics** sector, component manufacturers have been running down large palladium stocks, which they accumulated towards the end of 2000. The use of inventories, however, has declined compared to 2001 and purchases should recover moderately to 750,000 oz.

Norilsk Nickel has continued to abstain from the palladium spot market and, with demand weak, Russian **supplies** are forecast to drop by 63 per cent to 1.6 million oz. Growing South African output of palladium will exceed Russian shipments this year. North American output is also forecast to rise, reaching 970,000 oz.

The reduction in Russian shipments of palladium has helped to prevent the **price** from dropping much below $320 since June 2002, in the face of weak demand.

Supply

Russia withdrew from the palladium spot market in August 2001. This, plus the lack of demand from the US auto industry, is expected to result in a collapse in Russian sales to only 1.6 million oz in 2002.

Norilsk Nickel wants to sell the bulk of its palladium production via contracts negotiated directly with consumers and does not envisage returning to the spot market in 2003. The company recently announced palladium supply contracts with both Mitsubishi and General Motors.

South African supplies of palladium are forecast to rise by 180,000 oz to 2.19 million oz in 2002, reflecting the expansions of platinum output achieved by all the established producers this year. In **North America**, Stillwater Mining Company and North American Palladium will produce greater volumes of palladium, and total supplies will grow to 970,000 oz.

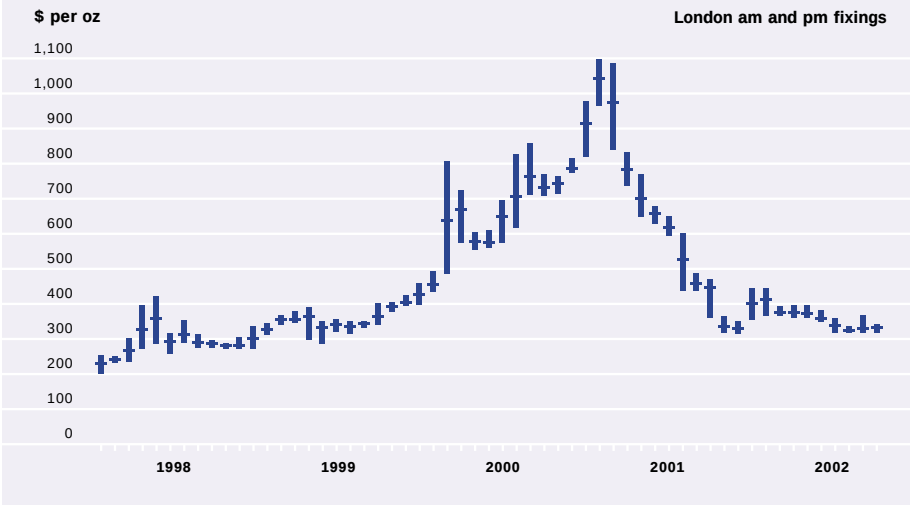
Demand

Purchases of palladium for **autocatalyst** manufacture are forecast to plunge to 3.16 million oz in 2002. This will be a considerable distance below the actual level of consumption due to the use of inventories by some US auto manufacturers in lieu of metal purchases.

From the mid-1990s through to early 2001, auto companies' demand for palladium rose rapidly and supplies from Russia were disrupted. However, as the price climbed towards $1,000, car companies began to thrift palladium and several moved towards greater use of platinum-based catalyst systems. These factors, combined with the need to minimise costs, have led some US auto makers to make substantial inroads into their palladium stocks this year, reducing purchases of metal.

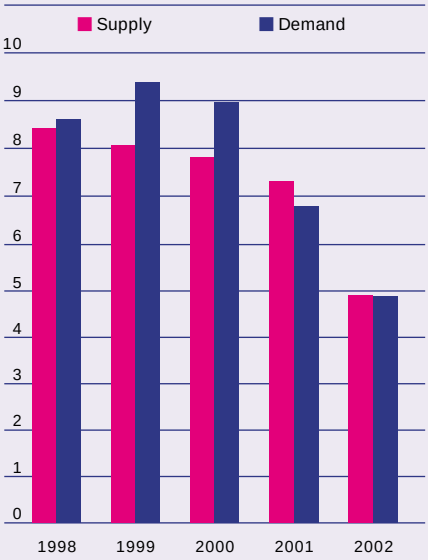
In addition, palladium thrifting programmes and its partial substitution by platinum are expected to reduce the underlying use of palladium in autocatalyst manufacture in the USA and Europe. European consumption has weakened as gasoline powered cars have continued to lose market share to diesels. The latter do not use catalysts containing palladium.

Monthly High, Low and Average Prices of Palladium 1998-2002



Supply and Demand for Palladium 1998-2002

Million oz



The upturn in the **electronics** industry has not materialised as strongly as had been expected, and component and metal stocks will again undermine palladium demand this year. The substitution of palladium by nickel in multi-layer ceramic capacitors (MLCC) has also continued and this trend is not likely to be reversed. The use of stocks, however, will be lower than in 2001 and so purchases of metal should increase modestly to 750,000 oz.

There has not as yet been any significant move back to palladium-based alloys in the **dental** sector this year, after previous price rises and volatility hastened the move towards alternatives.

Outlook

Overall, we forecast a moderate recovery in palladium demand in 2003 as inventories of metal held by manufacturers have been significantly depleted this year. Net demand, however, is expected to remain significantly below that of 2001.

Thrifting programmes will continue to have an impact on palladium consumption in autocatalysts, and diesel cars will take further market share from gasoline vehicles in Europe. The move away from palladium-rich systems to platinum-based autocatalysts on gasoline vehicles will continue to be felt, as programmes that are already at an advanced stage are unlikely to be reversed. However, the substantial price differential that currently exists between palladium and platinum has weakened the rationale for further switching to the latter.

Given the size of past inventories, further depletion of palladium stocks by US auto companies is possible in 2003. However, we believe that this is unlikely to be on the scale of this year and we expect North American demand to improve.

The majority of component inventories and palladium stocks should be largely eliminated from the electronics industry by the end of the year. As a result we expect to see small growth in net demand for palladium in 2003. However, the substitution of palladium by nickel in MLCC is continuing.

In August this year, the Russian Finance Minister, Alexei Kudrin, said that sales of precious metals and gemstones from central stocks would be increased in 2003 to help meet the country's debt repayments. These are scheduled to exceed $17 billion next year. There is potential for a significant increase in Russian sales of palladium, therefore, and this plus the continued weakness of demand will continue to act as a buffer to the spot price in the short-term. We expect palladium to trade between $250 and $330 during the next six months.

Supplies, Mining and Exploration

South Africa

Supplies of platinum from South Africa are expected to grow by 8 per cent to reach 4.44 million oz in 2002. Expansion projects will contribute significant quantities of metal this year, while output is also predicted to increase at several established operations. Production of palladium is forecast to rise to 2.19 million oz, in line with the growth in platinum, while rhodium sales will increase to 483,000 oz.

South African platinum output of 4.44 million oz in 2002 will be a new record. While expansions at Anglo Platinum will account for the majority of the increase, all of the other established producers will also expand production relative to 2001.

In August 2002, exploration licences were issued by the South African government for a number of properties on the Eastern Bushveld, the rights to which were formerly held by Anglo Platinum.

Anglo Platinum

Refined platinum output increased by 4.3 per cent at Anglo Platinum during the first half of 2002, reaching 1.043 million oz. Palladium production increased to 515,000 oz during the same period but rhodium production dropped to 82,500 oz due to a build up of stocks in the refining pipeline.

The Amandelbult section performed particularly strongly during the first half of the year as the tonnage milled, head grades and efficiencies all increased. However, this was partly offset by a decline in output at PPRust, where the grade fell sharply during the mining of a lower-grade intrusion in the South Pit ore body. At Waterval a new 400,000 tonnes per month concentrator was commissioned in February and throughput increased rapidly, although grades have been lower than initially planned. Milled tonnage increased significantly at BRPM but the grade fell, largely due to the processing of low-grade near surface ore. Underground development has been hampered by poor geological conditions at one of the shafts.

Anglo Platinum has reduced its full year production target by 100,000 oz to 2.25 million oz platinum. This, however, will still represent a substantial increase on 2001. This is to be achieved primarily through the continued growth in production from the Waterval and BRPM operations, plus a small initial contribution from Modikwa. Anglo Platinum will release an update on its plans to expand platinum output to 3.5 million oz by mid-2006 before the end of this year.

Impala Platinum

Platinum production from the Impala lease area climbed to 518,000 oz during the first half of 2002, up from 486,000 oz over the same period the previous year. The performance of the upgraded UG2 concentrator circuit improved and mill throughput was boosted by 2.5 per cent. The company is now considering further investment in its processing infrastructure to improve recoveries for Merensky Reef and to increase UG2 processing capacity. This would enable annual production to exceed 1.1 million oz of platinum. The company is also examining the economic viability of retreating old UG2 tailings.

Production at the re-opened Crocodile River mine, which Impala controls via its 83 per cent stake in Barplats, has risen during 2002. The operation produced around 39,000 oz of platinum during the financial year to the end of June 2002. Underground mining has now started and recoveries have improved to over 70 per cent as the proportion of unoxidised ore has increased. Difficulties with recommissioning the concentrator have been overcome, and a dense media separation plant to treat the underground ore is due to be commissioned in 2003.

In August 2002 Impala announced that the Marula Platinum project (formerly Winnaarshoek) on the Eastern Bushveld would be developed using a phased approach to reduce project risk. Phase 1 will involve mining UG2 at a rate of 142,000 tonnes per month to yield 103,000 oz of platinum per annum. Mining is scheduled to start in late 2003 or early 2004, with full production expected in 2005.

In August, Impala announced the acquisition of an additional 15 per cent shareholding in ZCE Platinum, owner of Mimosa, taking its stake to 50 per cent. Impala also increased its holding in Zimplats to 36 per cent and has pre-emptive rights covering an additional 15 per cent. Impala also owns a 30 per cent share directly in Makwiro Platinum, the Zimplats subsidiary that operates the Ngezi mine and Selous Metallurgical Complex.

Lonmin

Refined platinum output at Lonmin is expected to exceed 750,000 oz this year. During the financial year to end March 2002

PGM Supplies: South Africa
'000 oz

	2001	2002
Platinum	4,100	4,440
Palladium	2,010	2,190
Rhodium	452	483

the company produced a total of 1.36 million oz of pgm, a new record.

Lonmin is aiming to reach an annual production rate of 870,000 oz of platinum in 2003 after having accelerated its expansion programmes. The new Karee "B" concentrator has performed well, and two additional concentrator streams were scheduled to be commissioned by the end of October 2002. These will initially process ore from new open pits and, at a later date, will process ore from the expanded underground operations. In addition, the company's new smelter successfully completed commissioning during the first quarter of the year.

Northam Platinum

The tonnage of ore milled by Northam Platinum fell slightly to 1.03 million tonnes during the first half of 2002, however, the volume of ore processed in the second half should be substantially higher than in the same period of last year, when a strike resulted in the loss of 32 days of underground production. Overall, platinum production this year is expected to rise by up to 15 per cent compared with 2001.

Output is expected to grow again next year as the company's accelerated underground development programme leads to improved Merensky Reef face availability.

Aquarius Platinum

Kroondal Platinum is on target to produce over 215,000 oz of pgm in 2002, equivalent to 90 per cent of planned capacity. Output over the first nine months of the year reached 101,000 oz of platinum as the ramp up in mining and processing continued, following a concentrator expansion that was commissioned in 2001.

At the Marikana project, 8 km to the east of Kroondal, the first feed of ore to the mills is expected in mid-November 2002, several weeks ahead of schedule. The first concentrate should then be delivered to Impala for refining in January 2003, with full production of around 155,000 oz per annum by the end of the year.

The feasibility study of the Everest South project on the Eastern Bushveld is scheduled to be completed in December 2002. A 300 tonne bulk sample has been mined and is being processed, and mining is expected to begin in 2004.

SouthernEra

The first phase of mine and mill construction at Messina Platinum has continued throughout 2002, with small amounts of pgm produced from SouthernEra's Advanced Production Initiative. The main shaft at Voorspoed was commissioned in August, followed by the concentrator in September. Refined pgm output this year will be small but will build steadily throughout 2003 and 2004.

In August 2002, SouthernEra announced that it had completed a bankable feasibility study for its Messina Phase 2 project on the Doornvlei lease area (12 km east of the Voorspoed operation). The feasibility study was based on a total milling rate of 120,000 tonnes per month of a combination of Merensky Reef and UG2, yielding 173,000 oz of pgm plus gold. Also in August, the South African government awarded prospecting rights to the Dwaalkop properties to a 50:50 joint venture between SouthernEra and Mvelaphanda Resources. The properties are located between the two phases of the Messina project.

Russia

Sales of platinum by Russia are forecast to drop below 1 million oz in 2002, more closely aligned with mine production. Shipments of palladium are forecast to plunge by over 60 per cent to just 1.6 million oz. Norilsk Nickel has maintained its pledge not to sell palladium on the spot market.

Platinum supplies from Russia in 2002 are forecast to fall to 950,000 oz. Sales of platinum from Norilsk Nickel were boosted in 2001 by metal that had been held as loan collateral by a Russian bank. This year, however, Norilsk's platinum shipments are likely to be closer to the level of production. Output of platinum from the alluvial producers at Koryak and Kondyor in the Far East of Russia is expected to be stable.

Russian sales of palladium are forecast to fall dramatically this year to 1.6 million oz, down from 4.34 million oz in 2001. Norilsk suspended spot sales of palladium in August 2001 in an effort to support the rapidly declining price and in response to faltering demand. The company has continued to abstain from spot market sales throughout 2002 to date but continues to ship some metal under existing supply contracts.

Swiss trade statistics show that around 410,000 oz of palladium were imported from Russia between January and the end of April, but since then very little metal has been shipped into Zurich. Russia also shipped around 537,000 oz to the USA during the first seven months of the year.

In September, Norilsk stated that it had repaid a loan from the Ministry of Finance dating from 1994. While details were not released, the repayment is understood to have been made by delivering substantial

PGM Supplies: Russia
'000 oz

	2001	2002
Platinum	1,300	950
Palladium	4,340	1,600
Rhodium	125	65

volumes of palladium to the state stockpile (Gokhran), perhaps as much as six months' output.

Norilsk intends to sell the majority of its future palladium production under supply contracts negotiated directly with consumers, via its London-based subsidiary Norimet. Earlier this year, Norimet gained the right to market all of Norilsk's palladium output from the state pgm export agency Almaz. By the end of September, Norimet had secured supply contracts with Mitsubishi and General Motors, and said that negotiations with other major consumers were continuing. The volumes and duration of the contracts were not disclosed.

Despite the large reduction in palladium sales this year, Norilsk Nickel's cash flow will be supported by firm nickel prices and output. The company, however, reduced its capital investment budget for 2002 from $400 million to $265 million. Norilsk intends to make public its long-term production and marketing strategy before the end of the year.

North America

Stillwater Mining and North American Palladium will both substantially increase pgm production this year. Total North American platinum shipments are forecast to rise 4.4 per cent to 355,000 oz, while palladium output is expected to climb by almost 17 per cent to 970,000 oz.

Stillwater Mining Company produced 331,000 oz of platinum and palladium during the first half of 2002 versus 247,000 oz during the first half of 2001. Palladium output reached 255,000 oz and platinum production totalled 76,000 oz.

Milled tonnage increased substantially at the Stillwater Mine but this was partly offset by a decline in grade as lower-grade sections of the ore body were mined. The ramp up of production at the new East Boulder mine continued, yielding 54,000 oz of platinum plus palladium during the first six months of 2002.

The company's target production for the full year has been reduced from 680,000 oz to 640,000 oz pgm because of a labour dispute and delays in infrastructure development. This has required the company to renegotiate some of its financial covenants with its lenders.

North American Palladium commissioned a new 15,000 tonnes per day mill and concentrator in June 2001 and this has increased production capacity substantially. The operation milled 3.7 million tonnes of ore during the first nine months of 2002 compared to 1.5 million tonnes during the same period the previous year. As a result, palladium output jumped to 167,000 oz.

Production for the full year is expected to exceed 200,000 oz, despite the company having to take its primary crusher out of service for several weeks in September for unexpected repairs.

Production of by-product pgm from the nickel operations of Inco and Falconbridge is expected to be close to 2001 levels. Inco intends to produce 425,000 oz of pgm in 2002, including production from purchased materials. Output of pgm from Falconbridge is forecast to be broadly in line with 2001, despite an extended maintenance and vacation shutdown of its smelter during the summer.

Zimbabwe

Expansion of the Zimbabwean pgm industry began in earnest during 2002. Construction of a new plant at Mimosa has almost been completed and sinking of a new shaft is proceeding, while Zimplats' Ngezi mine reached its target milling rate by the end of June. Total pgm production in Zimbabwe is forecast to rise from less then 30,000 oz in 2001 to 120,000 oz in 2002.

Mimosa produced a total of 22,000 oz of pgm (12,000 oz platinum) during the first nine months of 2002, little changed from 2001. However, the planned expansion from an annual rate of 15,000 oz platinum to 65,000 oz platinum is underway. A new crushing circuit was commissioned in the third quarter of 2002 and the concentrator is due to be commissioned before the end of the year. Mill throughput is scheduled to reach the planned level of 3,100 tonnes per day in March next year, with recoveries rising through to October 2003.

Ngezi produced its first pgm during the first half of 2002, milling 662,000 tonnes of ore to produce concentrate and matte containing 43,000 oz of pgm. The processing plant was operating at its design capacity by the end of June 2002 and a further 346,000 tonnes of ore were milled in July and August.

The company is currently conducting trial underground mining at Ngezi, which has the potential to offer cost savings compared with deeper portions of the planned open pit. Trial underground mining began in September 2002 and has been authorised to produce a total of 100,000 tonnes of ore through to June 2003. This will enable Zimplats to assess ground stability and develop grade control methods, and to complete a bankable feasibility study.

PGM Supplies: North America
'000 oz

	2001	2002
Platinum	340	355
Palladium	830	970
Rhodium	23	26

Platinum

Autocatalyst

The use of platinum in autocatalysts will continue to rise in 2002. Sales of metal to auto makers, however, are forecast to remain virtually unchanged at 2.52 million oz as US auto manufacturers reduce their pgm inventories. European autocatalyst demand for platinum will rise strongly as the growth in diesel car sales continues.

Europe

Sales of platinum to auto makers in Europe are forecast to rise to 1.25 million oz in 2002, an impressive increase of 17 per cent on 2001. The strength of demand has been built on growing sales of diesel powered cars, which utilise platinum-based autocatalysts; the move away from palladium-rich catalysts to those based on platinum on some gasoline models; and tightening emissions standards.

Data to the end of September suggest that the western European car market will contract by 3 per cent in 2002. Diesel car sales, however, continue to rise and take market share from gasoline vehicles. The number of diesels sold is forecast to increase by up to 7 per cent to reach 5.68 million cars this year, accounting for almost 40 per cent of total passenger vehicle sales in western Europe. Strong growth in European diesel car sales is forecast to continue in 2003 and this should support a further increase in platinum demand.

Sales of gasoline powered cars have been more susceptible to the lack of vigour in the economies of continental Europe. Gasoline vehicle sales and production across western Europe are both expected to drop by up to 9 per cent in 2002. The impact on platinum demand, however, will partly be compensated for by the move away from palladium in some autocatalysts. Several auto manufacturers implemented programmes in 2000 and 2001 to minimise their use of palladium after its price soared. The effects of these strategies have been apparent in increased platinum demand in 2002.

Platinum demand is also benefiting from the increasingly stringent European emissions legislation. All light vehicles manufactured in Europe are now certified to Euro Stage III standards and new models are increasingly certified to Euro Stage IV standards. Although these will not apply formally until 2005, some countries already offer financial incentives (such as reduced sales tax) for Euro IV compliant vehicles. The Euro IV regulations cut permissible emission levels for most pollutants by at least 50 per cent for both gasoline and diesel powered cars, and may necessitate higher catalyst pgm loadings.

Japan

Due in part to the adoption of higher emission standards by Japanese auto makers, 2002 will be the fourth year in succession in which Japanese autocatalyst platinum demand rises by a double-digit figure. Demand this year is expected to total 410,000 oz, a 19 per cent increase from 2001.

Japanese governmental bodies have proposed new emission standards for passenger cars but these have not yet been written into legislation. However, in anticipation of tighter regulations in future, auto companies have increased pgm catalyst loadings on new models to enable emission reductions. This is an important vehicle selling point in Japan.

As elsewhere, a greater proportion of Japanese gasoline cars will be fitted with platinum-rich rather than palladium-based catalyst systems in 2002. This shift is in response to the recent high price of palladium and will boost platinum demand. Production of light vehicles in Japan is expected to be up marginally compared to 2001, with strong exports offsetting a fall in domestic sales.

Platinum Demand: Autocatalyst
'000 oz

	2001	2002
Europe	1,065	1,250
Japan	345	410
North America	795	480
Rest of the World	325	380
Total	**2,530**	**2,520**
Autocatalyst recovery	**(530)**	**(570)**

North America

GDP growth in the USA was disappointing in the second and third quarters of 2002 but car sales have held up remarkably well. This is primarily due to the zero per cent interest credit deals and other financial incentives offered to consumers by the big three US manufacturers. On the production side, auto makers and their dealers entered 2002 with low inventory levels and this spurred a strong increase in manufacturing rates in the first half of the year.

Current estimates for full year sales of light vehicles in the USA (including imports) are for a 3.4 per cent drop to just over 16.5 million cars and light-duty trucks; however, the rebuilding of inventories is expected to see domestic production climb 9 per cent to 12.2 million units.

As light vehicle production rises this

European Demand for Platinum in Autocatalysts 1998-2002

'000 oz

year, the total use of platinum in autocatalysts will also increase. Purchases of metal, however, are forecast to slump 40 per cent to 480,000 oz. Some US auto companies have been making very large reductions in their pgm inventories this year after building stocks between 1998 and 2001. While the main focus has been on running down palladium inventories, platinum holdings have also been eroded.

As in Europe, use of platinum in autocatalysts in the USA has benefited from the move away from palladium-rich systems by some manufacturers. The recent decline in the palladium price, however, has reduced the justification for switching from palladium in favour of platinum. Consequently, the move towards greater use of platinum in autocatalysts is expected to slow.

Rest of the World

Autocatalyst demand for platinum in the Rest of the World is forecast to expand to 380,000 oz, a jump of 17 per cent from 2001. Rapidly expanding car output in Asia will account for much of the growth.

Chinese light vehicle production will surpass the 2 million mark this year, a rise of over 20 per cent. All Chinese cars must comply with Euro Stage I equivalent emission limits and there are incentives for those that meet Euro II standards.

In South Korea, where LEV regulations will come into force in 2003, production will exceed 3 million light vehicles, and strong increases in output will also be seen in India and Malaysia. This rapid growth in Asian production will far outweigh a weakening of sales and production in South America.

Autocatalyst Recovery

An estimated 570,000 oz of platinum will be recovered from recycled autocatalysts in 2002, a gain of 40,000 oz from 2001. A significant proportion of the increase will come from greater collection and processing of spent catalysts in Europe.

High pgm prices in 2000 and early 2001 stimulated awareness of the potential profitability of autocatalyst recovery, and improved collection rates. The European End of Life Vehicle (ELV) recycling directive, which will apply from 2005, is also focusing attention on recycling. In addition, an increasing proportion of the cars currently being scrapped are fitted with catalysts – it was only in 1993 that all new gasoline cars in Europe were equipped with catalytic converters.

Recovery has also increased in the USA, although to a lesser extent as collection rates were already high relative to Europe. The firm platinum price, which averaged just under $524 over the first nine months of 2002, supported the profitability of recovery and recycling businesses, despite the fall in the price of palladium.

Jewellery

Total sales of platinum to jewellery makers are forecast to grow by 9 per cent to reach 2.78 million oz in 2002, led by another year of strong sales in China. Chinese demand is expected to reach 1.47 million oz, up 13 per cent year-on-year, as jewellery consumers continue to view platinum very favourably. In contrast, the weak economy in Japan has dampened jewellery sales. Demand for platinum from fabricators, however, will rise as less old stock is recycled. European demand is expected to be flat, while US demand should rise modestly.

Europe

European demand for platinum in jewellery is forecast to be stable at 170,000 oz in 2002, unchanged from the previous year. The main platinum jewellery markets and manufacturing centres, however, have experienced markedly different fortunes.

The UK will retain its position as the largest European jewellery market for platinum in 2002. Demand for platinum bridal jewellery, which accounts for about 90 per cent of the UK's total platinum jewellery market, is set to grow strongly again. The weight of platinum articles hallmarked by UK assay offices during the first three quarters of the year jumped by 45 per cent to 46,715 oz, including a substantial increase in imported items. At this rate of growth the full-year figure for hallmarked items will rise to over 62,000 oz, of which around 70 per cent will be fabricated in the UK.

The German jewellery market has had a disappointing year to date. The persisting weakness of the economy has dampened consumer spending on luxury goods

Platinum Demand: Jewellery

'000 oz

	2001	2002
Europe	170	170
Japan	710	735
North America	280	310
Rest of the World	1,390	1,565
Total	**2,550**	**2,780**

across the board. The German platinum jewellery market is not as reliant on bridal products as is the case in the UK, and the fashion sector of the market has proved vulnerable to substitution by cheaper white metals such as titanium and steel. German fabricators have been able to increase exports of platinum products to the UK but this rise has not been sufficient to offset the downturn in the domestic market.

In Italy, where the platinum jewellery industry is heavily focused on export markets, there has been a modest increase in fabricator demand. Italian manufacturers have been able to increase sales to Japan, China and the USA but domestic sales have been largely static. The Swiss watch industry is now reflecting the economic weakness felt in key markets in the second half of 2001, the time lag being characteristic of an industry with relatively long manufacturing lead times. Swiss platinum demand is expected to fall this year as sales of watches and other luxury platinum jewellery items weaken.

Japan

Purchases of platinum by the Japanese jewellery industry are expected to rise slightly to 735,000 oz in 2002. Demand will increase, despite the third consecutive year of weakening retail sales of platinum jewellery, because less metal will flow out of inventories compared to 2001. Nevertheless, in the current poor economic climate all companies in the Japanese jewellery manufacturing and retail chain continue to reduce their metal and product stocks as far as possible.

Total retail sales of jewellery in Japan fell below 2001 volumes during the first seven months of 2002, with sales of platinum items on a piece basis down 17 per cent year-on-year. Sales of wedding rings have been least affected, down 2 per cent to the end of July, whereas sales of platinum engagement rings, other women's rings, and most platinum fashion jewellery have dropped substantially. White gold has made further inroads into

platinum's market share at the lower price points but has also taken considerable market share from yellow gold. This illustrates the continuing consumer preference for white metal jewellery, and platinum retains a 25 per cent share of Japan's total jewellery market.

North America

North American jewellery demand for platinum is forecast to improve this year on the back of moderate growth in retail sales. Demand has also benefited to a limited degree from restocking in the first quarter of the year following better than expected sales over the 2001 Christmas season. In total, platinum consumption should recover by 30,000 oz to 310,000 oz. Retailers and consumers, however, lack confidence in the economy. This caution is constraining orders from fabricators, who want to keep inventories to a minimum, and is dampening retail sales.

Firm platinum prices have held back any further penetration of the fashion sector, where manufacturers are using white gold to obtain higher margins while satisfying consumer demand for inexpensive white jewellery. Nevertheless, major retail chains have shown themselves to be keen to stock and promote a broader range of platinum products when key price points can be met.

Rest of the World

The Chinese jewellery market has continued to grow rapidly in 2002 and platinum demand from this industry is forecast to climb 13 per cent to 1.47 million oz.

Sales during the first half of 2002 were exceedingly strong, following the 18 per cent rise in demand in 2001. Retailers reported excellent sales over the Chinese New Year in February and during the week-long Labour Day holiday in May. Early reports from the National Holiday week at the start of October were also very positive. Platinum rings set with small diamonds have become especially popular in both the bridal and fashion sectors. In the major metropolitan areas where platinum jewellery is now well established, product design and branding is becoming increasingly important.

The Chinese jewellery market is extremely competitive at both the fabrication and retail levels. Consumers can easily make price comparisons because jewellery is sold on the basis of weight and precious metal prices plus a margin, rather than being priced on a piece-by-piece basis. As platinum prices rose this year, retailers held back from passing on raw materials costs to their customers until declining margins became unsustainable, at which time retail prices increased. However, product prices this year remain below peak 2001 levels and have not dampened consumers' demand for platinum items.

Other platinum jewellery manufacturing centres in Asia continue to rely very heavily on exports to Japan, the USA and Europe. Any significant upturn in platinum demand for jewellery fabrication, therefore, will depend on a return to stronger economic growth in these highly competitive export markets.

Industrial

Demand for platinum in industrial applications is expected to be 1.55 million oz in 2002,

Platinum Demand: Industrial
'000 oz

	2001	2002
Chemical	285	300
Electrical	385	385
Glass	290	260
Petroleum	130	135
Other	460	470
Total	**1,550**	**1,550**

JM

unchanged from the previous year. Demand for process catalysts from the chemicals industry should rise moderately due to additions to paraxylene manufacturing capacity in the Middle East and Asia. Demand from the Chinese glass industry will fall following the heavy investment in the construction of new plants in 2001, while electrical demand is forecast to be flat.

Consumption of platinum in the chemical industry will total 300,000 oz this year, a 5 per cent increase over 2001. Demand for platinum catalysts for the manufacture of paraxylene is primarily related to the construction of new capacity as metal losses during operation are minor. Plants currently being built in the Middle East and Asia have lifted catalyst demand this year.

The silicones industry, a major consumer of platinum catalysts, has had a subdued 2002 to date, suffering from the weak economic activity in North America and Europe. Overall platinum catalyst demand is expected to be stable this year but there has been a shift in manufacturing capacity from the USA to Europe and Asia.

Demand for platinum gauzes from the nitric acid industry broadly reflects the level of nitrogen fertiliser sales. Sales of fertilisers in the first half of 2002 were affected by the high levels of inventories carried over from 2001 and prices were poor. Demand for platinum from the nitric acid industry is not expected to change significantly in Europe or North America this year but should improve in the Rest of the World as new capacity comes on stream in Asia.

The use of platinum in electrical applications in 2002 is not expected to change from the 2001 total of 385,000 oz. Demand from the hard disk sector is expected to decrease marginally, depressed by weak personal computer sales and the continuing decline in the number of disks required per computer as storage capacity increases. However, these factors will be largely offset by the rising use of hard disks in non-computing applications. The nascent fuel cell industry will consume more platinum in 2002, in line with accelerating development programmes, but volumes remain small.

Demand for high temperature thermocouples that utilise platinum wire will decrease in 2002. Steel production in the USA and western Europe (where use of platinum-based thermocouples is highest) was down by 2 per cent and 3.4 per cent respectively as of the end of August. The semiconductor industry is showing signs of a recovery in sales, but overcapacity remains and orders for manufacturing equipment are expected to be as much as 20 per cent lower than in 2001.

Platinum use in glass production will fall back from last year's high of 290,000 oz to 260,000 oz in 2002. Substantial additions were made to glass manufacturing capacity in Asia in 2001, particularly in China, and the overall rate of capacity expansion will ease in 2002. Investment is continuing as demand for LCD glass in Asia as a whole and for fibreglass in China remains high.

In 2002 demand for platinum from most other industries is forecast to remain at or close to 2001 volumes. The petroleum refining industry will consume marginally more platinum in the form of catalysts this year but no major expansions of reforming capacity are currently under construction.

The consumption of platinum in dental alloys is also expected to be stable – dentists who switched from palladium-based formulations to high-gold alloys that contain platinum have so far shown little inclination to move back to palladium, despite the fall in the price of the latter.

Investment

Net demand for platinum investment products is expected to be positive in 2002, with sales of both large bars in Japan and platinum coins in the USA running at similar levels to 2001. However, as demand is closely tied to the price of platinum, sales weakened as the price rallied from $450 at the start of February to over $560 at the end of September.

Demand for the US Mint's platinum American Eagle coins during the first eight months of 2002 was slightly higher than over the same period in 2001. However, not all of the 2001 proof coins were sold and remelting of these will restrict fresh metal demand to 45,000 oz in 2002.

The price of platinum was under $480 during January and February this year and Japanese investors took advantage of the relative price weakness by purchasing significant quantities of 500 g and 1 kg bars. As the platinum price started to climb from March onwards the volume of purchases waned, although the strengthening of the yen against the dollar in July gave demand a short boost. Net Japanese investment demand for 2002 is forecast to be of the order of 45,000 oz.

Platinum Demand: Investment
'000 oz

	2001	2002
Coins and bars		
Europe	0	0
Japan	5	5
North America	45	45
Rest of the World	0	0
	50	**50**
Large bars in Japan	**40**	**40**
Total	**90**	**90**

JM

Palladium

Autocatalyst

Demand for palladium from the autocatalyst market is forecast to slump to 3.16 million oz in 2002, a drop of 38 per cent compared to 2001. The fall will be largely due to a massive run down in metal stocks by US auto companies, a reversal of the inventory accumulation that took place in the late 1990s. Demand will also be hit by efforts to thrift palladium loadings and by the move towards greater use of platinum-based autocatalysts on gasoline cars. These are consequences of the very high and volatile palladium prices of 2000 and early 2001.

Europe

European autocatalyst demand for palladium is expected to drop by 18 per cent in 2002 to 1.41 million oz, the lowest level since 1998. Consumption will be affected by a decline in sales of gasoline cars, moves by some auto makers to reduce the use of catalyst systems based on palladium, and a reduction in average metal loadings on palladium-based catalysts.

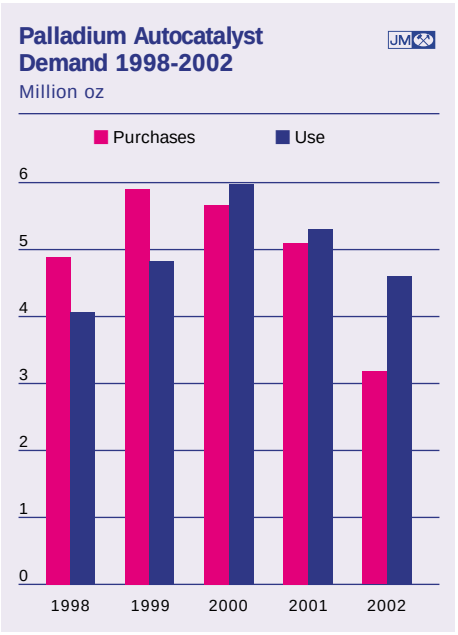
The growth of the diesel car sector in Europe in 2002 will again reduce palladium autocatalyst demand as gasoline vehicles lose market share. Diesel cars, which for technical reasons do not utilise catalysts containing palladium, will account for almost 40 per cent of new car sales this year. Consequently, sales of gasoline passenger vehicles are forecast to fall from 9.49 million in 2001 to 8.67 million in 2002.

The trend by auto companies to engineer greater use of platinum-based catalysts at the expense of palladium-based formulations has been less pronounced in Europe than in the USA. Nevertheless, it will still have a measurable impact on palladium consumption in 2002 as technical programmes initiated in 2000 and 2001 take effect.

The majority of catalyst systems used on European gasoline vehicles are still palladium-based. But auto manufacturers have been able to reduce average palladium loadings through thrifting programmes and these efforts will also account for an element of the total decline in European autocatalyst demand in 2002.

Palladium Demand: Autocatalyst
'000 oz

	2001	2002
Europe	1,730	1,410
Japan	505	490
North America	2,375	760
Rest of the World	480	500
Total	**5,090**	**3,160**
Autocatalyst recovery	**(280)**	**(370)**



Japan

Consumption of palladium by the Japanese auto industry is forecast to rise moderately in 2002 but demand will edge down by 15,000 oz to 490,000 oz as manufacturers supplement purchases with the use of inventories. Some Japanese car companies accumulated significant stocks of palladium in the late 1990s and have been utilising these to satisfy a proportion of their metal requirements this year.

The growth in underlying palladium use reflects both an expected small rise in Japanese light vehicle production plus an increase in average pgm loadings. Although domestic light vehicle sales will drop this year (sales were down almost 4 per cent year-on-year at the end of July), deliveries to North America and Europe have increased substantially. These factors are expected to equate to a small rise in light vehicle production in 2002.

It appears likely that Japanese vehicle emission standards will be tightened considerably by the end of 2005. In April 2002, the Central Environment Council (which advises the Ministry of Environment) announced its targets for reducing emissions. These are similar to earlier proposals published by the JEA that would cut current NOx and HC limits by half. Japanese auto manufacturers, in an effort to attract consumers, are already producing models that would meet the suggested new standards and average pgm loadings have increased accordingly.

North America

Consumption of palladium in autocatalysts will be considerably higher than purchases of metal in North America this year,

MLCC Production by Electrode Type 1998-2002

Billions

remaining well in excess of 2 million oz. Nevertheless, thrifting of palladium and greater use of platinum-based autocatalysts are expected to reduce actual use of palladium by an estimated 16 per cent.

North American demand for palladium in autocatalysts in 2002 will be heavily distorted by the large scale use of stocks by some US auto manufacturers. As a result, purchases of palladium by US car companies this year are expected to plummet and some palladium has also been sold back to the market. Total North American demand is forecast to sink to only 760,000 oz – the majority of which will be accounted for by plants owned by foreign manufacturers.

The major US car companies have minimised their purchases of palladium as far as possible during the year to date, and have satisfied a very substantial proportion of their requirements from inventories. In addition to the financial pressures on the US auto industry to cut costs, there are several reasons for the heavy stock run down. Inventories at the start of 2002 were considerable, following the accumulation of large volumes of metal in previous years, and auto companies have reduced their minimum inventory requirements as technical improvements have enabled reductions in catalyst pgm loadings. Uncertainty about the stability of supply has also eased somewhat, with growing palladium production in South Africa and North America.

The forecast 16 per cent fall in palladium consumption is partly a consequence of successful auto company initiatives to thrift palladium autocatalyst loadings. Reductions in average loadings have been achieved through advances in catalyst technology and engine management systems.

The drop in palladium use is also due to the move away from gasoline vehicle catalyst systems that primarily employ palladium to alternatives that utilise a much greater proportion of platinum. The effects of development programmes that were instigated in 2000 and 2001 as the palladium price soared are now being manifested in lower palladium consumption.

Rest of the World

Palladium autocatalyst demand in the Rest of the World is expected to expand by 4 per cent (20,000 oz) to reach 500,000 oz in 2002. Higher light-duty vehicle production in Asia, particularly in China, will be the main driver of purchases. Demand for palladium, however, is not forecast to grow as rapidly as that for platinum due to thrifting and substitution programmes initiated by leading auto companies over the last two years.

Autocatalyst Recovery

The volume of palladium recovered from scrapped autocatalysts is forecast to increase by almost one-third to reach 370,000 oz in 2002. Recovery rates in the USA have remained relatively high after rising pgm prices in 2000 and 2001 stimulated increased autocatalyst collection in scrap yards. Recovery rates are also growing strongly in Europe, but from a low base.

Auto manufacturers started using significant loadings of palladium in autocatalysts from the mid-1990s. As greater numbers of these vehicles are now being scrapped, the amount of palladium available for recovery is rising noticeably.

Dental

Demand for palladium in dental alloys is forecast to increase slightly to 730,000 oz in 2002. The fall in the palladium price from its early 2001 peak has had a stabilising effect on demand but there is little evidence to date that palladium will be able to regain a significant proportion of the markets lost to alternative materials in recent years.

Japanese dental demand for palladium is largely independent of price and should grow marginally to 480,000 oz in 2002. The government-backed subsidy of dental treatment using a 20 per cent palladium alloy has underpinned consumption, although spending on dental treatment as a whole remains affected by the weakness of the economy.

Europe has seen a strong move away from the use of palladium alloys to alternative dental materials over the past three years. Rising and volatile prices have slashed demand from a consistent level of around 250,000 oz per year in the mid-1990s to an estimated 45,000 oz in 2002. The substitution of palladium by high-gold alloys and ceramic alternatives has required considerable investment in

Palladium Demand: Dental

'000 oz

	2001	2002
Europe	50	45
Japan	470	480
North America	190	195
Rest of the World	10	10
Total	**720**	**730**

equipment and training. Consequently, the European dental industry has shown little inclination to move back to palladium-based products.

In North America, however, the recent fall in the palladium price is expected to spur a small increase in the use of the metal in dental alloys to 195,000 oz. Although the substitution of palladium has not been as widespread in the USA as in Europe, consumption this year will still be less than half the level of demand five years ago.

Electronics

Use of palladium in electronics is forecast to decline further in 2002 due to the continuing weakness in equipment sales, further substitution by nickel in capacitors, and thrifting of metal in plating applications. However, as the use of inventories by component manufacturers will be lower than in 2001, purchases of metal are expected to stage a muted recovery to 750,000 oz.

Shipments of multi-layer ceramic capacitors (MLCC), by far the largest electronic use for palladium, slumped in 2001 when a sharp downturn in demand for electronic goods left manufacturers with exceptionally large inventories of components and raw material stocks. The excess component inventories had, to a certain extent, been run down by the end of the first quarter of 2002. In spite of this, MLCC fabricators still held significant stocks of palladium pastes and metal at that time and have continued to use these to supplement palladium purchases.

Palladium Demand: Electronics
'000 oz

	2001	2002
Europe	130	110
Japan	275	170
North America	70	155
Rest of the World	235	315
Total	**710**	**750**

Total output of MLCC is forecast to improve by 5 per cent to just over 450 billion this year. However, although MLCC manufacturers reported an upturn in orders during the second quarter of the year, by July the tentative recovery in sales had already weakened again. In addition, the substitution of palladium by nickel will increase again in 2002. This will have reduced the overall market share of palladium electrode MLCC to an estimated 45 per cent by the end of 2002. The exception is China, where penetration of nickel electrode MLCC remains low and demand for all electronic components continues to grow rapidly.

Palladium demand for use in plating applications is expected to fall further in 2002 after dropping by 50 per cent in 2001. Substitution of palladium by gold continued during the first half of the year, and manufacturers have been successful in thrifting the amount of precious metals used to plate lead frames. Demand for palladium conductive pastes used in hybrid integrated circuits (HIC) and surge resistors is forecast to be flat.

Other

Palladium demand from other applications is forecast to increase by 60,000 oz to 610,000 oz in 2002. Greater demand will be seen from the Japanese jewellery sector as less old stock is returned for remelting. Increased production of white gold, which is typically alloyed with a proportion of palladium, will also have an influence. The lower palladium price has halted the substitution of some palladium-based petroleum cracking catalysts with base metal formulations in the USA.

Demand for palladium in jewellery alloys is expected to increase by 15 per cent this year to 265,000 oz, primarily due to increased purchases by the Japanese jewellery trade. Demand will rise despite weakening sales of platinum jewellery because fabricators are not depleting their stocks as heavily as in 2001. In addition, production of white gold, in which palladium is often used as a whitening agent, has grown. It has increased its penetration of the Japanese jewellery market and has taken market share from yellow gold.

Palladium Demand: Other
'000 oz

	2001	2002
Europe	125	120
Japan	170	200
North America	90	120
Rest of the World	165	170
Total	**550**	**610**

In China, jewellery trade demand for palladium as an alloying agent will increase in concert with growing platinum jewellery production and white gold output.

The use of palladium in the chemical industry will be stable at 255,000 oz this year as weak market conditions have persisted in Europe, Japan and North America. In China, construction of new production capacity for purified terephthalic acid is expected to provide a small fillip to palladium catalyst demand. The lower palladium price has improved the cost effectiveness of palladium catchment gauzes in the nitric acid industry, but acid producers have been suffering from poor sales and prices of nitrogen fertilisers – the primary end use for nitric acid.

The fall in the palladium price has also reduced the incentive with petroleum companies to substitute palladium-based hydrocracking catalysts with base metal products. After net sales of palladium back to the market from this source in 2001, demand this year across the industry is expected to be positive.

Other Platinum Group Metals

Rhodium

Demand for rhodium in 2002 is expected to be marginally reduced compared to 2001 at 568,000 oz. Autocatalyst demand continues to grow, supported by increased light vehicle production in the USA and Japan over the first nine months of the year. Several auto companies, however, are believed to have further reduced rhodium inventories that were heavily augmented in 2000. Rhodium usage in chemical process catalysts and glassmaking equipment has weakened slightly.

Autocatalyst

Net demand for rhodium by auto makers is forecast to increase by 1.2 per cent to 574,000 oz in 2002. Automobile emission legislation continues to tighten worldwide and rhodium is an indispensible component of gasoline vehicle autocatalysts for the control of NOx. In addition, programmes to thrift palladium that were initiated in 2000 and 2001 are taking effect and have raised rhodium loadings in some instances.

The increase in metal purchases by the auto sector this year has not been as great as it might have been due to some US-based auto makers reducing their inventories. Meanwhile, recovery of rhodium from spent autocatalysts continues to rise and will reach almost 100,000 oz this year.

In North America, rhodium sales to auto companies will fall by over 20 per cent despite rising vehicle production. Although actual use of rhodium in autocatalysts will continue to increase, the drive by US auto makers to reduce costs has led to a significant draw down of pgm stocks, including rhodium. This will outweigh rising US production of cars and light trucks, which is forecast to grow by up to 9 per cent in 2002.

Japanese demand for rhodium in autocatalysts is expected to increase substantially this year. This is due in part to rising production and exports – Japanese output of passenger cars rose 3.6 per cent between January and August 2002, driven by a 15 per cent increase in exports to North America. Growing rhodium demand in Japan is also a function of auto manufacturers producing vehicles to tighter emission standards than are required by present legislation. Loadings of pgm have generally been increased on new models to achieve greater emission reductions as this is a strong sales incentive.

Rhodium Supply and Demand
'000 oz

	2001	2002
Supply		
South Africa	452	483
Russia	125	65
North America	23	26
Others	4	7
Total Supply	**604**	**581**
Demand		
Autocatalyst: gross	567	574
recovery	(89)	(99)
Chemical	44	40
Electrical	6	6
Glass	39	37
Other	10	10
Total Demand	**577**	**568**
Movements in Stocks	27	13

Rhodium sales in Europe this year are expected to rise moderately compared to 2001. Passenger car sales in most countries across the region have been weak (with the exception of the UK) and light vehicle production for the year is forecast to drop by around 2 per cent. However, sales of premium and performance cars have held up much better than other sectors – these cars typically require a greater number of catalysts, with higher than average precious metal loadings.

In the Rest of the World, rhodium demand in 2002 should increase significantly in percentage terms, although the volumes involved are still relatively small. Chinese light vehicle production continues to expand at a rapid rate and emission legislation is gradually following the European Union model. Falling car production in South America, due to the economic problems in Brazil and Argentina, will be more than compensated for by growing output in India, Malaysia and South Korea.

The outlook for rhodium consumption in autocatalysts continues to be positive, although in the short-term much will depend on whether the current level of cars sales in the USA can be maintained in 2003. In the longer term, demand will continue to benefit from tightening emission legislation in all major regions, including the US Tier II regulations that will be phased in from 2004 onwards.

Other Demand

Demand for rhodium in chemical applications is expected to fall by 9 per cent to 40,000 oz in 2002. Many sectors of the European chemical industry have experienced a difficult year and reduced demand for rhodium-based process

Ruthenium Demand by Application
'000 oz

	2001	2002
Chemical	61	102
Electrochemical	92	100
Electronics	136	163
Other	62	64
Total Demand	**351**	**429**

Iridium Demand by Application
'000 oz

	2001	2002
Automotive	10	6
Electrochemical	22	23
Electronics	27	22
Other	31	33
Total Demand	**90**	**84**

catalysts will account for most of the overall decline. Rhodium consumption in glass applications, thermocouples, and other uses is expected to be broadly in line with 2001 levels.

Ruthenium & Iridium

Ruthenium demand in 2002 is forecast to rebound by more than 22 per cent from the slump of 2001 to reach 429,000 oz. The recovery is due to excess inventories largely having been eliminated from the electronics industry, and to growing demand for ruthenium-based catalysts. Iridium demand, however, is expected to fall to 84,000 oz as the oversupply of iridium crucibles persists in the electronics market.

Consumption of ruthenium in electronic components is expected to stage a recovery in 2002 following the slump in orders in 2001. Although consumer demand for electronics remains weak, the large component inventories present at the start of 2001 have been reduced to more normal working levels. Production of ruthenium-based products such as resistors has therefore increased. With few component manufacturers holding significant inventories of ruthenium pastes, demand for the metal should grow to 163,000 oz in 2002.

This year's total includes a small contribution from a new application for ruthenium in computer hard disks. This is expected to be consuming significant volumes of metal within the next three to four years as leading manufacturers adopt the new technology.

Iridium's primary application in electronics is in the form of crucibles used to grow high-purity crystals. Significant overcapacity has persisted in this sector following very strong sales in 2000. Component demand has been hit by a steep decline in sales in the mobile telecommunications industry, and total iridium demand in electronics is forecast to drop to 22,000 oz in 2002.

Both ruthenium and iridium are used to coat electrodes used in the chloralkali process, which involves the electrolysis of brine to chlorine and caustic soda. The chloralkali industry has been relatively stable during 2002, and this will be reflected in steady demand for iridium and ruthenium this year.

The chemicals industry consumes significant volumes of ruthenium in process catalysts used in the manufacture of acetic acid, ammonia and speciality chemicals. Demand is set to increase to 102,000 oz this year as additions are made to manufacturing capacity for several products. In addition, the Cativa® process for the production of acetic acid, which uses an iridium-ruthenium catalyst, is becoming more widely used.

In other sectors, orders for corrosion resistant titanium-ruthenium pipe from the oil and mining industries have remained firm but autocatalysts containing iridium have now largely been replaced by platinum-based formulations.

Supplies

Rhodium

Total rhodium supplies in 2002 are forecast to change little from 2001, falling moderately to 581,000 oz. The balance of supply will move increasingly in favour of South Africa, where output is increasing in line with growing platinum production. The majority of expansions and new projects in South Africa are exploiting UG2 ore, which has a higher rhodium content than the Merensky Reef.

Russian sales are forecast to continue to slip back from the exceptional total in 2000, when large volumes were sold from state inventories to western auto manufacturers. Several of them are understood to have satisfied a proportion of their requirements this year by reducing their inventories and total demand has been comfortably covered by supply.

Ruthenium & Iridium

The price of iridium fell by 44 per cent and that of ruthenium by 25 per cent during the first nine months of 2002. This was in part a reflection of greater availability of metal from South Africa – UG2 ore contains higher concentrations of ruthenium and iridium compared to the Merensky Reef. For both metals supply is more than sufficient to meet demand.

Prices

Platinum

The platinum price fell from $481 to $455 in January 2002 under the weight of long liquidation on the futures markets. From then on, the tightness of the physical market fuelled several rallies, punctuated by short bouts of fund and investor profit-taking. The peak fixing price increased from $559 in April, to $567 in June, then to $574 in August and September. With overall demand higher and Russian supplies lower than in 2001, more than 560,000 oz of metal were withdrawn from Swiss stocks during the first eight months of the year. Despite this, a lack of short-term liquidity forced the platinum price and lease rates upwards on several occasions.

Platinum began 2002 steadily, trading between $470 and $480 for much of the first three weeks of **January**. On the 24th, a flurry of long liquidation by private investors on TOCOM pushed platinum contracts down by the daily limit. Funds on NYMEX also started selling, but strong physical demand kept the spot price buoyed for several days. The support was broken on the 29th by a fresh wave of futures selling, the spot price falling to $455 on the 31st.

The decline was reversed in **February** as investors started to open new long positions, while strong bullion bank buying in Europe and solid physical demand underpinned the spot price. Sentiment was also helped by a robust rally in gold. Over the first seven days of trading the platinum price gained $26 on the London fixings, reaching $475 on the morning of the 11th. After a brief pause the rally resumed, the platinum price climbing to $493 by the end of February, spurred by short-covering.

Platinum continued its upward surge in early **March**, breaking through the $500 mark on the 4th and hitting $526 on the 11th as short-covering and fund buying continued. Following a degree of profit-taking, it traded between $510 and $520 through to the end of the month. With little evidence of Russian spot sales during the first quarter, substantial volumes of metal were withdrawn from stocks in Zurich.

The upward momentum recommenced in **April**. A combination of strikes at Anglo Platinum operations in South Africa, healthy physical demand, investor short-covering, and subdued spot sales fuelled a spurt in the platinum price. As lease rates climbed, the London fixing was propelled from $526 on the 9th to $559 on the 18th, its highest level since July 2001.

The price weakened when higher volumes of metal were placed on the fixings, attributed in part to offers of Russian metal. This, coupled with profit-taking by Japanese investors, pulled the price back down to $536 on the 30th.

Platinum opened **May** trading at, or close to, $520. The strong market fundamentals and positive sentiment meant that this level was now a significant base of support, and fund and investor buying returned. The price rose from $525 on the 13th to $546 on the 21st and held ground near $540 until rallying to $548 between the 29th and 31st.

June started with platinum still buoyed by the continuing firmness of physical demand. By the 7th platinum was fixed at $564, responding to rising futures prices on TOCOM. The price stabilised between $554 and $558 for several days as physical purchases thinned, then began to climb once more from the 14th as fund buying resumed. Although bids for metal became lighter as the price moved past $560, the London fix reached $567 on the 21st, a twelve month high.

The market then turned sharply downwards as investors became concerned about the continuing fragility of the US economy, sliding equity prices and the depreciation of the dollar versus the yen. Selling of metal on the London fixings and heavy liquidation of long futures positions caused the platinum price to fade to $539 by the 27th.

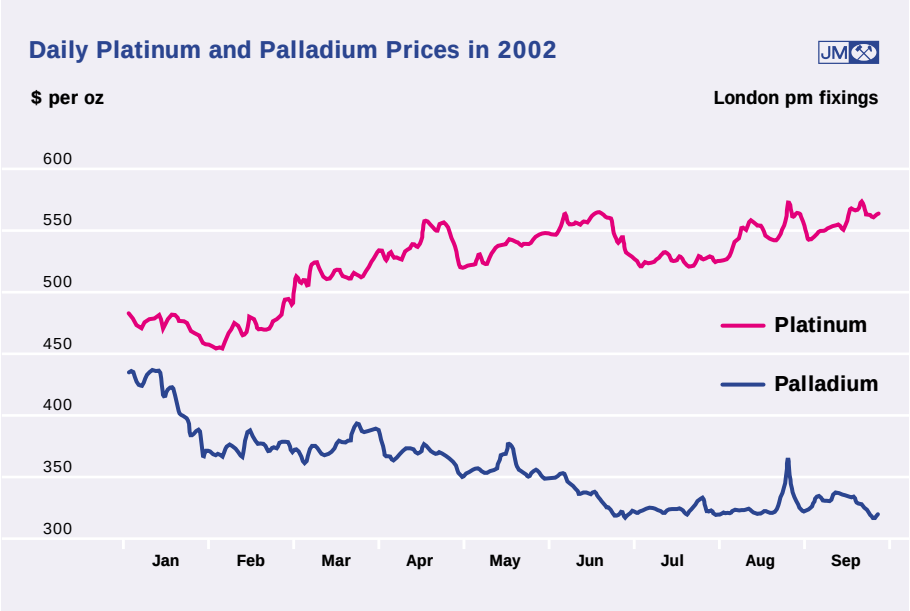
The slide continued into **July** as bearish investors opened new short positions. TOCOM closed limit down on the 1st and the London fix dropped $13 to $532. Again, however, steady physical demand on the London fixings underpinned the platinum spot market around $520; price fluctuations experienced over the following three weeks were driven primarily by speculative activity on TOCOM. The spot market was fairly quiet, platinum mostly trading between $520 and $530.

Platinum spent a quiet first week of **August** floating around $525, before fund

Average PGM Prices in $ per oz

	Jan-Sep 2001	Jan-Sep 2002	Percentage Change
Platinum	558.88	523.55	–6%
Palladium	687.26	355.08	–48%
Rhodium	1,829.79	888.28	–51%
Iridium	415.00	329.64	–21%
Ruthenium	143.97	70.48	–51%

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



purchasing on NYMEX sparked a new rally. Platinum hit $540 on the 8th and passed $550 on the 12th as funds opened new long positions, while in the spot market near-term borrowing interest increased. Short-covering by investors in Japan contributed to the rise – the June 2003 contract moving above ¥2,000 per gram in heavy trading. Amongst this futures activity, Chinese purchases of physical metal faltered as the price moved above $550.

The final week of August saw a jump in the price of platinum to $574 in reaction to an intense bout of short-covering in the palladium market. As the brief palladium rally reversed, however, platinum also fell, ending the month at $564.

Another round of profit-taking by investors in the USA and Japan, coupled with good offers of metal on the London fixings, pushed the price down to $542 on the 4th **September**. As the price neared $540, however, physical buying interest strengthened and the fall was arrested.

On the 18th and 19th, sizeable borrowing via short-term forward contracts put pressure on the spot market. One-month lease rates jumped towards 12 per cent, driven in part by reports of low metal stock levels in Zurich. The platinum price climbed to $570 on the 20th. A second surge of short-term borrowing was seen on the 24th, which bumped the afternoon fix up to $574, equalling the August high. The following day, however, the borrowing fell away and lease rates eased back. With good offers of metal on the fixings, platinum ended September trading steadily close to $560.

Palladium

The Russians maintained their effort to support the price of palladium by staying out of the spot market during the first nine months of 2002. However, with heavy inventory overhangs in the autocatalyst and electronics sectors the price slid from $440 at the start of the year to $320 in June, and revisited the November 2001 trough of $315 in September. Activity on TOCOM fell by almost 50 per cent from the already low levels of 2001. In such thin trade, small volumes had a large influence on the price, as evidenced by two brief short-covering spikes in July and August.

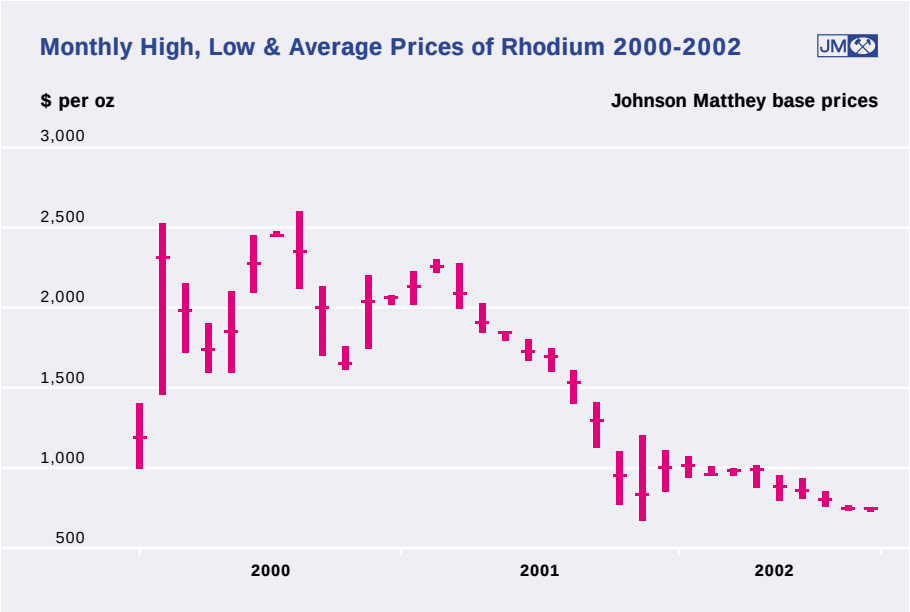
Palladium traded either side of $430 during the first two weeks of **January** but fell sharply to $413 on the 15th as the market digested reports that Ford Motor Company was to take a $1 billion charge against its inventories of precious metals. Speculation that Ford would sell palladium back to the market pushed the price down to $400 by the 21st. With increasing pressure from fund selling in New York, it had dropped to $370 by the end of the month.

After a dull start to **February** for palladium, borrowing by a US trader on the 13th led to a jump in lease rates as banks hurried to cover their positions. The London fix moved up to $383 before the NYMEX March contract touched a high of $395. TOCOM subsequently traded limit up and palladium fixed at $388 on the 14th. This liquidity squeeze quickly subsided as larger offers of physical metal appeared on the fixings, palladium dropping to $380 the following day. The market remained quiet for the remainder of February, the metal fixing at $377 on the 28th.

After opening **March** at $373, palladium dipped to $360 on the 6th as large volumes were sold on the London fixing. Improved spot market bids lifted the price to $380 on the 20th, then fund buying on NYMEX on the 25th triggered a flurry of short-covering. Sentiment was influenced by reports that Norilsk Nickel would not ship pgm until May and palladium fixed at $393 on the 26th. Investor buying waned, however, and palladium slipped back to $386 at the end of the month.

The palladium market weakened during early **April** following confirmation from Ford that it was actively reducing its pgm inventories and was prepared to sell metal back to the market. The palladium price slumped by $30 to $362 between the 2nd and 8th of the month, then traded thinly and settled at $360 on the 30th.

During the first half of **May** the palladium price mostly fixed in a tight range of $350 to $357. From the 15th onwards the price strengthened in line with rallies in platinum and gold as both physical and fund purchasing increased. The illiquid market enabled palladium to reach $378 on the morning of the 21st, but as fund buying evaporated the price slid and ended the month at $348.



The palladium market turned bearish in **June**, the metal losing almost $30 over the course of the month after initially following platinum upwards. Open interest increased on NYMEX as funds opened new short positions and this put pressure on futures prices. With only limited physical demand, the London fix had fallen to $333 by the 14th. At the end of the month palladium was trading either side of $320, its lowest point since November 2001.

Liquidity in the palladium futures market declined from already depressed levels during **July**, only 4,191 contracts being traded on TOCOM. Physical demand remained weak but was sufficient to keep the price near $320 in the absence of further fund selling. A minor short-covering rally lifted palladium to $332 on the 29th but by the 31st it was back at $322.

The palladium price was virtually static at $320 in very thin summer trade during the first three weeks of **August**. The calm was broken by a sudden short-squeeze in the final week of the month that drove the price up by $30 on the London fixings and by over $50 on the New York spot market. This speculative move, initiated by a single US-based fund, caused a rash of short-covering on both NYMEX and TOCOM. In response, the fixing jumped from $330 on the morning of the 27th to $365 the following afternoon. The spot price touched $375 at one point but increased offers of metal rapidly appeared at this level, and selling on the London fixings pushed the price down to $330 on the 30th.

As the effects of the speculative short-squeeze dissipated, the palladium price settled at $320 on the 3rd **September**. For the next two weeks the market was very quiet, the metal mostly fixing between $330 and $335. Volumes of physical trade were thin, and activity on TOCOM was exceptionally light. Renewed downward pressure emerged in the final week of September as pessimism about the short-term global economic outlook resurfaced. With physical demand stunted and indications that Russian shipments had increased, palladium slid from $331 on the 23rd to $315 on the 30th – trading at a discount of almost $250 to platinum.

Other PGM

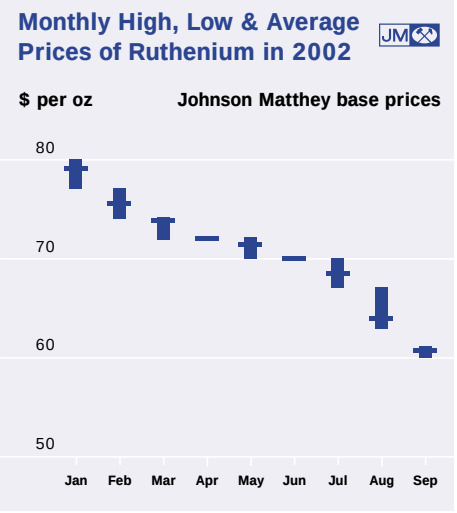
The rhodium price drifted downwards during the first nine months of 2002. Autocatalyst demand remained firm but with no concerns over availability, the price moved down from $1,075 in January to $730 by the end of September. Ruthenium and iridium prices also declined substantially due to a combination of plentiful supplies and weak markets. Ruthenium dropped by $20 to $60 and iridium fell by $175 to $220 over the period.

The Johnson Matthey base price for rhodium gradually drifted down from $1,075 during January in a subdued market. It traded steadily between $960 and $1,010 from then until late April, supported by a lack of Russian sales.

By the 8th of May, however, increased offers had driven the price to $800, with much of the metal believed to be of Russian origin. Buying interest returned at this level and briefly pushed rhodium back up towards $1,000 but by June offers were again outweighing bids. The JM base price weakened throughout the summer, slipping under $800 in July in thin trade and settling at $730 by the end of September.

The ruthenium and iridium markets were uninspiring during the first nine months of 2002. Ruthenium demand from the electronics sector experienced a degree of recovery, component inventories having fallen from their 2001 peak, but demand remained well below supply. The JM ruthenium base price subsided from $80 in January to $60 in September.

Slack demand for iridium against a background of increasing availability from South Africa saw the price flag. The JM base price fell from $395 in January to $220 by the end of the third quarter.



Supply and Demand Tables

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 consumers 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.

From 1996, consumption in China is incorporated into our figures for the **Rest of the World** region. 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.

Platinum Supply and Demand

'000 oz	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Supply										
South Africa	3,360	3,160	3,370	3,390	3,700	3,680	3,900	3,800	4,100	**4,440**
Russia	680	1,010	1,280	1,220	900	1,300	540	1,100	1,300	**950**
North America	220	220	240	240	240	285	270	285	340	**355**
Others	130	140	100	130	120	135	160	105	110	**135**
Total Supply	**4,390**	**4,530**	**4,990**	**4,980**	**4,960**	**5,400**	**4,870**	**5,290**	**5,850**	**5,880**
Demand By Application										
Autocatalyst: gross	1,685	1,870	1,850	1,880	1,830	1,800	1,610	1,890	2,530	**2,520**
recovery	(255)	(290)	(320)	(350)	(370)	(405)	(420)	(470)	(530)	**(570)**
Chemical	180	190	215	230	235	280	320	295	285	**300**
Electrical	165	185	240	275	305	300	370	455	385	**385**
Glass	80	160	225	255	265	220	200	255	290	**260**
Investment: small	125	155	75	110	180	210	90	40	50	**50**
large	180	240	270	130	60	105	90	(100)	40	**40**
Jewellery	1,615	1,740	1,810	1,990	2,160	2,430	2,880	2,830	2,550	**2,780**
Petroleum	105	90	120	185	170	125	115	110	130	**135**
Other	165	190	225	255	295	305	335	375	460	**470**
	4,045	**4,530**	**4,710**	**4,960**	**5,130**	**5,370**	**5,590**	**5,680**	**6,190**	**6,370**
Western Sales to China	20	50	130	-	-	-	-	-	-	-
Total Demand	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,370**	**5,590**	**5,680**	**6,190**	**6,370**
Movements in Stocks	325	(50)	150	20	(170)	30	(720)	(390)	(340)	**(490)**
	4,390	**4,530**	**4,990**	**4,980**	**4,960**	**5,400**	**4,870**	**5,290**	**5,850**	**5,880**
Demand By Region										
Europe	895	935	880	840	875	910	995	1,150	1,500	**1,675**
Japan	1,975	2,145	2,215	2,005	1,885	1,795	1,820	1,410	1,280	**1,365**
North America	760	940	1,015	1,180	1,250	1,325	1,080	1,225	1,290	**995**
Rest of the World	415	510	600	935	1,120	1,340	1,695	1,895	2,120	**2,335**
	4,045	**4,530**	**4,710**	**4,960**	**5,130**	**5,370**	**5,590**	**5,680**	**6,190**	**6,370**
Western Sales to China	20	50	130	-	-	-	-	-	-	-
Total Demand	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,370**	**5,590**	**5,680**	**6,190**	**6,370**

Platinum Demand by Application: Regions

'000 oz	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Europe										
Autocatalyst: gross	610	605	560	515	510	545	560	680	1,065	**1,250**
recovery	(5)	(10)	(15)	(20)	(25)	(30)	(30)	(40)	(70)	**(90)**
Chemical	40	50	55	60	70	60	80	100	95	**105**
Electrical	20	25	25	25	45	45	70	80	65	**65**
Glass	15	30	35	40	20	25	20	20	15	**10**
Investment: small	25	45	10	5	5	5	5	0	0	**0**
Jewellery	105	100	120	125	150	160	185	190	170	**170**
Petroleum	25	25	15	15	15	15	15	15	15	**15**
Other	60	65	75	75	85	85	90	105	145	**150**
Totals	**895**	**935**	**880**	**840**	**875**	**910**	**995**	**1,150**	**1,500**	**1,675**
Japan										
Autocatalyst: gross	320	290	270	245	255	240	250	290	345	**410**
recovery	(50)	(45)	(40)	(50)	(50)	(55)	(60)	(60)	(55)	**(60)**
Chemical	15	15	20	20	20	20	20	20	25	**30**
Electrical	45	45	45	45	65	55	75	90	80	**80**
Glass	30	80	105	80	85	80	65	65	85	**80**
Investment: small	55	40	35	25	25	25	20	5	5	**5**
large	180	240	270	130	60	105	90	(100)	40	**40**
Jewellery	1,350	1,450	1,480	1,480	1,390	1,290	1,320	1,060	710	**735**
Petroleum	10	5	5	5	5	5	5	5	5	**5**
Other	20	25	25	25	30	30	35	35	40	**40**
Totals	**1,975**	**2,145**	**2,215**	**2,005**	**1,885**	**1,795**	**1,820**	**1,410**	**1,280**	**1,365**
North America										
Autocatalyst: gross	600	790	820	850	800	775	535	620	795	**480**
recovery	(200)	(230)	(260)	(275)	(290)	(310)	(315)	(350)	(370)	**(380)**
Chemical	75	65	70	80	80	80	95	100	100	**85**
Electrical	65	75	115	130	100	105	120	145	120	**120**
Glass	15	20	25	30	45	20	25	50	30	**35**
Investment: small	40	65	25	75	145	175	60	35	45	**45**
Jewellery	45	55	65	90	160	270	330	380	280	**310**
Petroleum	40	5	40	60	50	40	40	35	40	**45**
Other	80	95	115	140	160	170	190	210	250	**255**
Totals	**760**	**940**	**1,015**	**1,180**	**1,250**	**1,325**	**1,080**	**1,225**	**1,290**	**995**
Rest of the World										
Autocatalyst: gross	155	185	200	270	265	240	265	300	325	**380**
recovery	0	(5)	(5)	(5)	(5)	(10)	(15)	(20)	(35)	**(40)**
Chemical	50	60	70	70	65	120	125	75	65	**80**
Electrical	35	40	55	75	95	95	105	140	120	**120**
Glass	20	30	60	105	115	95	90	120	160	**135**
Investment: small	5	5	5	5	5	5	5	0	0	**0**
Jewellery	115	135	145	295	460	710	1,045	1,200	1,390	**1,565**
Petroleum	30	55	60	105	100	65	55	55	70	**70**
Other	5	5	10	15	20	20	20	25	25	**25**
Totals	**415**	**510**	**600**	**935**	**1,120**	**1,340**	**1,695**	**1,895**	**2,120**	**2,335**

Palladium Supply and Demand

'000 oz	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Supply										
South Africa	1,395	1,500	1,600	1,690	1,810	1,820	1,870	1,860	2,010	**2,190**
Russia	2,400	3,300	4,200	5,600	4,800	5,800	5,400	5,200	4,340	**1,600**
North America	415	410	470	455	545	660	630	635	830	**970**
Others	70	70	70	95	95	120	160	105	120	**150**
Total Supply	**4,280**	**5,280**	**6,340**	**7,840**	**7,250**	**8,400**	**8,060**	**7,800**	**7,300**	**4,910**
Demand By Application										
Autocatalyst: gross	705	975	1,800	2,360	3,200	4,890	5,880	5,640	5,090	**3,160**
recovery	(100)	(105)	(110)	(145)	(160)	(175)	(195)	(230)	(280)	**(370)**
Chemical	190	185	210	240	240	230	240	255	255	**255**
Dental	1,210	1,265	1,290	1,320	1,350	1,230	1,110	820	720	**730**
Electronics	2,015	2,230	2,620	2,020	2,550	2,075	1,990	2,160	710	**750**
Jewellery	210	205	200	215	260	235	235	255	230	**265**
Other	35	115	110	140	140	115	110	60	65	**90**
Total Demand	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,600**	**9,370**	**8,960**	**6,790**	**4,880**
Movements in Stocks	15	410	220	1,690	(330)	(200)	(1,310)	(1,160)	510	**30**
	4,280	**5,280**	**6,340**	**7,840**	**7,250**	**8,400**	**8,060**	**7,800**	**7,300**	**4,910**
Demand By Region										
Europe	680	885	1,340	1,525	1,840	1,985	2,095	2,410	2,005	**1,640**
Japan	1,990	2,200	2,445	1,885	2,350	2,215	2,205	2,105	1,380	**1,300**
North America	1,295	1,430	1,960	2,185	2,675	3,690	4,255	3,445	2,525	**970**
Rest of the World	300	355	375	555	715	710	815	1,000	880	**970**
Total Demand	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,600**	**9,370**	**8,960**	**6,790**	**4,880**

Palladium Demand by Application: Regions

'000 oz	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Europe										
Autocatalyst: gross	115	260	650	860	1,100	1,370	1,530	1,900	1,730	**1,410**
recovery	0	0	0	(5)	(5)	(5)	(10)	(15)	(30)	**(45)**
Chemical	65	60	65	65	70	65	65	95	70	**70**
Dental	265	255	250	255	260	210	180	100	50	**45**
Electronics	210	255	325	300	340	270	255	265	130	**110**
Jewellery	35	30	30	30	50	50	50	45	35	**35**
Other	(10)	25	20	20	25	25	25	20	20	**15**
Totals	**680**	**885**	**1,340**	**1,525**	**1,840**	**1,985**	**2,095**	**2,410**	**2,005**	**1,640**
Japan										
Autocatalyst: gross	90	125	145	180	245	480	600	510	505	**490**
recovery	(30)	(30)	(25)	(30)	(45)	(50)	(55)	(50)	(40)	**(40)**
Chemical	20	20	20	20	20	20	20	20	20	**20**
Dental	500	550	580	600	620	590	545	470	470	**480**
Electronics	1,280	1,400	1,600	990	1,390	1,060	980	990	275	**170**
Jewellery	120	120	115	115	110	105	105	150	140	**170**
Other	10	15	10	10	10	10	10	15	10	**10**
Totals	**1,990**	**2,200**	**2,445**	**1,885**	**2,350**	**2,215**	**2,205**	**2,105**	**1,380**	**1,300**
North America										
Autocatalyst: gross	450	525	950	1,230	1,680	2,820	3,490	2,805	2,375	**760**
recovery	(70)	(75)	(85)	(110)	(105)	(115)	(125)	(155)	(200)	**(260)**
Chemical	65	60	70	70	70	70	75	65	75	**75**
Dental	400	410	410	410	415	390	350	230	190	**195**
Electronics	420	450	545	490	550	460	405	485	70	**155**
Jewellery	5	5	5	5	10	10	10	10	0	**0**
Other	25	55	65	90	55	55	50	5	15	**45**
Totals	**1,295**	**1,430**	**1,960**	**2,185**	**2,675**	**3,690**	**4,255**	**3,445**	**2,525**	**970**
Rest of the World										
Autocatalyst: gross	50	65	55	90	175	220	260	425	480	**500**
recovery	0	0	0	0	(5)	(5)	(5)	(10)	(10)	**(25)**
Chemical	40	45	55	85	80	75	80	75	90	**90**
Dental	45	50	50	55	55	40	35	20	10	**10**
Electronics	105	125	150	240	270	285	350	420	235	**315**
Jewellery	50	50	50	65	90	70	70	50	55	**60**
Other	10	20	15	20	50	25	25	20	20	**20**
Totals	**300**	**355**	**375**	**555**	**715**	**710**	**815**	**1,000**	**880**	**970**

Rhodium Supply and Demand

'000 oz	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Supply										
South Africa	278	330	342	359	377	400	410	457	452	**483**
Russia	80	80	80	110	240	110	65	290	125	**65**
North America	17	15	13	5	16	16	18	17	23	**26**
Others	1	1	1	2	3	4	8	3	4	**7**
Total Supply	**376**	**426**	**436**	**476**	**636**	**530**	**501**	**767**	**604**	**581**
Demand By Application										
Autocatalyst: gross	356	379	464	424	418	483	509	793	567	**574**
recovery	(25)	(34)	(37)	(45)	(49)	(57)	(65)	(79)	(89)	**(99)**
Chemical	11	10	13	21	36	31	34	39	44	**40**
Electrical	9	8	8	9	9	6	6	7	6	**6**
Glass	3	14	17	53	43	34	35	42	39	**37**
Other	12	11	9	9	10	10	9	10	10	**10**
Total Demand	**366**	**388**	**474**	**471**	**467**	**507**	**528**	**812**	**577**	**568**
Movements in Stocks	10	38	(38)	5	169	23	(27)	(45)	27	**13**
	376	**426**	**436**	**476**	**636**	**530**	**501**	**767**	**604**	**581**
Demand By Region										
Europe	127	129	139	154	165	175	178	199	201	**205**
Japan	68	68	59	64	70	75	84	153	109	**142**
North America	127	139	224	170	137	177	167	332	133	**83**
Rest of the World	44	52	52	83	95	80	99	128	134	**138**
Total Demand	**366**	**388**	**474**	**471**	**467**	**507**	**528**	**812**	**577**	**568**

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
Almaz	Almazjuvelirexport, the pgm marketing agency of the Russian Federation
CO	carbon monoxide
DLA	US Defense Logistics Agency
GDP	gross domestic product
HC	hydrocarbons
HIC	hybrid integrated circuit
JEA	Japanese Environment Agency
LCD	liquid crystal display
LEV	Low Emissions Vehicle
Merensky, UG2, Platreef	platiniferous orebodies in South Africa
MLCC	multi-layer ceramic capacitor
NOx	oxides of nitrogen
NYMEX	New York Mercantile Exchange
PEM	proton exchange membrane
PET	polyethylene terephthalate
PM	particulate matter
PTA	purified terephthalic acid
TOCOM	Tokyo Commodity Exchange
ULEV	Ultra Low Emissions Vehicle
VAM	vinyl acetate monomer
ZEV	Zero Emissions Vehicle

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