

# PALLADIUM

- Gross demand for palladium increased by 23% to 9.63 million ounces in 2010, its highest ever level.
- Open loop recycling of palladium returned 1.85 million ounces to the market in 2010.
- Gross demand for palladium from the autocatalyst sector in 2010 increased by 35% to 5.45 million ounces as economic recovery drove vehicle production higher in all regions.
- Net identifiable physical investment demand for palladium grew by a remarkable 74% in 2010 to reach 1.09 million ounces on the back of heavy buying of exchange traded funds.
- Gross industrial demand for palladium rose by 70,000 oz to 2.47 million ounces in 2010.
- Purchases of palladium by the jewellery sector declined by 20% in 2010 to a total of 620,000 oz.

## AUTOCATALYST

Palladium purchasing by the automotive sector increased by 1.40 million ounces to 5.45 million ounces in 2010, the highest since 1999, as vehicle markets in all regions fared better than in the previous year. Higher global production of light duty passenger vehicles, principally gasoline cars, benefited palladium demand, as did tightening emissions legislation in various markets. Substitution of platinum with palladium in autocatalyst formulations showed no signs of abating despite a narrowing of the price differential between the two metals.

## Europe

The light duty vehicle sector continued to see some recovery in the opening months of 2010 as ongoing car scrappage schemes and generous discounts in European markets tempted the car buying public back to showrooms. Small, inexpensive gasoline vehicles tended to be the main beneficiaries of such schemes aimed at reviving car sales, which led to an associated increase in palladium demand. Markets such as Spain, Portugal and Ireland, which were beset by economic problems later in the year, registered strong gains in the first half of 2010.

The second half of the year saw decreasing monthly sales in western Europe as scrappage schemes in major markets came to an end and the effects of sovereign debt crises and austerity measures began to be felt in several countries. New car sales declined in the second half in Greece and Spain, due to the financial crises there, while monthly sales in usually robust markets such as the UK and Germany also shrank. An interesting dynamic of this slump was that it tended to affect gasoline vehicles more than diesels with sales of diesels in Germany, for example, continuing to rise even as gasoline sales declined. This can be partly attributed to the end of 2009's

market-distorting car scrappage schemes, which had favoured gasoline cars. It also marked the return of fleet buyers to the market and renewed interest by consumers in fuel efficient diesel vehicles.

Although diesel vehicles regained much of their market share in Europe in 2010, with diesels representing almost half of the total light duty market, the effect of this on palladium demand was far from negative. The introduction of tougher Euro 5 emissions standards for new models in late 2009 resulted in higher palladium loadings as automakers took the opportunity to further substitute platinum with palladium in both diesel and gasoline catalysts. In 2010 only a few manufacturers still used platinum in gasoline autocatalysts. Substitution of platinum in both gasoline and diesel formulations grew incrementally in 2010, as in previous years. The typical proportion of palladium used in a European diesel catalyst rose to around 25%. Despite much higher palladium prices during 2010, platinum still traded at more than twice the price of palladium throughout the year, giving manufacturers an incentive to continue the substitution of platinum with palladium.

One of the biggest drivers of the rise in palladium demand in the European automotive sector was the rebound in the export market. Export destinations tended to be gasoline markets such as China, thereby favouring palladium.

Palladium Demand: Autocatalyst						
'000 oz						
	Gross		Recycling		Net	
	2009	2010	2009	2010	2009	2010
Europe	995	1,325	(280)	(335)	715	990
Japan	590	815	(50)	(75)	540	740
North America	1,020	1,360	(540)	(790)	480	570
China	685	975	(35)	(50)	650	925
Rest of the World	760	975	(60)	(75)	700	900
<b>Total</b>	<b>4,050</b>	<b>5,450</b>	<b>(965)</b>	<b>(1,325)</b>	<b>3,085</b>	<b>4,125</b>

Gross demand for palladium in European autocatalysts increased by 33% in 2010 to 1.33 million ounces, a pronounced rise compared with the sector's depressed state in 2009. Although vehicle production in 2010 was at its second lowest level of the past decade, palladium autocatalyst demand in Europe was at its highest since 2002.

### Japan

Gross demand for palladium in the Japanese automotive sector rose by 38% in 2010 to 815,000 oz as production of vehicles recovered from recession.

As the Japanese economy improved, light duty vehicle sales increased, driving up demand for gasoline cars in the domestic market, and therefore palladium demand. Full-year auto production data reveal that vehicle production grew overall, including production of diesels. Although the domestic light duty vehicle market performed strongly in 2010, the export sector showed the biggest rise. In terms of vehicles manufactured for overseas markets, production of gasoline vehicles remained larger than production of diesels. Continuing substitution for platinum in domestic and export models also helped increase palladium demand.

### North America

Purchasing of palladium in the North American automotive sector rose by 33% in 2010 to 1.36 million ounces. Following a desperate year for many auto manufacturers in the US in 2009 when production lagged behind weak sales, 2010 marked a strengthening of production levels. Higher levels of consumer confidence resulted in car sales growing from 11.9 million vehicles in 2009 to 13.1 million in 2010. This was further augmented by an easing of gasoline prices which helped drive purchasing of larger vehicles such as trucks and SUVs, with higher palladium loadings per vehicle.

While the North American market made some gains in 2010, a combination of high personal debt levels, limited credit and stubbornly high levels of unemployment in the US continued to weigh on new car sales.

### China

Production of vehicles in China rose sharply in 2010 as economic growth enabled an increasingly affluent population to buy vehicles. This was aided by government intervention in the form of tax breaks for small vehicles, making car purchases

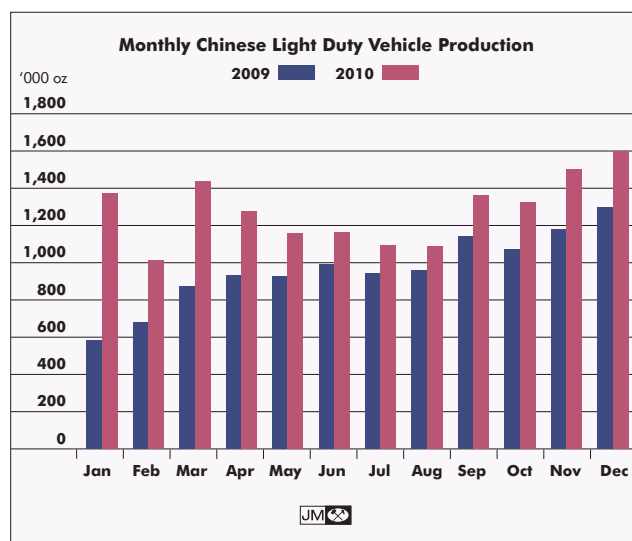
Growth of the light duty vehicle market in China helped boost palladium demand.



more affordable for consumers. Total vehicle production in China was 16.5 million units in 2010, with the majority of these gasoline fuelled. The rise in car sales was greatest in the SUV and crossover sectors; these larger vehicles require more pgm per vehicle to control emissions. Sales of smaller vehicles also grew strongly.

In anticipation of China 4 emissions standards coming into force across the country in mid-2011, some automakers raised pgm loadings in vehicles made in China. This tended to favour palladium-rhodium catalyst formulations, which are used by the majority of manufacturers. High production levels in China saw palladium demand reach 975,000 oz in 2010, a gain of 290,000 oz compared with 2009.

Despite some signs of a cooling of the auto market in cities such as Beijing and Shanghai, partly as a result of measures

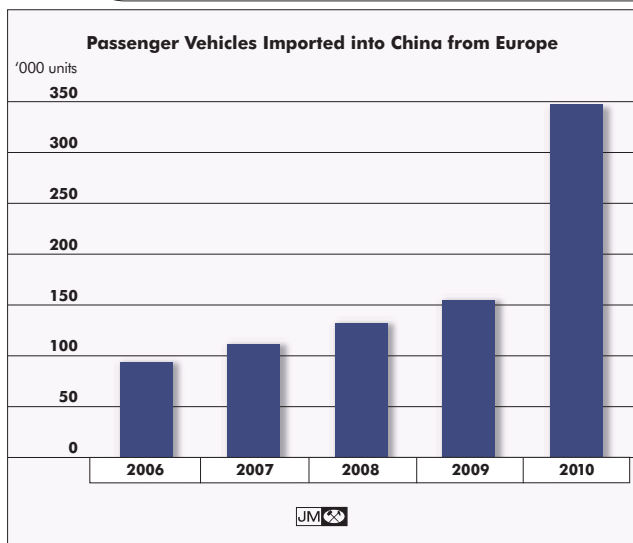


Chinese light duty vehicle production was higher in every month of 2010 than the previous year, supporting demand for palladium.

Physically-backed  
palladium exchange  
traded funds grew to  
record levels in 2010.



Imports of European-manufactured vehicles into China strengthened in 2010, boosting palladium demand in Europe.



to control inflation and manage congestion, car ownership remains a key aspiration of the increasingly affluent Chinese public. Growth remains strong in second and third tier cities where road infrastructure is being rapidly developed to keep pace with car sales.

### Rest of the World

In Russia, the early part of 2010 saw vehicle sales continue their downward trend, prompting the introduction of a scrappage scheme in March for vehicles produced in Russia. The scheme immediately provided a boost to the Russian market and by the end of April, year-on-year sales had grown for the first time in 18 months. Within three months the original quota of 200,000 certificates towards the purchase of a new vehicle had all been allocated. The scheme was therefore extended with the addition of a further 300,000 certificates. The Russian government announced in April 2011 that it may provide another extension to the scheme. By the end of 2010, Russian production had grown by 29% year-on-year. Sales of inexpensive Russian-brand vehicles saw the biggest rise, but western brands assembled locally also expanded production. Since Russia is mainly a gasoline market, this overwhelmingly benefited palladium.

Manufacturers in South Korea also had a strong year, with higher production levels for both domestic and export markets. Both at home and abroad, small gasoline vehicles sold well, driving up palladium demand. Raised production levels of larger gasoline vehicles with higher catalyst loadings also helped to boost palladium.

Passenger car production in Mexico rose by almost 51% to

reach 2.3 million units in 2010 due to an increase in confidence of domestic consumers and also better conditions in the US, the principal export destination for Mexican-produced cars. Demand in the domestic market was aided by loan guarantees from the state development bank to auto financing institutions, which helped increase the number of cars bought on finance.

### JEWELLERY

Gross demand for palladium in the worldwide jewellery sector reduced by 20% in 2010 to 620,000 oz. Although purchases of palladium jewellery continued to grow in Europe and North America, albeit from a low level, there was a tailing off in demand in China, the largest market for palladium jewellery. Elevated palladium prices and adequate retail and manufacturer stock levels proved to be a drag on uptake of palladium for jewellery overall.

### Europe

Palladium demand in the European jewellery sector reached 70,000 oz in 2010, a 40% rise over the previous year. Much of this came from raised production of palladium jewellery in the UK market. Between July 2009 when hallmarking of palladium in the UK began and the end of 2009, 40,000 palladium pieces received a hallmark. Data for the full year of 2010 show that 102,000 British-made palladium pieces were hallmarked. The increase in demand was also evident in the weight of palladium hallmarked in 2010, with an average weight per piece of 8.4 grams in 2010 compared with 7.5 grams in 2009. A good deal of interest in palladium jewellery has been



Non-road emissions control is a promising future market, covered in our 'Other' category.

See notes to table on page 29.

Palladium Demand: Jewellery '000 oz						
	Gross <sup>1</sup>		Recycling <sup>2</sup>		Net <sup>3</sup>	
	2009	2010	2009	2010	2009	2010
Europe	50	70	0	0	50	70
Japan	80	75	(20)	(20)	60	55
North America	60	65	0	0	60	65
China	560	380	(50)	(60)	510	320
Rest of the World	25	30	0	0	25	30
<b>Total</b>	<b>775</b>	<b>620</b>	<b>(70)</b>	<b>(80)</b>	<b>705</b>	<b>540</b>

generated by the trade in the UK recently, with manufacturers adding to their product ranges and retailers augmenting their stock levels. Palladium continues to gain popularity as a metal for men's wedding bands, where larger, chunkier designs can be made at a price competitive with white gold. Growth in palladium demand in the UK partly offset declines elsewhere, particularly in the use of palladium in white gold alloys, and in Swiss watches.

### Japan

Gross demand for palladium jewellery in Japan was higher than in most regions in 2010, but softened by 5,000 oz. Since palladium is used as an alloying agent in Japanese platinum alloys, the downward trend in platinum also affected palladium. Use of palladium in white gold alloys also suffered as white gold sales dropped, mainly due to high gold prices.

Several manufacturers are testing the market for palladium jewellery in Japan and for export overseas, including chains and wedding bands. Overall however manufacture of palladium jewellery, as opposed to its use in alloys, remains minimal.

### North America

Gross demand for palladium in North American jewellery increased by 5,000 oz in 2010 to 65,000 oz. This followed a number of manufacturers and retailers adding palladium to their product offerings in 2009. The popularity of men's palladium rings in the wedding band market was robust in the first half of 2010. However, the elevated palladium price and competition from non-precious metal alternatives moderated its progress later in the year.

Some demand came from the use of palladium in certain white gold alloys, where it is used to enhance the look and finish, and also in a number of new sterling silver formulations where it adds cachet to a lower-end product.

### China

Gross palladium purchasing by the Chinese jewellery sector reduced by around a third in 2010 to 380,000 oz. Elevated palladium prices combined with sufficient levels of stock were mainly responsible for this fall. The rising palladium price also had the effect of reducing previously high margins and adding to the funding cost to retailers, thus reducing the attractiveness of stocking palladium.

In first tier cities such as Beijing, many retailers have ceased selling palladium due to poor consumer demand and competition from gold, which many customers perceive as retaining its value to a greater degree. Some manufacturers in Shenzhen, many of whom supply other cities in China, stopped manufacturing palladium in 2010 due to low retail demand. In addition to a lack of awareness amongst consumers, a key challenge in retailing palladium is that, unlike gold and platinum, it is not traded on the Shanghai Gold Exchange. This means the metal lacks credibility as an investment for the Chinese jewellery-buying public, who typically view jewellery items in part as investments that can be traded.

Palladium jewellery continued to sell in certain second and third tier cities and outlying metropolitan and rural areas. However, demand even in these areas faces competition from other luxury goods as the population there becomes more affluent. In late 2010, marketing campaigns aimed at promoting palladium to consumers restarted, but it remains too early to judge their effectiveness.

The rising price throughout most of 2010 encouraged the return of old palladium jewellery by consumers, reducing net palladium demand. Unlike in other markets, low manufacturing margins in China increased the attractiveness of recycling jewellery. The recycling of palladium is covered in our recycling chapter on page 24.

### CHEMICAL

**Demand for palladium from the chemical industry increased by 70,000 oz in 2010 to 395,000 oz as consumer demand for a variety of downstream products worldwide drove up rates of chemical plant throughput, therefore stimulating demand for top-up catalysts. Considerable new capacity also came on-stream, especially in China.**

In the improved global economic climate of 2010, demand for consumer products such as packaging and clothing expanded. In many of these products, polyethylene terephthalate (PET) is a key component. PET is made from purified terephthalic acid

Palladium Demand: Chemical '000 oz			
	2008	2009	2010
Europe	100	85	105
Japan	20	20	20
North America	55	50	65
China	55	75	90
Rest of the World	120	95	115
<b>Total</b>	<b>350</b>	<b>325</b>	<b>395</b>

(PTA), a petrochemical intermediate which is manufactured from paraxylene using palladium process catalysts. Greater demand for the end-use consumer products drove the need for top-up catalyst in upstream chemical plants. Some new capacity was built in Europe in 2010, requiring palladium process catalysts. In Saudi Arabia, new capacity was also being built to serve the fast-growing Indian and Chinese markets, where PET is required in the textile and construction sectors. China continued to see strong domestic demand for PET, and high levels of purchasing of palladium process catalysts for new plant during 2010.

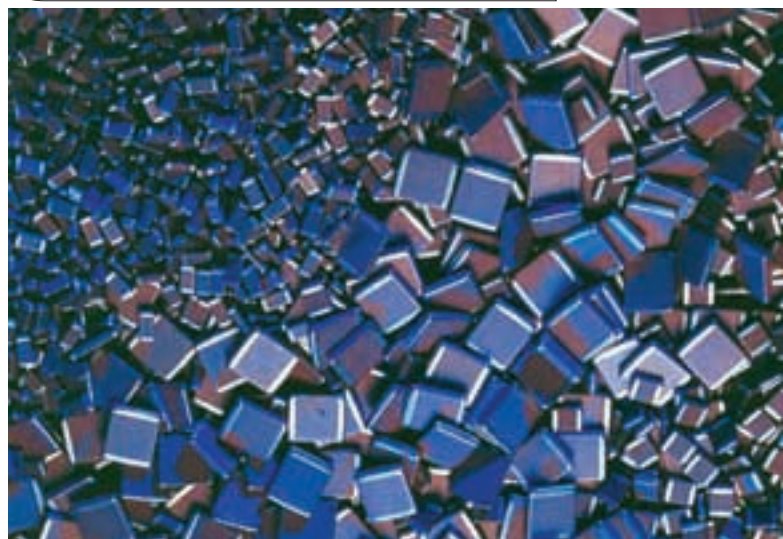
The production of vinyl acetate monomer (VAM), used in adhesives, paints, paper and textiles, increased during 2010 in line with the recovery in the global economy. VAM uses a supported palladium catalyst in its manufacture. Purchases of palladium therefore grew, particularly in Asia where expansion of production is currently strongest.

## DENTAL

**Purchasing of palladium by the dental sector worldwide amounted to 580,000 oz in 2010. Demand for palladium in dentistry continued to feel the long-term effects of improved dental health worldwide and the greater use of resin-based, all-ceramic and base metal dental treatments. In Japan, the largest market for palladium dental alloys, demand fell mainly due to these long-term trends.**

Statistics published by the Japanese Ministry of Health, Labour and Welfare suggest that use of Kinpala alloy, which has a palladium content of 20%, is declining, thus reducing palladium demand. We have adjusted our 2010 demand figure downwards to 250,000 oz to take into account this development. For most of last year subsidies for Kinpala alloy were lower than they were previously, but they increased once again in late 2010. Other trends were also felt such as better preventative care and a declining population as well as higher costs to patients.

Palladium demand in electronic components rose during 2010.



The worldwide trend towards base metal and all-ceramic treatments for crowns and bridgework continued in 2010 as patients and dentists elected these treatments for aesthetic reasons, further impacting palladium demand. The one bright spot was the high price of gold in 2010, which led to greater substitution with palladium. However, the cost saving of using palladium is relatively small compared with the total cost of the treatment. Consequently, the additional palladium demand from substituting gold was more than offset by the move to non-precious metal procedures.

## ELECTRICAL

**Gross purchasing of palladium by the electrical sector increased by 40,000 oz to 1.41 million ounces as improved economic conditions prompted consumer and business demand for downstream electronic products. As manufacturing of palladium-containing electronic components climbed, there was heavy buying of palladium by manufacturers. This continued the stock building that began in late 2009.**

Palladium Demand: Dental '000 oz			
	2008	2009	2010
Europe	65	65	65
Japan	275	295	250
North America	270	260	250
China	0	0	0
Rest of the World	15	15	15
<b>Total</b>	<b>625</b>	<b>635</b>	<b>580</b>

The recovery of the global economy and stimulus measures introduced by various national governments helped the electrical sector in late 2009 and into 2010. Higher sales, particularly in emerging markets, and stock building helped raise demand levels. Production of silicon for semiconductor manufacture, a proxy for general electrical sector growth, reached pre-2009 levels. However, lingering economic uncertainty and high unemployment in developed markets started to weaken consumer demand in the second half of 2010. With high retail and manufacturer stock levels, sales of electrical items slowed, although they remained positive on a year-on-year basis.

Demand for palladium resistors and passive components such as multi-layer ceramic capacitors (MLCCs) continued to grow as production of circuit boards increased in line with consumer demand. Although nickel components have threatened palladium's market share for some time, nickel remains less durable than palladium in MLCCs, and palladium-based MLCCs remain the technology of choice in higher-end applications. The increasing complexity of electronic devices also means that, generally, more MLCCs per device are needed. Growth of palladium in MLCCs was strongest in Japan and China in 2010, highlighting the importance of these markets in electrical production.

The use of palladium in plating applications also saw a rise during 2010. With an upswing in the number of components produced worldwide, there was a consequent expansion in demand for palladium in lead frames and connectors. Palladium competes with gold in plating applications, and the high price of gold relative to palladium during 2010 continued to act as an incentive for substitution with palladium.

Recovery of palladium from open loop recycling of electronics increased in 2010, reaching 440,000 oz. Elevated palladium prices helped drive greater levels of recycling, as did the continuing effects of legislation and consumer awareness. Recycling of electronic scrap was particularly high in Europe, where the Waste Electrical and Electronic Equipment legislation continued to drive greater levels of collection and recycling of end-of-life electronic goods.

## INVESTMENT

**Physical investment demand for palladium increased by a remarkable 74% to reach 1.09 million ounces last year. ETFs were responsible for most of this; specifically, ETF Securities' US-based palladium ETF registered heavy investment inflows throughout much of 2010.**

Palladium Demand: Electrical						
'000 oz						
	Gross		Recycling		Net	
	2009	2010	2009	2010	2009	2010
Europe	195	195	(160)	(175)	35	20
Japan	270	295	(55)	(55)	215	240
North America	170	160	(70)	(80)	100	80
China	335	360	(25)	(35)	310	325
Rest of the World	400	400	(85)	(95)	315	305
<b>Total</b>	<b>1,370</b>	<b>1,410</b>	<b>(395)</b>	<b>(440)</b>	<b>975</b>	<b>970</b>

Although overshadowed by the rise in automotive demand in 2010, increased sales of palladium investment products made an important contribution to the palladium market moving into substantial deficit for the full year of 2010.

Changes in investor sentiment can lead to swings in the physical investment market which do not necessarily reflect the underlying supply-demand fundamentals. This makes the investment market one of the most interesting to analyse. Although the fundamentals for palladium were positive throughout 2010, the second half of the year saw palladium's price track upwards as part of a wider commodity rally. This was spurred by eurozone uncertainty, the fluctuating fortunes of the dollar and continuing concerns over the strength of the worldwide economic recovery. These same factors also help explain some of the volatility seen in the palladium market over the same period. Although the price rose, investors continued to see palladium as undervalued and ETFs continued to attract investment. There was also perhaps some pricing-in of perceived future supply shortfalls due to possible lower palladium sales from Russian stock. Interestingly, given that palladium reached its highest price for a decade in late 2010, all fund holdings effectively had the potential for investors to take profit. Apart from some profit-taking in the relatively mature ZKB fund and ETF Securities' London fund, there was not much selling of positions, suggesting that palladium investments may be relatively long-term. Profit-taking in the younger US fund was certainly limited, and investors continued to see considerable upside to palladium.

Total palladium ETF investments reached a record high of around 2.2 million ounces on 31st December 2010, increasing from approximately 1.2 million ounces at the end of 2009. In late 2010, palladium's price stood at a ten-year high approaching \$800, the rising price having accompanied higher levels of investment. Most of the rise in ETF holdings was a result of additions to the US fund, which grew by 1.1 million ounces between its launch at the beginning of 2010 to the end of the

year. Growth of the US fund was fastest in the opening weeks of its launch, before declining in late April as the price softened. However, US fund holdings initially rose by 20,000 oz during palladium's price correction in mid-May, while platinum's holdings remained flat in the US fund, although eventually a period of profit-taking occurred as the price recovered. A quieter phase with few additions to the fund followed in the middle of the year, before a renewed wave of buying into the fund occurred from October onwards. Another period of heavy buying occurred in early December. The launch of two new ETF basket funds containing palladium by ETF Securities also added some demand, although holdings of palladium in these funds were relatively small.

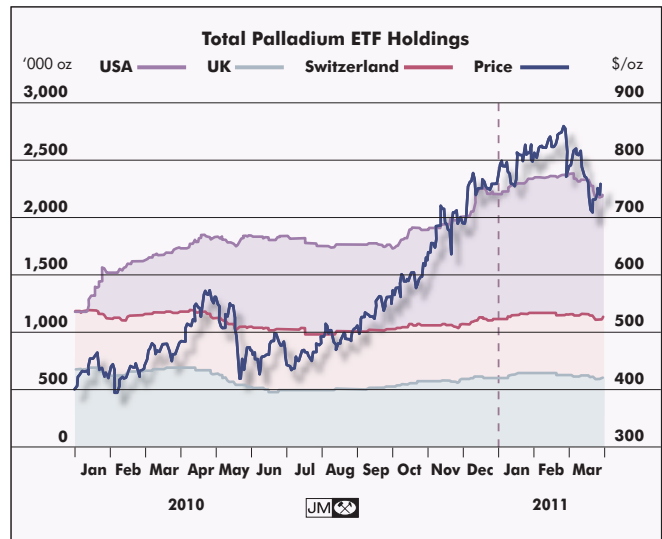
In the European ETFs, the overall trend was one of profit-taking, in contrast to the situation in 2009. Last year marked the third full year that the London and Swiss funds had been in operation. As investors looked to close positions in the higher price environment, net profit-taking took place, bringing our net European investment figure to minus 55,000 oz. Investors started to take profit before the price correction, and continued to do so after it; although the London fund showed investment during times of rising palladium prices and disinvestment during dips, liquidation in this fund was stronger than new investment. The Swiss ZKB fund saw steady profit-taking throughout the year with a net 61,000 oz of holdings being liquidated, not surprisingly since in the higher price environment of 2010 many investors would have been able to yield profit from positions bought the previous year. However, unlike in the London fund, there was steady investment during palladium's downward price correction in May.

In January 2010, a palladium ETF was launched by the Swiss bank Julius Baer. Although initial buying into this fund was high, it moderated towards the middle of the year, only to pick up in the final months, adding a total of 75,000 oz of demand by year-end. In 2010, Deutsche Bank also launched a palladium ETF, which saw some investment interest.

In July 2010, a new physically-backed palladium ETF,

Palladium Demand: Investment '000 oz			
	2008	2009	2010
Europe	370	525	(55)
Japan	0	0	10
North America	50	95	1,130
China	0	0	0
Rest of the World	0	5	0
<b>Total</b>	<b>420</b>	<b>625</b>	<b>1,085</b>

Palladium exchange traded funds proved popular with investors, supported by strong supply-demand fundamentals.



managed by Mitsubishi, together with ETFs in platinum, silver and gold was launched on the Tokyo stock exchange (TSE). This marked the first time a physical palladium investment vehicle achieved primary listing on the TSE, and was responsible for an additional 10,000 oz of palladium demand in 2010.

In terms of coin production, few palladium coins were produced in 2010, although consumer demand for those that were released was strong. The Royal Canadian Mint once again issued palladium Maple Leaf coins, albeit at a lower level than in 2009. The elevated palladium price in 2010 triggered healthy secondary market activity, reducing primary demand to around 25,000 oz. Production and sale of small palladium bars was minimal in 2010.

## OTHER

**Demand for palladium in all other applications increased by 15,000 oz to 85,000 oz in 2010 as the global economy improved. There was rising demand for palladium in pollution control devices for non-road engines, driven by forthcoming legislation, especially in Europe.**

Palladium Demand: Other '000 oz			
	2008	2009	2010
Europe	20	20	25
Japan	10	10	10
North America	20	15	25
China	10	10	10
Rest of the World	15	15	15
<b>Total</b>	<b>75</b>	<b>70</b>	<b>85</b>