Palladium

Autocatalyst

Global demand for palladium from auto makers fell by over 9 per cent in 2001 to 5.11 million oz. Sales to car companies in Europe and North America dropped substantially, as several thrifted palladium and increased the use of platinum in their catalytic converters. Lower gasoline vehicle production in both regions also affected demand. On the positive side, the reduction in palladium inventories by the North American car industry was not as pronounced as we had predicted. In Japan, tighter auto emissions legislation offset a decline in vehicle production and palladium demand was similar to 2000.

Europe

The use of palladium by the European auto industry slid by 170,000 oz to 1.73 million oz in 2001. The primary cause of the fall was the shift away from palladium to platinum-rich catalysts on gasoline vehicles that was undertaken by several auto manufacturers.

Palladium was used at progressively higher loadings on gasoline autocatalysts between 1995 and 2000, and helped car companies meet the Euro Stage III emissions regulations (it is very effective at reducing hydrocarbon emissions from gasoline engines). The rise in the price of palladium from mid 1999 onwards, however, and concerns about security of supplies led many auto makers to seek to reduce palladium use, both by minimising total pgm loadings and by increasing the use of platinum based autocatalysts on new car models. The effect of this strategy on palladium demand became increasingly apparent throughout 2001.

The growth in the diesel car sector in Europe also affected palladium demand in 2001. Although European production of passenger cars increased by 1 per cent last year, output of gasoline vehicles fell as the market share accounted for by diesels climbed to 36 per cent. Because diesel cars utilise platinum based catalysts, the rise in sales of diesels at the expense of gasoline vehicles reduced autocatalyst demand for palladium.

Japan

Total Japanese auto industry demand for palladium was broadly unchanged in 2001 from the previous year, slipping just 1 per cent to 505,000 oz. New emissions regulations meant that higher loadings of pgm were utilised in autocatalysts fitted to Japanese cars for the domestic market, but this mainly affected platinum rather than palladium demand.

Cars manufactured in Japan for the US export market continued to use palladium based technology to meet the stringent US hydrocarbon emissions limits for gasoline vehicles. The US car market, however, was subdued in 2001 and although Japanese manufacturers gained market share, this had little effect on palladium demand within Japan as car production has been increasingly transferred to facilities abroad.

North America

North American demand for palladium in autocatalysts fell by 415,000 oz to 2.39 million oz last year as thrifting of the metal had a major impact. US car manufacturers have reduced average palladium loadings both through advances in engine management and catalyst technology, and by substituting a proportion of the palladium used with platinum and rhodium.

Palladium Demand: Autocatalyst
'000 oz

	2000	2001
Europe	1,900	1,730
Japan	510	505
North America	2,805	2,390
Rest of the World	425	485
Total	**5,640**	**5,110**
Autocatalyst recovery	**(230)**	**(290)**

North American autocatalyst demand for palladium was also hit by the pronounced fall in production of light duty vehicles. US output dropped 10 per cent as manufacturers cut back new car assembly rates, with the auto trade reducing vehicle inventories in the face of the slowing economy.

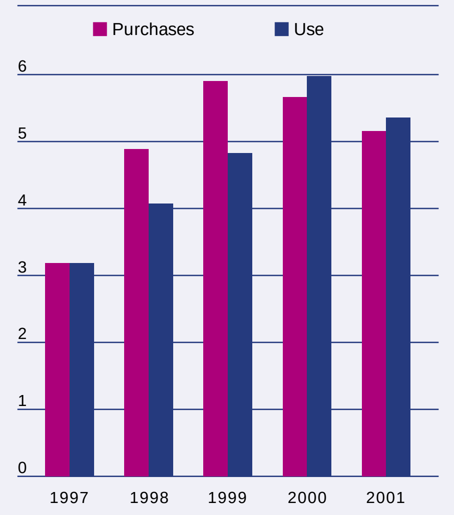
The fall in palladium demand, however, was not as great as we had predicted in our Platinum 2001 Interim Review. The US auto industry was expected to draw heavily on inventories of palladium in 2001 due to the high price in the early part of the year and the increasingly difficult business conditions. This was forecast to reduce greatly purchases of fresh metal.

In the event, however, we believe that stock reductions across the industry as a whole were not very substantial last year. This can be attributed to several factors: the uncertainty that persisted about the future availability of Russian metal, auto makers' continued need for palladium in the longer term, given its effectiveness as

Good delivery specification palladium bars

Palladium Autocatalyst Demand 1997-2001

Million oz



a catalyst for the control of gasoline vehicle hydrocarbon emissions, and the rapid fall in the palladium price during the second half of the year.

It is too early to determine the US auto industry's approach to pgm stocks this year. In January 2002, however, Ford Motor Company announced a pre-tax write-down of $1 billion against the value of its pgm inventories and forward contracts. While no information was released about the volumes of individual pgm concerned, Ford has been one of the larger users of palladium in the past.

The company subsequently said that a technical advance in catalyst design would enable it to reduce its use of palladium markedly, estimating that its consumption in 2002 will be approximately half that used in 2000. As a result, Ford now holds palladium in excess of its stock requirement and may sell a proportion of the surplus back to the market this year.

Rest of the World

In the Rest of the World region, the use of palladium in autocatalysts increased by 60,000 oz to 485,000 oz. The increase would have been greater by several thousand ounces had the introduction of South Korean LEV regulations not been postponed. As with platinum, palladium demand benefited from the introduction of tighter vehicle emission regulations in China and India, and rising light vehicle production in China and Brazil.

Autocatalyst Recovery

There was a strong rise in the amount of palladium recovered from recycled autocatalysts in 2001: the total volume increased from 230,000 oz to 290,000 oz. Three quarters of the 60,000 oz increase was accounted for by greater recovery of palladium in North America.

Between July 2000 and January 2001 the rapid increase in the price of pgm, particularly palladium, stimulated efforts to maximise collection of autocatalysts from scrapped vehicles and recovery of the precious metal content. Return of autocatalysts for pgm recovery also climbed in Europe and Japan, boosting secondary palladium supply, but the volumes remain relatively small.

Cars fitted with catalytic converters that primarily contain palladium, rather than platinum, are beginning to be scrapped in rising numbers, increasing the availability of palladium for recovery. Auto manufacturers started using palladium based autocatalysts in significant numbers from the mid 1990s. As many of these vehicles come to the end of their lives over the next few years, the supply of recovered palladium is expected to grow accordingly.

Chemical

After a strong 2000, chemical industry demand for palladium last year fell by 8 per cent (20,000 oz) to 235,000 oz. Sales of palladium catalysts for vinyl acetate monomer production declined, while demand for palladium catchment gauzes from the nitric acid sector was static.

Palladium catalysts are used in the production of vinyl acetate monomer (VAM), the precursor to a wide range of polymers that find application in products such as paints and adhesives. The slowing global economy in 2001 weakened demand for products derived from VAM. This, in turn, reduced demand for palladium catalysts.

The other leading application for palladium process catalysts is in the manufacture of bulk petrochemicals, particularly purified terephthalic acid

BP Chemicals' plant at Hull, UK has an annual capacity of 250,000 tonnes vinyl acetate monomer

(PTA) and polyethylene terephthalate (PET), which are widely used in packaging materials and artificial fibres such as polyester. As with VAM, reduced economic activity in North America, Europe and Japan acted as a brake on PTA and PET demand in 2001.

In contrast, the pharmaceutical and speciality chemicals sectors continued to provide solid growth in demand for palladium based catalysts. Growth was driven by development of new drug treatments, personal care products and food production technologies.

Demand for palladium catchment gauzes from the nitric acid industry was limited by the same market factors that held back demand for platinum catalysts – poor crop prices and a bad spring planting season led to weak fertiliser demand. However, there are indications that the large fall in the palladium price during 2001 may now be increasing demand for palladium gauzes in the North American market.

Palladium Demand: Chemical
'000 oz

	2000	2001
Europe	95	65
Japan	20	20
North America	65	75
Rest of the World	75	75
Total	**255**	**235**

Dental

The rise in the palladium price to over $1,000 per oz in early 2001 affected demand for palladium based dental alloys markedly. Demand fell by 18 per cent to 670,000 oz as base metal and gold alloys took market share from palladium. The impact was most severe in Europe, where demand plunged by 60 per cent.

The European dental industry has made considerable investment over the past 2 to 3 years in equipment and staff training to enable greater use of base metal alloys, rather than the more traditional palladium-rich formulations. Consequently, when the price of palladium soared, many European dental practices were able to move quickly towards the use of alternatives. Demand for palladium slumped to 40,000 oz in 2001, down from 100,000 oz in 2000 and 180,000 oz in 1999. Because of the investment made in the development of substitute materials, many of these losses are unlikely to be recovered, even if the palladium price remains relatively low.

North American and Japanese use of palladium dental alloys also suffered from the metal's price in early 2001: demand fell by 40,000 oz in each region last year. The Japanese market has become more sensitive to the price of palladium since 1999, when the state health insurance scheme placed an increasing proportion of the costs of treatment on the patient.

Electronics

Palladium demand from the global electronics industry collapsed from 2.16 million oz in 2000 to only 700,000 oz in 2001, a slump of almost 70 per cent. There were two main causes: high product and component inventories compounded by poor sales of electronic goods, and the high and volatile price of palladium, which caused manufacturers to run down their strategic stocks of the metal.

Palladium Demand: Dental
'000 oz

	2000	2001
Europe	100	40
Japan	470	430
North America	230	190
Rest of the World	20	10
Total	**820**	**670**

A sharp downturn in the electronic products market at the end of 2000 left retailers and manufacturers with higher than expected inventories. This, in turn, meant producers of electronic components also had high stock levels at the start of 2001. The impact of this stock build up on demand for electronic raw materials was compounded by falling sales of finished goods during the year as the leading economies of the USA, Japan and Germany all slowed. Both personal computer and mobile phone sales are estimated to have fallen by 5 per cent worldwide last year, while orders for automobile electronics were hit by the decline in vehicle production in North America and Japan.

Attempts by manufacturers to reduce their component stock levels, coupled with weaker retail sales, had a pronounced effect on the production of multi-layer ceramic capacitors (MLCC) – by far the leading electronics application for palladium. MLCC output dropped by 27 per cent to 435 billion units last year.

The impact of the high palladium price on demand for the metal from MLCC manufacturers was even more pronounced than the decline in component production. MLCC producers, who were experiencing an erosion of profitability, increasingly worked from strategic stockpiles of palladium during the year and made strenuous efforts to maximise recycling of production scrap. Many manufacturers, particularly those in Japan, are believed to have had substantial holdings of palladium in January and made few purchases of new metal during the year. The result was that demand for palladium from the MLCC industry fell considerably.

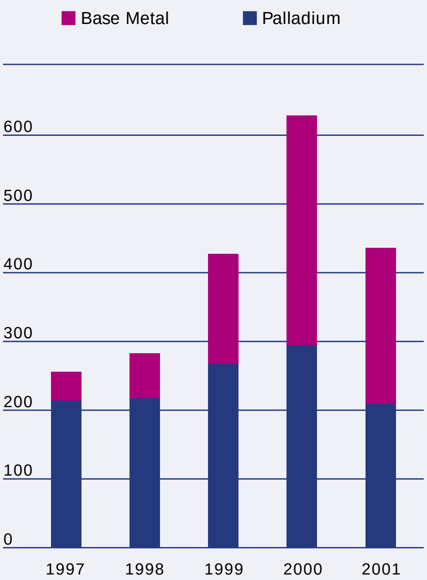
The rapid increase in market share taken by nickel electrode MLCC since the mid 1990s abated last year. Palladium based MLCC, however, are likely to lose further ground when the profitability of manufacturers improves and investment in base metal MLCC production equipment gathers pace.

The weakness in electronics sales and high component inventories also affected demand for palladium based conductive pastes in hybrid integrated circuits (HIC). However, demand was supported to a certain extent by the automotive aftermarket – a major user of HIC. Repair rates increased last year as consumers deferred new vehicle purchases. The performance advantages of palladium in HIC mean that it faces less competition from base metal products in this sector than for MLCC. The fall in the palladium price in the second half of 2001 has further reduced the threat of substitution.

Demand for palladium in plating applications fell by almost 50 per cent during 2001. In addition to the market and inventory issues that affected demand for electronic components, the high price of palladium meant that gold was increasingly used to plate connectors. Manufacturers also made efforts to thrift palladium coatings on lead frames. The price of palladium will have a large bearing on the level of demand for plating electrical components in 2002.

Deferred replacement of electronic products by businesses and consumers reduced the availability of electronic scrap in 2001. In addition, efforts to thrift the use of precious metals in electronics applications is reducing the concentration of pgm in scrap. The amount of palladium returned to the market from this source fell to 290,000 oz, versus 320,000 oz the year before.

MLCC Production by Electrode Type 1997-2001
Billions



Palladium Demand: Electronics
'000 oz

	2000	2001
Europe	265	135
Japan	990	280
North America	485	90
Rest of the World	420	195
Total	**2,160**	**700**

Other

Demand for palladium in jewellery and other applications slipped by 10,000 oz in 2001 to 305,000 oz. In the Japanese jewellery sector, intensive inventory reduction of platinum jewellery and lower retail sales cut fabricator demand for platinum-palladium alloys (typically 5 to 15 per cent palladium). This offset a rise in the production of white gold jewellery, which often contains palladium as a whitening agent. Further substitution of palladium occurred in the North American petroleum refining industry, whilst consumption in most other applications was stable.

Global demand for palladium from jewellery fabricators fell by 15,000 oz to 240,000 oz in 2001. Japan is by far the largest consumer of platinum-palladium jewellery alloys and the Japanese platinum jewellery industry had a relatively poor year. Many manufacturers and retailers reacted to falling retail sales by cutting their inventory levels of jewellery as much as possible and remelting old stock. This greatly reduced demand for platinum, diminishing the need for palladium as an alloying agent.

The Japanese jewellery trade tried to cut costs by increasing output of white gold products. However, although white gold alloys in Japan usually contain a proportion of palladium, the impact was not sufficient to outweigh the drop in the platinum sector. At the same time manufacturers reduced the percentage of palladium used in white gold alloys when the palladium price rose.

In China, platinum jewellery manufacture expanded strongly in 2001 but the impact on palladium was limited. The Chinese jewellery industry uses several different alloying metals in addition to palladium, and also migrated towards alloys containing a higher percentage of platinum.

Demand for palladium in petroleum refining continued to be affected by the replacement of some palladium based hydrocracking catalysts with base metal formulations last year. The scale of substitution, however, was lower than in 2000, resulting in reduced sales of reclaimed metal back to the market. In most other palladium applications, such as brazing alloys and catalysts for stationary pollution control, demand was largely unchanged.

Palladium Demand: Other
'000 oz

	2000	2001
Europe	65	55
Japan	165	150
North America	15	25
Rest of the World	70	75
Total	**315**	**305**