PALLADIUM

Net global demand for palladium increased by 15,000 oz in 2008 to a total of 6.85 million ounces. Gross demand from the autocatalyst sector fell to 4.38 million ounces due to slowing vehicle production in North America. Net purchases of palladium by the electronics sector rose to 1.33 million ounces but chemical sector demand fell to 350,000 oz as the economic slowdown took hold. Palladium usage in the dental sector remained steady at 630,000 oz while physical investment demand reached 400,000 oz of metal, 54 per cent up on the 2007 figure.

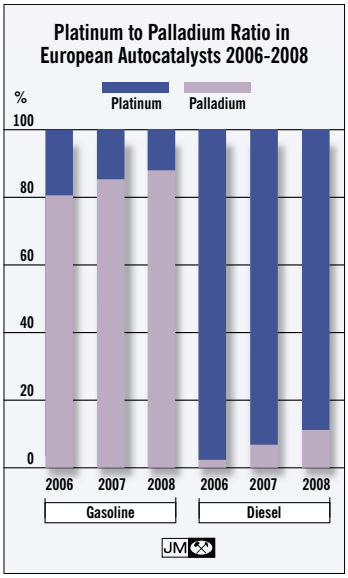
The increasing use of palladium in diesel filters provided some support for autocatalyst palladium demand in Europe.

AUTOCATALYST

Gross demand for palladium from the autocatalyst sector fell by 165,000 oz in 2008 to an annual total of 4.38 million ounces. Global vehicle sales slowed throughout the year and a steep drop in North American light duty vehicle output cut gross palladium demand in this region by 350,000 oz compared to 2007. Continued penetration of palladium into the diesel catalyst sector in Europe provided good support for overall demand, as did growing vehicle production and tighter emissions rules in countries such as China and Russia.

Europe

Palladium use on gasoline vehicles decreased in 2008 in Europe but total demand grew in this region due to increased use in the diesel sector.



Gross demand for palladium from the European autocatalyst industry climbed by 3.3 per cent to 950,000 oz in 2008, despite a 6 per cent fall in European light duty vehicle production to an annual total of 19.3 million units.

This fall in vehicle production was broadly matched by a decrease in the use of palladium demand on gasoline vehicles. As we have previously noted, very little scope remains for replacement of platinum by palladium in three-way catalysts on gasoline vehicles within Europe. Nonetheless, a small amount of switching of catalyst formulations was seen during 2008, adding marginally to palladium demand. The Euro 5 emissions rules due to be applied to new light duty vehicle models in late 2009 (and to all new cars in early 2011) also provided a boost to palladium demand as manufacturers fitted new, higher-loaded catalysts to a range of vehicles in advance of their introduction.

Changes in the diesel sector, however, were more significant in terms of palladium demand. Auto makers continued to replace many platinum-only diesel oxidation catalyst formulations with platinum/palladium analogues. A growing amount of palladium is also being used in diesel particulate filters alongside platinum – partly to provide thermal stability to the catalytic particles on the filter. These trends drove palladium demand in the European diesel vehicle market to close to 250,000 oz in 2008. (Further information on the use of palladium in diesel catalysts can be found in our special feature on page 39.)

Japan

Japanese auto makers bought 30,000 oz more palladium in 2008 – 850,000 oz in total – than in 2007. Light duty vehicle production in Japan slipped only marginally to 11.1 million units, although both domestic and export sales weakened at the end of the year.

Gross Palladium Demand: Autocatalyst
'000 oz

	2007	2008
Europe	920	950
Japan	820	850
North America	1,695	1,345
China	325	385
Rest of the World	785	850
Total	**4,545**	**4,380**

JM

A large proportion of the vehicles manufactured in Japan are sold in other countries. While exports grew by two per cent during 2008, the final quarter was very weak with vehicle sales to the most important export markets – North America and Western Europe – falling quickly. The decline in sales had little impact on 2008 production but has continued and is set to lead to lower domestic production this year.

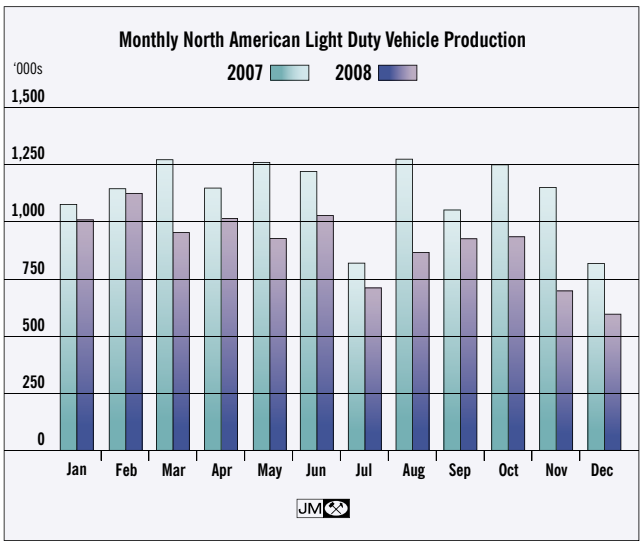
In Japan, there have been no new emissions regulations for some time. Despite this, auto makers have continued to improve the environmental performance of their vehicles in order to keep pace with developments in Europe and North America. Many cars now meet the voluntary J-ULEV standard. Although the precious metal loadings of some catalysts have been increased to achieve lower emissions, this has been accompanied by thrifting of other catalyst formulations. Average catalyst metal loadings in the domestic market have thus remained relatively static.

However, as we have previously reported, the Japanese car makers tend to use a large proportion of platinum on their export vehicles in comparison with other manufacturers. They have therefore increasingly replaced platinum/rhodium catalysts with palladium/rhodium catalysts on many of their locally-sold vehicles in order to balance their usage of the different metals and to control costs. High rhodium prices have also encouraged the thrifting of rhodium and its partial replacement by larger amounts of palladium, adding some strength to palladium demand in this country.

North America

North American purchases of palladium for use by the autocatalyst sector fell dramatically – by 20.6 per cent or 350,000 oz – to 1.35 million ounces in 2008, the lowest figure since 2003.

Although a slowdown in the US economy had initially been predicted to cut North American vehicle sales by more than ten per cent last year, the reality was substantially worse. While sales were somewhat weak in the first half of the year, a rapidly weakening economy saw sales decline further each month, with vehicle purchases in December falling a hefty 36 per cent below December 2007 levels. With inventories of unsold vehicles rising, the major auto makers cut production sharply in the second half of the year with some factories experiencing long shutdowns in the final quarter, leading to a decrease in demand for catalytic converters and for palladium.



North American light duty vehicle output worsened throughout the year as the economic gloom deepened in that region.

Historically-high oil prices also had an effect in early 2008 as consumers purchased more economical smaller vehicles instead of the largest sports utility vehicles (SUVs). A combination of an increasingly feeble economy and a lack of available credit for consumers also negatively affected demand for larger, more expensive vehicles. Both SUVs and light trucks are typically fitted with larger autocatalysts with a higher precious metal content than smaller vehicles. The decrease in the market share of such vehicles therefore drove down the average metal content per vehicle, further cutting palladium consumption.

Palladium demand did derive some slight support from the continuing trend to replace platinum with palladium in three-way catalysts. While this has been underway for some time, it continued during 2008, helping support palladium use at the expense of platinum. However, we believe that this process is now essentially complete.

China

Gross palladium purchases by Chinese vehicle manufacturers increased from 325,000 oz to 385,000 oz in 2008. Although domestic passenger car production grew by 5.9 per cent in 2008, this was the slowest rate of growth for a number of years. Moreover, the pattern of vehicle sales during 2008 was unusual: consumer

A fall in consumer confidence and a lack of availability of credit depressed vehicle sales in North America during 2008.

purchasing was soft around the time of the Beijing Olympics and weakened again later in the year before the Chinese government cut sales taxes in order to reinforce demand.

New emissions legislation was enacted throughout China in mid-2008. Every light duty vehicle manufactured for sale in China should now meet either Euro 3 or Euro 4-equivalent legislation. This tightening of emissions standards has driven an increase in the palladium loading of a typical catalyst and added to palladium demand.

Rest of the World

Demand for palladium for autocatalysts in the Rest of the World region climbed by 65,000 oz to a total of 850,000 oz in 2008. In Brazil, vehicle sales increased strongly as the economy expanded. With auto makers changing some catalyst formulations to meet the Proconve L-5 emissions rules due to come into force in 2009 in Brazil, palladium demand there rose healthily.

In Russia, annual vehicle production soared by roughly ten per cent to 1.7 million units despite a sharp downturn at the end of the year. With new emissions legislation also coming into force in Russia in 2008, palladium usage increased significantly. Mexican automotive palladium demand climbed too, due to an increase in vehicle production in 2008 following the relocation of some manufacturing from the USA to Mexico.

Autocatalyst Recovery

The weight of palladium recovered from end-of-life catalytic converters grew by 15.3 per cent to 1.17 million ounces in 2008. The record platinum group metal prices of the first half of 2008 – particularly that of rhodium – made the recovery and recycling of catalytic converters from end-of-life vehicles highly economically attractive in every region.

Palladium Demand: Autocatalyst Recovery
'000 oz

	2007	2008
Europe	(300)	(365)
Japan	(35)	(65)
North America	(590)	(625)
China	(20)	(30)
Rest of the World	(70)	(85)
Total	**(1,015)**	**(1,170)**

JM

The weight of palladium recovered from spent autocatalysts in North America climbed to 625,000 oz in 2008. Sales of new vehicles were depressed by the economic climate and scrappage rates for vehicles fell as a consequence. However, the average palladium content of a scrapped autocatalyst continued to grow, reflecting heavy use of palladium in the North American automotive market at the end of the last decade. This, when combined with the processing of stocks of spent catalysts which recyclers had already built up, outweighed the effect of lower numbers of vehicles being scrapped.

High commodity prices during the first half of 2008 drove record autocatalyst recycling volumes in every region.

In Europe, palladium recycling volumes also increased in 2008, to a record 365,000 oz. As in North America, the peak period for usage of palladium in the autocatalyst sector was from 1999 to 2001 and the average palladium loading of an end-of-life catalyst has continued to increase. As with platinum, recycling rates were extraordinarily strong in the first half of the year as high prices drove the recycling industry to minimise stocks and increase its throughput. When metal prices eventually fell, recycling volumes rapidly dwindled as collectors became more reluctant to sell their stocks of scrap catalysts, leaving annual palladium recycling volumes only 65,000 oz higher than one year previously.

In Japan, a large proportion of vehicles which are deregistered is exported for re-use elsewhere in the world. As a result, volumes of metal recovered from autocatalysts remain relatively low at 65,000 oz. Combined palladium recovery from China and the Rest of the World region was 115,000 oz.

JEWELLERY

Net demand for palladium from the jewellery industry climbed by 19.6 per cent to 855,000 oz in 2008. High platinum and gold prices drove manufacturers to produce more palladium jewellery in China and recycling rates fell, driving net annual demand there 30 per cent higher to 650,000 oz. In Europe and in North America, the steady improvement in the uptake of palladium by manufacturers and consumers continued and demand grew in both regions.

Palladium Demand: Jewellery
'000 oz

	Gross		Recycling		Net	
	2007	2008	2007	2008	2007	2008
Europe	40	45	0	0	40	45
Japan	125	115	(30)	(40)	95	75
North America	55	60	0	0	55	60
China	705	740	(205)	(90)	500	650
Rest of the World	25	25	0	0	25	25
Total	**950**	**985**	**(235)**	**(130)**	**715**	**855**

JM

See notes to table on page 26.

China

The volume of palladium jewellery manufactured in 2008 initially showed healthy growth from the previous year. The dizzying rise in the prices of platinum and gold – as well as the highly volatile behaviour of their prices – reduced profit margins on jewellery made from either of these metals throughout the trade. As a result, a number of manufacturers switched some of their production capacity to the manufacture of palladium in the first half of the year, driving demand higher than it had been one year previously.

In fact, production volumes of palladium jewellery remained strong throughout the first three quarters of the year. They fell only when manufacturing was switched back into platinum as the platinum price, having dropped by more than half, reached some level of stability in the final quarter. Additionally, we believe that many manufacturers and wholesalers increased their working stocks of palladium metal and jewellery during 2008, adding further to demand.

Palladium jewellery is popular with many consumers in the West and North-East of China.

However, the retail picture for palladium jewellery remains very mixed. It is virtually absent from many first tier cities but has a much stronger presence and market share in second and third tier cities, particularly as plain metal jewellery rather than gem-set pieces (although this latter sector is growing). Its popularity is also geographically-varied with provinces in the West and North-East of China being the largest markets. It is therefore worth noting that the earthquake in May in Szechuan – perhaps the largest market for palladium jewellery – had a negative impact on demand.

Part of the reason for the slow development of the palladium jewellery market may be due to the pricing structure for this metal. Unlike gold and platinum, the retail price for palladium jewellery is typically several times the cost of the metal itself and some retailers will neither exchange nor buy-back worn palladium jewellery. It is thus not seen as a store of value by consumers in the same way that gold and platinum often are. The sharp fall in the metal price in the second half of last year depressed both the resale value of palladium jewellery and the volumes of old jewellery exchanged. Should the current low resale value persist, this could affect consumer sentiment and have a negative impact on future retail sales.

As we had previously forecast, the flow of recycled metal from unsold palladium jewellery stock within the industry back into jewellery manufacturing also fell last year. Most stock seen at retailers is now in the form of Pd990 (a 99 per cent pure alloy) or even Pd999 (a purer 99.9 per cent alloy) and very little of the old stock of Pd950 now remains to be recycled.

With jewellery manufacturing volumes climbing and recycling decreasing (as shown in the table on page 35), net palladium demand increased by 30 per cent to 650,000 oz in 2008. Implied imports of palladium into China were significantly higher than this figure. It should be noted, however, that some of this imported palladium was subsequently re-exported. We also believe that in the region of 150,000 oz of this metal was not sold for use in industrial or jewellery applications but was instead purchased for short-term speculative purposes. Although this metal may yet be used within the jewellery industry, we do not include this metal in our figure for Chinese jewellery demand and treat it as a movement in market stocks until such time as it unequivocally enters the jewellery trade.

Other Regions

Net jewellery sector demand for palladium also rose in Europe and North America, to 45,000 oz and 60,000 oz respectively, while it decreased to 75,000 oz in Japan.

In Europe and North America, palladium's profile as a jewellery metal continued to grow. Product availability, although still limited, continued to improve. Retailers responded to the high prices of more traditional jewellery metals by introducing palladium into their stores in order to meet attractive price points for consumers. Sales of men's wedding bands in palladium have grown in both regions but fewer women's rings are currently made in this material.

High platinum and gold prices also encouraged a greater number of manufacturers in both regions to start working with this metal and to add it to their product ranges. At the same time, new casting alloys have improved product quality and simplified the manufacturing process.

European jewellery sector demand for palladium was also boosted by strong sales of palladium watches in 2008. We expect further growth in demand within Europe when a hallmark for palladium jewellery is introduced within the UK in late 2009.

In Japan, by contrast, almost no palladium jewellery is manufactured or sold domestically. Palladium demand there is entirely dependent therefore on its use in platinum and white gold alloys. 2008 saw very high levels of consumer scrap jewellery, including platinum, being sold to collectors and refiners. The amount of palladium recovered – typically 10-15 per cent of the total metal content of a piece of jewellery – climbed accordingly. Manufacturing volumes of jewellery were a little lower than in the previous year as a result and net demand fell from 95,000 oz to 75,000 oz. We expect this figure to increase in 2009 if jewellery recycling rates remain at their current low levels.

CHEMICAL

The chemical industry purchased a net 350,000 oz of palladium in 2008. This represented a decrease of 6.7 per cent from 2007, reflecting both an expected slowdown in construction of new plant capacity and the weak performance of the global economy in the final quarter of the year.

As we reported in our Platinum 2008 Interim Review, demand for palladium in the nitric acid industry was strong in the first half of 2008. Palladium catchment gauzes are used in many low to medium pressure nitric acid plants to capture platinum lost from the catalytic burner gauzes. However, as the platinum price fell in the second half of the year, the economic incentive to fit new palladium catchment gauzes decreased. Additionally, as demand for nitric acid itself softened, fewer plants were operated at full capacity, allowing less frequent changes of catalyst. Overall, palladium demand fell slightly.

In other subsectors of the chemical industry, palladium demand was relatively strong throughout much of last year. Extra production capacity for chemicals such as purified terephthalic acid (PTA) and hydrogen peroxide was constructed in China and in the Rest of the World region, contributing substantial demand for palladium. However, with fewer new plants constructed in Asia than in the previous year, demand fell marginally.

Later in the year, as demand for many of these commodity chemicals fell, industry participants worked to reduce stocks of them, leading to substantially lower manufacturing volumes. This trend of destocking continued in early 2009 and with no short-term requirement for new

Palladium Demand: Chemical
'000 oz

	2007	2008
Europe	95	100
Japan	25	20
North America	75	55
China	80	55
Rest of the World	100	120
Total	**375**	**350**

production capacity, demand is likely to fall this year. The lack of credit available to finance the construction of new projects is also likely to delay growth in this sector in the medium term and therefore temper any growth in metal demand over that timescale.

DENTAL

Demand for palladium for dental applications was steady in 2008 at a global total of 630,000 oz. The two key dental markets for palladium are Japan and North America. Demand changed little in either of these locations as a lower metal price helped defend the market share of palladium-based treatments against newer ceramic technology.

Palladium Demand: Dental
'000 oz

	2007	2008
Europe	70	65
Japan	275	275
North America	265	270
China	5	5
Rest of the World	15	15
Total	**630**	**630**

JM

The long-term trend in Japan remains for a decrease in palladium demand. New non-pgm treatments are increasingly competing with the use of the palladium-containing Kinpala alloy. However, the steep decline in the palladium price in the second half of 2008 drove a fall in the amount of scrap alloy recycled. We estimate that the fall in gross manufacturing demand was balanced by this decrease in recycling during the year. Net demand therefore remained static at 275,000 oz in 2008.

In North America, palladium is also primarily used in restorative dental treatments such as the capping of teeth. While the economic slowdown has depressed the number of visits to dentists, it has had little impact so far on this type of dental treatment. Indeed, demand rose by 5,000 oz to 270,000 oz as the high price of gold drove a move towards the use of lower-gold, higher-palladium content dental alloys.

ELECTRONICS

Electronics sector demand for palladium climbed by 6.9 per cent to 1.33 million ounces during 2008. The use of palladium pastes in multi-layer ceramic capacitors (MLCC) continues to be the most important application and a small rise in demand here was the largest single factor in the increase in overall palladium usage.

Palladium Demand: Electronics
'000 oz

	2007	2008
Europe	160	165
Japan	270	250
North America	140	155
China	325	365
Rest of the World	345	390
Total	**1,240**	**1,325**

JM

Sales of consumer electronics goods performed well in the first nine months of 2008 before worsening as the global economy slowed. The increasing complexity of consumer electronics also boosted the number of passive components – such as MLCC – per device. However, the effects of the economic downturn were felt towards the end of the year. Once consumers started to restrict their spending, they not only bought fewer electronic products but also began to purchase cheaper, lower specification devices instead of the more advanced options available. With these typically containing fewer capacitors and hence less precious metal, palladium demand was depressed in the final quarter of 2008, a trend that has continued into 2009.

The fall in automotive output also hit palladium demand in late 2008. Cars now feature increasingly complex electronic systems for applications as diverse as engine control and in-car entertainment. However, a decrease in the number of vehicles manufactured in the more mature markets of North America and Europe led to a decline in demand for palladium-

Despite slowing demand at the end of the year, more palladium was used in multi-layer ceramic capacitors in 2008 than in 2007.

containing electronic components.

There was though, little change in the share of the MLCC market taken by palladium technology. While this has decreased during recent years, many manufacturers still use palladium pastes in higher specification products and palladium-based MLCC still represent some 10-15 per cent of the market.

Finally, palladium competes with gold in some electronics applications. The wide price differential between these two metals might have been expected to boost palladium use in electronic connectors, for example. In this application, layers of palladium can be used in place of some of the gold content, thereby reducing the overall cost of the component. However, the electronics industry exhibits a degree of conservatism, which meant that little production was switched to using palladium. In fact, with the production of connectors falling in 2008, palladium demand for this application was only marginally higher than a year previously.

INVESTMENT

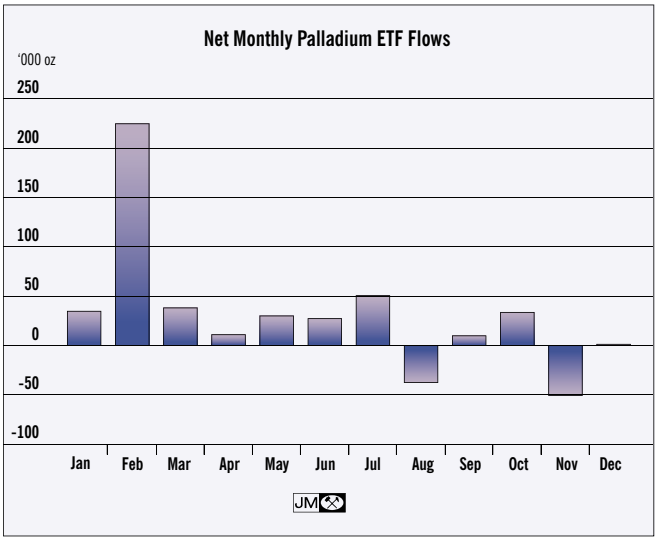
Net demand for physical palladium investment products grew by more than half to 400,000 oz in 2008, from 260,000 oz in 2007. Purchases of coins and bars accounted for 30,000 oz of demand, more than in the previous year when there had been net disinvestment. However, the buying of metal through the two European Exchange Traded Funds (ETFs) was more important, being responsible for 370,000 oz of this total.

Palladium Demand: Investment
'000 oz

	2007	2008
Europe	280	370
Japan	0	0
North America	(20)	30
China	0	0
Rest of the World	0	0
Total	**260**	**400**

JM

All of the precious metals, including palladium, experienced significant price volatility during 2008. On several occasions in the year this restricted sales of gold and platinum coins as the various mints were unable to update prices frequently enough. Growing economic uncertainty in the second half of the year drove record sales of gold coins to the general public too. With the flow of precious metal coins to collectors and investors unable to meet demand, some purchasing overflowed into the palladium market. As with the other metals, a lack of availability of coin blanks restricted consumer sales. Nevertheless, demand for coins and bars grew from a net disinvestment of 20,000 oz in 2007 to a net investment of 30,000 oz last year.



Investors purchased a net 400,000 oz of palladium through the European Exchange Traded Funds during 2008 with relatively little disinvestment occuring.

This was less significant than the volumes of metal purchased through Exchange Traded Funds. A mixture of fund investors and private individuals bought large amounts of palladium in the first quarter of 2008 as the price followed that of platinum higher. While investors sold significant quantities of platinum from the ETFs in the second half of the year as the global economy weakened, there was little change in the amount of metal held in the two palladium ETFs, suggesting that some of these investors have a longer-term attitude towards their investments. Total net palladium demand through the two ETFs climbed from 280,000 oz in 2007 to 370,000 oz last year.

OTHER

Palladium demand for other applications fell by 5,000 oz to 80,000 oz in 2008. Applications such as stationary source emission control and petroleum refining generated marginally more palladium demand than in 2007. However, there were falls in net palladium purchases for a number of other minor industrial end-uses, driving overall demand lower.

Palladium Demand: Other
'000 oz

	2007	2008
Europe	20	20
Japan	10	10
North America	30	25
China	10	10
Rest of the World	15	15
Total	**85**	**80**

JM