

# PALLADIUM

Palladium demand is forecast to rise by 260,000 oz to 7.19 million ounces in 2008, its highest level since 2005. The autocatalyst sector should use marginally more palladium than in the previous year. The electronics and investment sectors will also take more metal than in 2007 but dental demand is set to edge lower. Palladium jewellery demand will rebound after falling for two successive years with growth in metal purchases in China, Europe and North America.

## AUTOCATALYST

Gross autocatalyst demand for palladium is forecast to increase by 0.7 per cent to a global total of 4.58 million ounces in 2008. Auto makers continue to replace platinum with palladium in their gasoline and diesel formulations where possible. With vehicle production rising in China and the Rest of the World region, palladium demand is growing despite much weaker North American output.

## Europe

Palladium purchases by the European autocatalyst sector are set to rise to 1.12 million ounces in 2008. Few catalysts fitted to gasoline cars contain platinum: most now use palladium formulations and little room remains for further substitution. Growth will instead be due to rising use of palladium on diesel vehicles.

With some car makers now fitting gasoline catalysts to meet the forthcoming Euro 5 emissions rules, some average catalyst loadings will rise in 2008. However, many palladium formulations which were already in use have been successfully thrifted. With European vehicle production expected to be flat in 2008, palladium demand for gasoline catalysts will change little this year.

In the diesel sector, a growing number of oxidation catalysts and particulate filters contains palladium as well as platinum.

This will drive much of the growth in consumption, contributing over 200,000 oz of gross demand in 2008.

## Japan

Japanese light duty vehicle production is set to climb slightly to 11.4 million units in 2008. Auto makers have been gradually moving catalyst formulations from being platinum-based to palladium-based. Despite this, gross annual palladium demand is expected to drop marginally, by 0.6 per cent, to 810,000 oz.

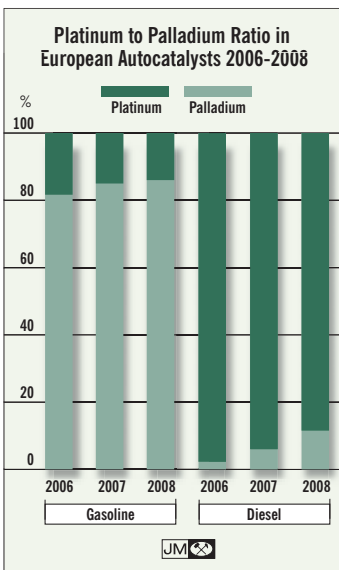
Fewer than half of all vehicles made in Japan are sold domestically with the remainder being exported. Domestic sales will be weak this year and Japan has recently become the first developed nation where the total number of cars in use is falling. However, more vehicles will be exported this year than in 2007, supporting palladium demand at close to last year's levels despite a small amount of ongoing thrifting.

## North America

North American (Canadian and US) light duty vehicle manufacturing volumes are set to fall for the third successive year, to only 11.0 million units in 2008. This will reduce regional autocatalyst demand for palladium significantly. However, an additional clear trend is the move to downsize both vehicle and engine sizes. High fuel prices and a weak domestic economy have led many consumers to move to vehicles which are, in North American terms, comparatively small. In mid-2008, Ford and General Motors announced plans to refocus their production on these smaller vehicles.

The number of trucks and sports utility vehicles manufactured in North America this year is therefore likely to fall by a greater percentage than is the number of conventional automobiles produced there. This will further exacerbate the effect of the downturn in production volumes, driving down average catalyst volumes and metal content. North American automotive palladium demand will therefore fall by an estimated 20.6 per cent to 1.35 million ounces this year.

The amount of palladium used in diesel oxidation catalysts and diesel particulate filters will be over 200,000 oz this year.



Palladium Demand: Autocatalyst '000 oz		
	2007	2008
Europe	925	1,115
Japan	815	810
North America	1,695	1,345
China	325	410
Rest of the World	785	895
<b>Total</b>	<b>4,545</b>	<b>4,575</b>

## China

Chinese light duty vehicle production is forecast to rise by more than ten per cent again this year despite some signs that the pace of growth may be slowing. This equates to additional annual production of more than one million catalysed vehicles. Chinese palladium purchases by the autocatalyst sector will therefore rise strongly in 2008, to a new record level of 410,000 oz.

New emissions rules for cars, closely equivalent to Euro 3, were introduced in July 2008, a year later than originally planned, due to the challenges of providing gasoline of sufficiently-high quality. However, many manufacturers were already fitting catalysts to meet these emissions limits and pgm loadings on these catalysts should change little. By contrast, the introduction of Euro 4 rules in the largest cities will lead to some increase in palladium usage this year.

However, the average pgm content of a catalyst in this region remains lower than at the equivalent stage of legislation in Europe, reflecting smaller average engine sizes in China, and the accumulated experience in thrifting of the pgm content of a catalyst.

## Rest of the World

Production in much of the Rest of the World region is healthy. Vehicle output in India, Russia and South America will grow strongly this year. In many of these markets there is a strong focus on meeting emissions legislation at low cost and palladium/rhodium catalysts are almost universally employed on gasoline vehicles. The tightening of emissions legislation – for instance the introduction of rules equivalent to Euro 3 in Russia earlier this year – and rising vehicle production numbers should push palladium demand up to a record 895,000 oz in the Rest of the World region.

## Autocatalyst Recycling

The amount of palladium recovered from end-of-life autocatalysts will rise by a forecast 12.6 per cent this year, to 1.08 million ounces.

The cumulative weight of metal in catalysts fitted on vehicles is greatest in North America where autocatalysts first came into use. The average vehicle size and pgm content of a catalyst are highest here

and North America also has the most well-established collection infrastructure. As a result, 55 per cent of all metal reclaimed globally from autocatalysts comes from cars and trucks scrapped in North America. We forecast that 600,000 oz of palladium will be recovered here in 2008, 7.1 per cent more than in the previous year, with high metal prices boosting recycling rates.

More palladium will be recovered from spent autocatalysts in Europe too. Palladium usage in the European automotive sector peaked around the end of the last decade. The average palladium content of a scrapped catalyst will continue to rise for the next few years as more of the cars produced at this point are recycled as they reach the end of their useful lives.

## DENTAL

**Net palladium demand from the dental sector is expected to be 630,000 oz, almost identical to the 2007 figure. Palladium is losing some ground in Europe – principally in Italy – but this will be balanced by slight additional demand in North America. The Japanese market will be flat in 2008.**

Long-term trends dominate the use of palladium in this conservative industry. Most Japanese demand derives from the use of Kinpala (a gold/silver/palladium alloy) where its use is subsidised by the government. A steady decrease in the aggregate annual number of visits to dentists in Japan is eroding this market and gross demand will fall again this year.

However, net demand will be more stable due to a fall in recycling of Kinpala scrap from dental laboratories. Before 2007 recycling rates were low but they rose that year, reflecting the increased efficiency of collection and reprocessing of a backlog of scrap alloy. With this material collected, recycling rates will return to a lower, more sustainable level in 2008. This decrease in recycling almost

Palladium Demand: Autocatalyst Recovery		
	'000 oz	
	2007	2008
Europe	(300)	(365)
Japan	(30)	(35)
North America	(560)	(600)
China	(5)	(5)
Rest of the World	(60)	(70)
<b>Total</b>	<b>(955)</b>	<b>(1,075)</b>



Palladium Demand: Dental		
	'000 oz	
	2007	2008
Europe	75	65
Japan	275	275
North America	265	270
China	5	5
Rest of the World	15	15
<b>Total</b>	<b>635</b>	<b>630</b>



exactly balances the fall in use of Kinpala, and net Japanese dental demand will be flat at 275,000 oz.

In North America, palladium demand will rise by 5,000 oz to 270,000 oz. In this market, a high price differential between palladium and gold has encouraged some dentists to switch from the use of high-gold content alloys to lower-gold palladium-based alloys, driving this slight additional demand.

## ELECTRONICS

**Electronics sector palladium demand is set to rise by 50,000 oz to a 2008 total of 1.29 million ounces. Palladium is benefiting from a cost advantage over gold in some applications, while growth in production of electronic components will outweigh any reduction in average palladium content.**

Palladium Demand: Electronics '000 oz		
	2007	2008
Europe	160	160
Japan	270	245
North America	190	200
China	325	355
Rest of the World	295	330
<b>Total</b>	<b>1,240</b>	<b>1,290</b>

The main use of palladium in the electronics industry is in multi-layer ceramic capacitors (MLCC) which are used in many applications. The number of MLCC produced will rise again in 2008, reflecting a move to greater functionality and complexity in the consumer and automotive electronics markets – including growth in the number of mobile

phones with cameras and the introduction of multicore processors in personal computers.

Component manufacturers continue to work on controlling costs. Thrifting of the palladium content of the pastes used is increasingly difficult, as much has already been achieved in this area. However, miniaturisation is a key trend and the average sizes of devices such as MLCC are shrinking. This will, though, not be sufficient to outweigh rising MLCC volumes.

Palladium is also used for plating in electronics where it often competes with gold. Its lower density and sustained price advantage compared to gold have allowed it to gain market share, increasing demand.

The recovery of palladium from scrapped electronic devices will rise in 2008, continuing the trend of recent years. Developed nations are increasingly subject to stringent rules on the recycling of a range of end-of-life consumer electronics and electrical devices. The weight of palladium reclaimed from these is rising

steadily. However, recovery rates are lower in China and much of the Rest of the World region. Recycling here is often subject to less strict rules and employs less-advanced technology. Recyclers will reclaim the highest value components first, which typically include copper and gold, and will often not recover the ppm content of this scrap material.

## JEWELLERY

**Global net jewellery demand for palladium is expected to grow by 7.6 per cent to 780,000 oz in 2008. Sales and manufacturing volumes of palladium jewellery are edging up in Europe and North America. Palladium purchases by the larger Chinese jewellery industry should also rise in 2008 as the rate of recycling of old stock decreases.**

### China

Net demand for palladium for jewellery production in China is forecast to grow by 10.0 per cent in 2008, to 550,000 oz, despite challenging market conditions.

In fact, palladium demand from jewellery manufacturers was relatively weak in the first half of 2008. The palladium price hit a six-year high in March and encouraged the industry to reduce stocks of metal in order to control working capital. The huge earthquake in Szechuan in May also appears to have temporarily affected jewellery sales. This area is one of the strongholds for palladium jewellery and the enormous damage caused unsurprisingly had a strong negative impact on jewellery sales.

However, purchases of palladium by manufacturers rose in the third quarter of 2008 and should be healthy in the final quarter. Palladium jewellery is benefiting from the fall in the palladium price compared to the price of gold. This has driven extra manufacturing and retail interest compared to earlier in the year.

Demand has also been supported by a decrease in the usage of recycled metal from unsold Pd950 (95 per cent purity) jewellery. Most of this material has now either been sold to

Palladium Demand: Jewellery '000 oz		
	2007	2008
Europe	45	50
Japan	100	80
North America	55	75
China	500	550
Rest of the World	25	25
<b>Total</b>	<b>725</b>	<b>780</b>

consumers or returned for conversion to higher-purity pieces. Fresh metal, therefore makes up an increasing percentage of the metal used by manufacturers, meaning that demand now more closely reflects manufacturing volumes.

### Other Regions

In Europe and in North America, palladium is steadily establishing itself as a jewellery metal. The high price differential which has existed between palladium and both platinum and gold for some time has encouraged manufacturers to work with this material. New, improved casting alloys have made the manufacturing processes easier to carry out and have improved product quality. Product availability and consumer acceptance of palladium are therefore growing in both markets. Combined palladium demand is expected to rise by 25 per cent to 125,000 oz this year.

In contrast, palladium demand in Japan is expected to fall. Palladium is used in platinum jewellery alloys. The volumes of all types of jewellery being sold in Japan are expected to fall this year and this will drag palladium demand lower. Additionally, large amounts of platinum jewellery were recycled in the first half of 2008, with the 10-15 per cent palladium content of a typical piece also being recovered. As a result, palladium demand in Japan – net of recycling – is set to fall by 20 per cent to 80,000 oz in 2008.

### CHEMICAL

**Net palladium demand from the chemical sector is forecast to grow by 10.4 per cent to a total of 425,000 oz this year, as companies construct further manufacturing capacity for commodity chemicals in**

Palladium Demand: Chemical '000 oz		
	2007	2008
Europe	100	105
Japan	25	25
North America	80	80
China	80	90
Rest of the World	100	125
<b>Total</b>	<b>385</b>	<b>425</b>

**the Rest of the World region.**

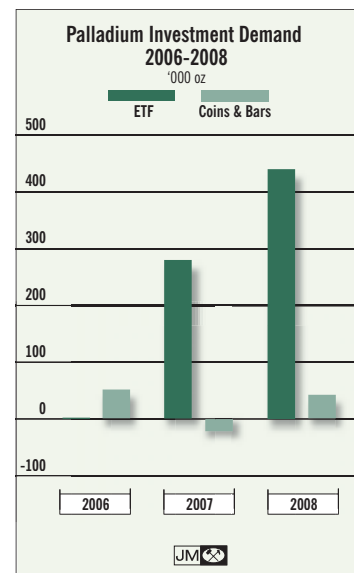
Output of chemicals such as purified terephthalic acid (PTA), vinyl acetate monomer (VAM) and hydrogen peroxide is rising in order to meet demand. Palladium process catalysts are used in the production of all three compounds and demand will rise by more than ten per cent. Growth will be seen in all regions

but is particularly strong in China and the Rest of the World region where the largest chemical production facilities are being constructed.

Growing numbers of nitric acid plants employ palladium catchment gauzes to cut losses of the more expensive platinum from the catalytic gauzes which are used. Palladium purchases for new installations of catchment gauzes and top-up catalyst will rise in China and the Rest of the World region and fall in Europe and North America in 2008.

### INVESTMENT

**Physical palladium investment demand is expected to soar by 80 per cent in 2008 to a record total of 470,000 oz. Purchases through Exchange Traded Funds, or ETFs, will constitute most of this demand but we also expect some investment in**



**coins and small bars in North America.** 280,000 oz of metal were bought through the two palladium ETFs in 2007 under steady buying. However, in 2008, the weight of metal purchased each month has varied with movements in the price. As palladium reached its highest price of the year to date in March, large amounts of metal were purchased. Interestingly, while platinum was sold from the ETFs from July to September, the palladium positions changed little, suggesting that many investors in this metal are willing to hold it for the longer-term. Assuming that there are no further price spikes in 2008, we expect to see net annual demand of 430,000 oz through the ETFs.

*The majority of physical palladium investment demand is now through the two European Exchange Traded Funds.*

Interest in palladium coins was muted for the first half of 2008 but has since returned. Rapid fluctuations in the prices of all of the precious metals reduced the availability of gold and platinum coins. This has reinvigorated buying interest in palladium coins as an alternative and investors will purchase a net 40,000 oz of palladium in this form.

Palladium Demand: Investment '000 oz		
	2007	2008
Europe	280	430
Japan	0	0
North America	(20)	40
China	0	0
Rest of the World	0	0
<b>Total</b>	<b>260</b>	<b>470</b>

# JEWELLERY RECYCLING

**Falling headline figures for net platinum and palladium jewellery demand over recent years have obscured some of the trends in this sector. High platinum prices have had a negative impact on platinum jewellery sales, while palladium has retained its price advantage over other materials and jewellery demand is rising.**

**However, rising pgm prices have also meant that recycling of unsold retail stock and old pieces from consumers has become ever more important in this industry, reducing net demand for metal.**

## PLATINUM RECYCLING

The recycling of platinum jewellery is greatest in China and Japan where the total weights of metal bought by consumers in recent decades are highest. However, there are significant differences in how recycling functions in these two countries.

In China, retail margins are lower than they are in most other countries and platinum jewellery often acts not just as a decorative item but also as a store of value. Consumers are therefore aware of the value of the precious metal and a market has built up where retailers will exchange old platinum jewellery for new pieces.

This material typically returns to the manufacturers for remelting and reworking into new jewellery, offsetting demand for new metal. Importantly, since jewellery is only returned in part exchange for a new piece of higher price, it is not possible for more metal to be recycled than is used in manufacturing.

High prices have driven this recycling activity and have also encouraged retailers and manufacturers to minimise their stocks, often by recycling and

re-manufacturing them. As prices fall, the level of recycling in China is therefore likely to fall too.

In Japan, the situation is somewhat different: in the last few years a network of jewellery collectors and pawn shops has become established which will buy old jewellery for cash from consumers. Much of this is in the form of neckchains or rings bought in the 1970s and 1980s.

Some of this scrap material is reused in jewellery production within Japan but a volume of scrap is also exported for refining and much is refined within Japan and then exported or used in other industries.

The rising Yen price for platinum over the last few years has raised the profile of the recycling industry and increased the weight of metal recovered dramatically. It is likely that more metal was recycled in the first half of 2008 than was used in domestic jewellery manufacturing, i.e. net Japanese jewellery demand was temporarily negative.

However, as in China, the steep drop in the platinum price restricted the flow of jewellery scrap in the third quarter of 2008. Assuming that the price remains depressed for the remainder of 2008, net demand for the year should be positive.

Consumer behaviour is quite different in Europe and North America. Although the jewellery trade in these regions has reduced inventories due to high metal prices, very little second-hand jewellery is returned for resale or recycling. As a result, changes in jewellery demand here closely reflect trends in manufacturing volumes.

## PALLADIUM RECYCLING

By contrast, most global palladium jewellery demand is for the

manufacture and sale of jewellery items in China. While it is possible for consumers to trade in second-hand palladium jewellery, many shops do not offer this service or only allow exchange for new palladium pieces as the retail price is significantly higher than the raw material price. The market is also much younger than the platinum jewellery market and there are fewer palladium pieces to be returned. The purchase and reprocessing of old palladium jewellery is therefore not an important trend.

However, manufacturers are still receiving some quantities of Pd950, an earlier, lower-purity material, to rework into Pd990 (a 99 per cent palladium alloy). This Pd950 did not sell particularly well to consumers and shops have therefore sought to minimise their inventory costs by returning jewellery made from this alloy and recycling it into Pd990, reducing the amount of metal that manufacturers have had to buy in order to manufacture new product. However, it is likely that most of this Pd950 stock has now been reprocessed.

Material flows from this source have therefore started to decrease and Chinese manufacturers have been forced to purchase more of their palladium requirements as new metal, driving demand higher.

*Net platinum jewellery demand will be depressed by over 500,000 oz of recycling during 2008.*

