



# PLATINUM 2012



Johnson Matthey

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*Background image: Iridium crucibles in which single crystal sapphire, used in light-emitting diodes (LEDs), is grown.*

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by **Jonathan Butler**

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Johnson Matthey

# EXECUTIVE SUMMARY

**The platinum market swung into a surplus of 430,000 oz last year.** A 2% rise in gross demand to just under 8.1 million ounces, led by resurgent purchasing for industrial applications, was more than offset by higher supplies and rising levels of recovery from autocatalyst and jewellery scrap.



**Primary supplies of platinum grew by 7% last year to 6.48 million ounces.** Underlying production in South Africa was hit by safety stoppages and strikes, but growth came from pipeline and inventory releases. A return to normal output levels in North America and ramping up at new operations in Zimbabwe also helped raise global supplies of platinum.

**Gross demand for platinum in the autocatalyst sector grew by 1% to 3.11 million ounces in 2011.** Pent-up demand for large trucks stimulated an increase in purchases of platinum for heavy duty diesel emissions control. This was partly offset by greater substitution of platinum with palladium in light duty autocatalysts as well as lower output by Japanese manufacturers.



**Platinum jewellery demand rose by 2% to 2.48 million ounces last year.** The second half of 2011 saw a surge in purchasing by manufacturers in China to take advantage of a weaker platinum price and platinum's discount to gold, bringing gross demand in China to 1.68 million ounces. In India, platinum jewellery offtake grew strongly from a low base.

**Demand for platinum in industrial applications reached a new record high of 2.05 million ounces.** New capacity installations, together with pre-buying in anticipation of future growth, drove platinum demand in the glass sector up by 44% to 555,000 oz. Expansions in the petrochemical industry in developing markets and construction of new refining capacity in Europe and North America also helped to lift demand.



**Physical investment demand for platinum remained positive but was 30% lower than in 2010, at 460,000 oz.** Total exchange traded fund (ETF) holdings grew in the first eight months of 2011, but there was substantial liquidation from mid-September onwards, leaving ETF investment at just 190,000 oz for the full year. However, net investment in the Japanese large bar market surged to 235,000 oz.

**The rhodium market remained oversupplied in 2011 by 139,000 oz.** Higher demand from the glass industry and inflows into a new rhodium ETF offset reduced purchasing in the autocatalyst sector. Growth in supplies and recycling outpaced the rise in gross demand however, increasing the market surplus.





**The palladium market was in a 1.26 million ounce surplus in 2011.** Substantial quantities were once again sold from Russian state palladium inventories, although shipments from this source, at 775,000 oz, were the lowest for five years. Gross demand fell last year by 13% to 8.45 million ounces due to sharply negative net investment demand. Total palladium recycling rose by 27% to 2.35 million ounces.

**Supplies of palladium remained almost flat at 7.36 million ounces last year.** The fall in Russian state stock shipments largely offset growth in output from North America and Zimbabwe as operations ramped up to full production. In South Africa, palladium supplies fell as producers added to stocks while primary output from Russia changed little overall.



**Gross demand for palladium in autocatalysts reached a record level of 6.03 million ounces in 2011.** This was the result of higher vehicle output in all regions apart from Japan, which was affected by the Great East Japan Earthquake and its aftermath, together with the greater use of palladium in light duty diesel aftertreatment systems.

**Demand for palladium in industrial applications rose to 2.48 million ounces last year.** Purchasing of palladium for use in catalysts for the production of chemical intermediates, particularly in China, increased by 20% to 445,000 oz. There was softer demand in the electrical and dental sectors.



**Investment demand for palladium turned negative in 2011, returning 565,000 oz to the market.** Deep liquidations in the ETF market, especially in the final quarter of the year as prices were falling, left physical investment demand in starkly negative territory by the year-end. This was in contrast to the high level of net investment in 2010.

**Gross demand for palladium jewellery fell by 15% to 505,000 oz last year.** Palladium purchasing in the Chinese jewellery sector softened once again in 2011 due to high metal prices and a lack of marketing. In other regions, competition and high prices led to declining demand.



**'Open loop' recycling of platinum and palladium both increased to over two million ounces in 2011.** Greater numbers of end-of-life vehicles being returned for recycling helped drive up platinum, palladium and also rhodium recovery from autocatalysts. Higher prices than in 2010 stimulated returns of old platinum and palladium jewellery for recycling.

# SUMMARY

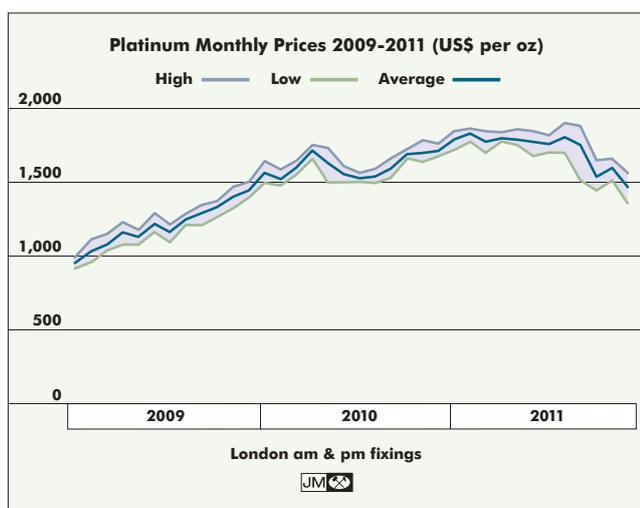
## PLATINUM

- The platinum market swung into an oversupply of 430,000 oz last year.
- Supplies of platinum rose by 7% to 6.48 million ounces due to inventory releases from South Africa as well as higher output in North America and Zimbabwe. Recycling increased by 12% to 2.05 million ounces.
- Gross demand for platinum rose by 2% to 8.1 million ounces largely as a result of heavy purchasing by the glass and petrochemical industries.
- Demand for platinum for use in heavy duty diesel autocatalysts was strong but this was partly offset by lower use in light duty diesel emissions control and reduced buying by Japanese auto manufacturers. Autocatalyst demand grew by 1% to 3.11 million ounces.
- Purchasing last year by jewellery manufacturers was 2% higher than in 2010 at 2.48 million ounces.
- Investment demand declined by 30% year-on-year but remained positive at 460,000 oz.

Gross platinum demand rose by a modest 2% in 2011 to just under 8.1 million ounces, with growth in every sector apart from investment. Supplies increased to a four-year high, supplemented by a pipeline drawdown in South Africa in the second half, while recycling also rose. As a result, the platinum market swung into a surplus of 430,000 oz last year. The price of platinum partly reflected these weaker fundamentals but was also dragged down by a wider asset sell-off by investors in the fourth quarter, falling to a two-year low of \$1,364 by the end of 2011. Net long speculative platinum positions reached the lowest level since the second half of 2009 by the year-end. However, platinum traded on average at \$1,721 for the year as a whole, 7% higher than the previous year.

Global supplies of platinum grew by 7% to 6.48 million ounces last year as a result of higher sales from all of the major producing regions. Supplies from South Africa rose by 5% to 4.86 million ounces – this increase was entirely due to releases of metal from in-process and refined inventories, and in fact underlying mine production in South Africa fell by 3%, or around 120,000 oz, in 2011. The loss was largely attributable to safety stoppages, which under Section 54 of the Mines Health and Safety Act can be ordered by a government inspector if conditions are deemed to be dangerous. The South African industry was also affected by a number of labour disruptions and stoppages last year, including a three-week strike at Lonmin's Karee mine. Overall, the cost of production in South Africa continued to rise faster than inflation.

Supplies of platinum from Russia remained almost flat at 835,000 oz. PGM output from Russian operations has been maintained despite the depletion of the richest ore reserves and increased reliance on relatively lower grade ore, by the refining of surface sources of material including pyrrhotite concentrate. Our special feature on page 24 gives more detail on the current Russian pgm mining industry and looks at how supplies from Russia may be augmented in future.



The platinum price reached a three-year high in August 2011, but suffered a severe downwards correction in September as investors turned away from risk assets.

Platinum supplies from North America increased by 75% to 350,000 oz as output recovered following shutdowns that had affected production at North American Palladium and Vale in 2010. Supplies from Zimbabwe increased by 21% to 340,000 oz due to the commissioning of Anglo American Platinum's Unki mine and slightly higher output at existing operations run by Zimplats and Aquarius.

The heady rates of growth in global vehicle output seen in 2010, when the automotive industry was in a recovery phase, moderated last year as expected. Estimated total vehicle production worldwide rose by around two million units to just under 80 million in 2011. Light duty vehicle production and sales recovered well in the USA in 2011 and premium European carmakers did extremely well in domestic and export markets. However, a number of factors affected vehicle

production around the world last year. The Great East Japan Earthquake reduced Japanese vehicle output by 13%, while government measures in China, such as restrictions on vehicle registrations and tighter credit, had the desired effect of slowing growth rates. The eurozone debt crisis resulted in lower vehicle sales in southern Europe and high interest rates in some emerging markets affected consumer demand for new vehicles.

The heavy duty diesel sector was the star performer of the autocatalyst sector last year. Globally, purchasing of platinum for use in heavy duty emissions control grew by 27% to 515,000 oz. Much of the growth was due to pent-up demand for large trucks in North America as fleet operators returned to the market following the recession. Some European manufacturers began to release small numbers of vehicles fitted with Euro VI-compliant emissions systems. These typically consist of platinum-containing diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs) designed to meet the more stringent oxides of nitrogen (NOx) and particulate matter (PM) limits due to come into force from 2013.

Growth in platinum use in the heavy duty diesel sector was largely offset by continuing substitution of platinum by palladium in light duty diesel vehicles, particularly in Europe (the biggest market for diesel cars). This, together with the effects of the Great East Japan Earthquake, which disrupted vehicle production in Japan and elsewhere, meant that gross platinum demand across the autocatalyst sector was just 30,000 oz higher than in 2010 at 3.11 million ounces.

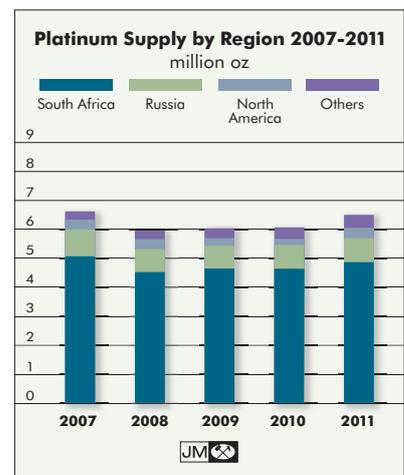
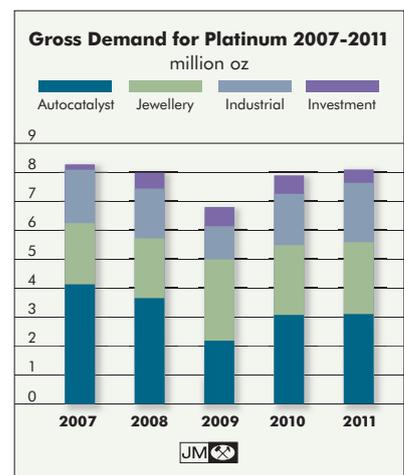
Recovery from recession in developed markets and rapid growth in emerging ones drove a period of capacity-building in a number of industrial sectors. Purchasing of platinum across various industrial applications rose for the second year in a row, by 17% to 2.05 million ounces. Demand for liquid crystal display (LCD) panels in consumer electronics led to the installation of a number of new platinum-rhodium melting tanks in Asia, used in the manufacture of LCD glass. Demand, which grew by 44% to reach a new high of 555,000 oz, was augmented by pre-buying of metal in advance of future expansion.

Demand for fuel and lubricant oil in emerging markets and the building of fuel refining plants in Europe and North America led to purchasing of platinum for use in refining catalysts. In the electrical sector, demand for platinum in hard disk drives remained flat last year due to the effects of flooding in Thailand in October, which disrupted hard disk production.

Jewellery manufacturers worldwide purchased 2.48 million ounces of platinum last year, 60,000 oz more than in 2010. Demand in China remained robust in the first half despite higher prices than in the previous year. In the second half, when platinum prices dropped and gold began to trade at a premium to platinum, there was a surge in buying as Chinese manufacturers took advantage of lower prices to build stock. Consumer purchasing in China was overall not greatly affected by the price movements. The middle market in Europe and North America suffered as a result of higher prices, on average, compared with the previous year, but high-end manufacturers had an excellent year catering for domestic and export demand. In India, an increase in retail outlets offering platinum and rising consumer purchases drove platinum jewellery demand up by a third to 80,000 oz.

Net physically-backed platinum investment demand decreased by 30% in 2011 to 460,000 oz, although compared with palladium investment (which moved sharply into negative territory) demand was impressive. There was net investment into exchange traded funds (ETFs) for the year as a whole, with inflows into funds tending to coincide with periods of rising prices. A peak in platinum ETF holdings in September was followed by some selling as the price fell in the fourth quarter. Substantial purchasing of large platinum bars by Japanese investors once again occurred during price dips.

Platinum Supply and Demand '000 oz			
<b>Supply</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
South Africa	4,635	4,635	4,855
Russia	785	825	835
Others	605	590	790
<b>Total Supply</b>	<b>6,025</b>	<b>6,050</b>	<b>6,480</b>
<b>Gross Demand</b>			
Autocatalyst	2,185	3,075	3,105
Jewellery	2,810	2,420	2,480
Industrial	1,140	1,755	2,050
Investment	660	655	460
<b>Total Gross Demand</b>	<b>6,795</b>	<b>7,905</b>	<b>8,095</b>
<b>Recycling</b>	<b>(1,405)</b>	<b>(1,830)</b>	<b>(2,045)</b>
<b>Total Net Demand</b>	<b>5,390</b>	<b>6,075</b>	<b>6,050</b>
<b>Movements in Stocks</b>	<b>635</b>	<b>(25)</b>	<b>430</b>



**PALLADIUM**

- The palladium market was in surplus by 1.26 million ounces last year. Gross demand fell by 13% to 8.45 million ounces, mainly due to net selling by investors. Further Russian state stock sales and higher recycling also helped push the market into oversupply.
- Supplies of palladium remained almost flat at 7.36 million ounces as rising output from North America and Zimbabwe was largely offset by lower sales from Russian state inventories.
- Gross demand for palladium in autocatalysts reached a new high in 2011 of 6.03 million ounces, driven by growth in vehicle output in all regions apart from Japan, and greater use of palladium in light duty diesel aftertreatment systems. Industrial demand for the metal remained strong.
- Purchases of palladium by the jewellery industry fell last year, while investment demand for palladium turned sharply negative.

Although autocatalyst and industrial demand for palladium rose, the sale of metal from Russian government-controlled inventories, together with a large amount of metal released from ETFs and higher recycling, meant that the palladium market moved into oversupply last year. Due to higher average year-on-year prices, many investors in palladium ETFs were in a position to take profit in 2011; others may have liquidated their positions to cover losses elsewhere. A deep sell-off in the ETF market, together with a perception of weaker fundamentals, led the palladium price, having tested the \$850 level, to shed all of its gains since late 2010 in August and September 2011 and trade below \$700 for the rest of last year.

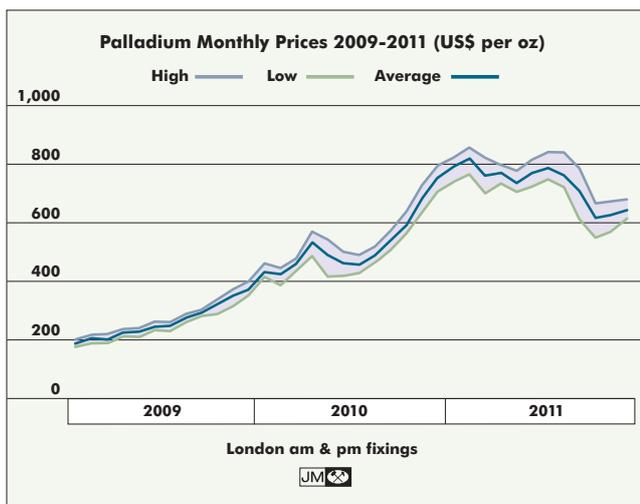
There was growth in supplies of newly-refined palladium last year due to higher output from North America and Zimbabwe as the two regions approached full production. Supplies from South Africa fell slightly as producers put some mined metal to stock. Shipments of palladium from current Russian mining operations were very marginally down on 2010 levels. Once again, substantial quantities of palladium were sold from Russian state stocks last year. This was sufficient to keep total palladium supplies largely flat in 2011, although the volume of these shipments, at 775,000 oz, was the lowest since 2006.

The prospective exhaustion of Russian state stocks has been the source of much speculation over recent years, and the anticipation of lower future supplies from Russia was one of the driving factors in palladium's remarkable price performance in 2010. Last year, there was a degree of investor fatigue on this aspect of the palladium 'story' and the eventual sale of Russian state stocks in the fourth quarter served to confirm that the palladium market was likely to be in surplus. We expect that there will be one further year of sales from Russian state stocks in 2012, albeit at a much reduced level than previously, which will represent the bulk of the remaining government-controlled inventories.

The palladium market was more industrially-driven in 2011 than for several years. Although total demand fell by 13% last

year to 8.45 million ounces, gross demand strengthened in the core autocatalyst and industrial markets. As well as growing in absolute terms, autocatalyst and industrial applications took the highest relative share (94%) of the palladium market excluding investment since 2003. The year-on-year decline in total demand in 2011 was primarily due to the investment sector switching from extremely high offtake in 2010 (of over one million ounces) to effectively supplying over half a million ounces back to the market last year.

In the autocatalyst sector, higher vehicle output in all regions, apart from Japan, as well as the greater use of palladium in light duty diesel autocatalyst formulations, helped spur purchasing of palladium to a record high level of 6.03 million ounces in 2011. Japanese domestic and overseas manufacturing plants suffered interruptions to output and component supply in the wake of



*Palladium traded at ten-year highs during the eight months to September 2011 before succumbing to negative investor sentiment.*

the March disaster. As a result, there was a 14% decline in passenger car production in Japan compared with 2010. Since gasoline cars (which use palladium-based emissions control) dominate the domestic market, the impact on palladium demand was not insignificant.

Several regions saw considerably higher output of gasoline-fuelled vehicles. A combination of an ageing vehicle fleet, pent-up demand, attractive pricing and improved economic conditions led light duty vehicle sales in North America to rise to a three-year high. Lean inventories meant that higher vehicle sales translated into higher production levels. In China, the removal of subsidies and the imposition of limits on new car registrations resulted in a slowing of growth in the car market. However, the implementation of China 4 emissions standards nationwide from mid-2011 led to the use of more highly pgm-loaded gasoline autocatalysts. Manufacturers in South Korea had a good year supplying small, inexpensive vehicles to domestic and export customers, while in Russia output of light duty vehicles set a new record. Inflationary pressures led to slower growth in vehicle sales in certain emerging markets – including India and Brazil – though palladium demand for emissions aftertreatment in the Rest of the World region grew strongly overall.

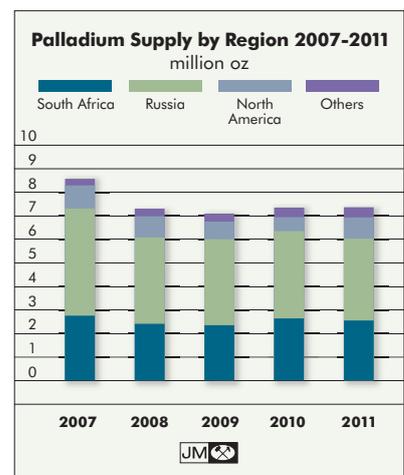
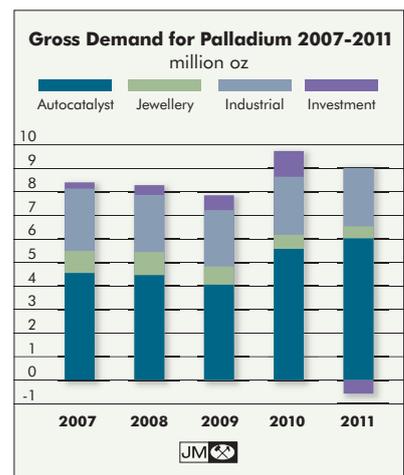
Palladium demand in industrial applications increased marginally in 2011 to 2.48 million ounces. Rising levels of personal wealth in China and other emerging markets helped drive the expansion of bulk chemical production in 2011, in which palladium-containing catalysts are used to manufacture ingredients for synthetic fibres and plastics. Recovering demand in export markets as well as government strategy in China to increase domestic consumption led to increased demand for process catalyst charges.

In the electrical sector, purchasing of palladium softened as competition from cheaper alternatives eroded palladium's market share. Palladium continues to be used where the metal's unique properties, allowing higher durability and reliability than other materials, are essential. The increasing complexity of devices has led to a rise in the number of electronic components per device over several years, but this has not ultimately benefitted palladium demand due to substitution with base metals and miniaturisation of components, which has reduced the amount of metal used. Palladium continues to be used in plating and in components employed in high-end electronics and fail-safe systems. Although purchasing for use in the electrical sector weakened by 2% to 1.38 million ounces last year, the greater use of palladium in lead-free plating and soldering helped shore up demand.

Purchasing of palladium by the jewellery industry globally declined once again in 2011, to 505,000 oz, as the metal continued to suffer from a lack of positioning and effective marketing in the key Chinese market. In Europe and North America, the price elasticity of demand was demonstrated – palladium traded on average 39% higher than in 2010, leading manufacturers to offer lower weight and lower fineness palladium alloys to meet retail price points, and increasing the exposure of palladium to competition from base metal alternatives. The high price of gold, which reduced manufacturers' and retailers' margins on white gold, made it more attractive to stock palladium in some instances.

The most price elastic demand sector last year was investment: elevated palladium prices for much of 2011 put many investors in ETFs in a position to sell at a profit. There were deep sell-offs in many of the funds during periods of falling prices in March, August, and between late September and early October, which suggests there may have been some selling as investors covered losses in other markets. With net disinvestment in the ETF market from late February onwards, total net ETF investment for 2011 was in negative territory by 530,000 oz. Together with liquidation in the coin and small bar market, the investment sector supplied 565,000 oz back to the market last year.

Palladium Supply and Demand '000 oz			
<b>Supply</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
South Africa	2,370	2,640	2,560
Russia	3,635	3,720	3,480
Others	1,095	995	1,320
<b>Total Supply</b>	<b>7,100</b>	<b>7,355</b>	<b>7,360</b>
<b>Gross Demand</b>			
Autocatalyst	4,050	5,580	6,030
Jewellery	775	595	505
Industrial	2,400	2,465	2,480
Investment	625	1,095	(565)
<b>Total Gross Demand</b>	<b>7,850</b>	<b>9,735</b>	<b>8,450</b>
<b>Recycling</b>	<b>(1,430)</b>	<b>(1,850)</b>	<b>(2,345)</b>
<b>Total Net Demand</b>	<b>6,420</b>	<b>7,885</b>	<b>6,105</b>
<b>Movements in Stocks</b>	<b>680</b>	<b>(530)</b>	<b>1,255</b>



## OTHER PGM

- Despite growth in demand, the rhodium market remained in surplus last year by 139,000 oz as a result of higher supplies and recycling.
- Rhodium supplies rose by 4% to 765,000 oz due mainly to higher output from North America and Zimbabwe.
- Demand for rhodium increased by 2% to 906,000 oz as a result of capacity building in the glass industry and investment in a new rhodium ETF.
- Gross demand for rhodium in autocatalysts softened by 2% to 712,000 oz due to lower output by Japanese car manufacturers.
- Ruthenium demand fell by 14% to 809,000 oz as purchasing by the hard disk drive sector declined.
- Demand for iridium, dampened by the electrical sector buying lower volumes of metal compared with 2010, fell by 14% to 301,000 oz.

## Rhodium

The rhodium market was once again oversupplied in 2011 as modest growth in demand was outpaced by a rise in supplies and higher volumes of metal recovered from scrap autocatalysts. As a result, the market surplus increased to 139,000 oz. The price reflected the weaker fundamentals, trading on average 18% lower than in the previous year and reaching a two-and-a-half-year low of \$1,400 by the end of 2011.

Primary supplies of rhodium increased by 31,000 oz to 765,000 oz last year. Sales of rhodium from South Africa were below the level of mined output, but nonetheless increased slightly to 641,000 oz. Growth in supplies was greatest in North America where, as a result of the resumption of normal operations, rhodium shipments doubled to 20,000 oz. A ramping-up of production capacity in Zimbabwe meant that output rose by 10,000 oz to 29,000 oz.

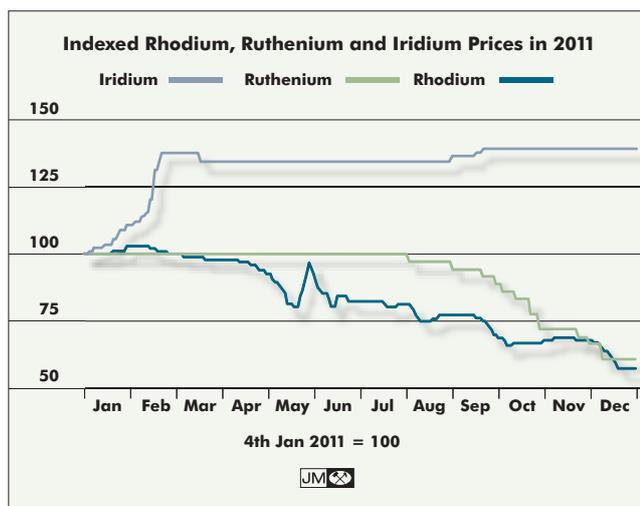
Disruption from the Japanese earthquake in March 2011 was felt in purchasing of rhodium for use in autocatalysts. Japanese manufacturers are the largest users of rhodium in gasoline aftertreatment and lower output as a result of the disaster reduced demand. With depressed demand also in Europe and North America, resulting partly from long-term efforts to thrift rhodium on the basis of cost and partly from disruption to Japanese car plants in those regions, purchasing fell by 2% to 712,000 oz last year.

Industrial buying of rhodium grew last year partly thanks to expansion in the glass manufacturing industry. Driven by strong consumer demand for LCD panels in consumer electronics, over a dozen new platinum–rhodium melting tanks were installed for the manufacturing of LCD glass, mainly in Asia. Demand for rhodium was also boosted by pre-buying in advance of future expansion. Low prices encouraged some switching to higher rhodium-content alloys in the glass fibre sector.

Demand for rhodium for use in the chemical industry was again strong as a result of expansion of Chinese oxo-alcohol and acetic acid production, which stimulated purchases of rhodium for use in process catalysts. Downstream demand for products such as paints and adhesives ultimately drove this expansion of upstream manufacturing capacity.

The first-ever physically-backed rhodium ETF was launched by Deutsche Bank in May 2011 and attracted steady net investment throughout the year, resulting in 17,000 oz of aggregate investment in the year as a whole.

Rhodium prices softened for much of last year. Weighed down by weak fundamentals, as well as the general negative sentiment towards industrial commodities, by the end of 2011 rhodium was trading at a two-year low of \$1,400. In an illustration of how physical demand can affect the relatively small, illiquid market for rhodium, prices surged in late May as the launch of the ETF, backed by physical rhodium sponge,



Rhodium gave back most of its gains from the last two years by the end of 2011. Ruthenium softened in the second half of the year while iridium remained at historic highs.

caused traders and speculators to scramble to cover their positions. This brief spike aside, a surfeit of sellers in the market dragged prices down for the remainder of the year, and although some bargain hunting industrial users were tempted back to the market, this was insufficient to give sustained upward momentum.

## Ruthenium

**Ruthenium demand declined by 14% in 2011 to 809,000 oz largely due to a drop in demand from the electrical sector.**

In the first half of 2011, demand for ruthenium was buoyant. The chemical sector bought strongly to cover refurbishments as the end of production campaigns generated a number of orders for new catalyst. Demand fell markedly in the second half of the year, as purchasing for use in the chemical sector returned to normal levels, leaving demand for the year 9% higher than in 2010.

Hard disk drive industry purchases, which make up the majority of the electrical demand category, reflected normal production requirements in the first half of the year. A focus on inventory management by manufacturers in the second half was compounded by some companies re-pressing ruthenium sputtering targets rather than refining them. In the fourth quarter, purchasing was also affected by the flooding disaster in Thailand, which reduced output of disks. Overall demand for ruthenium in electrical applications softened by 26% to 502,000 oz.

There was some further growth in ruthenium demand in the electrochemical sector last year. Ruthenium is used together with iridium in membrane cell technology in the chlor-alkali industry, where it is gradually replacing older mercury and diaphragm-based technology worldwide on environmental grounds. Although demand in this application has slowed in China, the biggest market, purchasing continues to come from other countries.

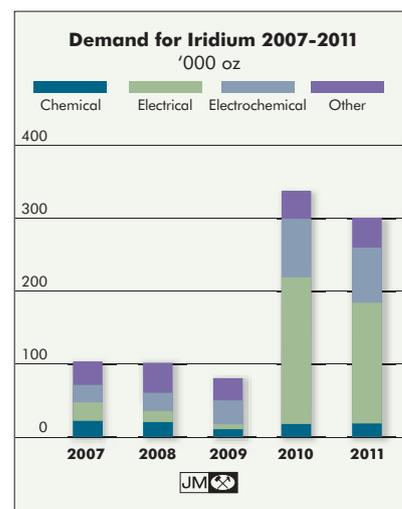
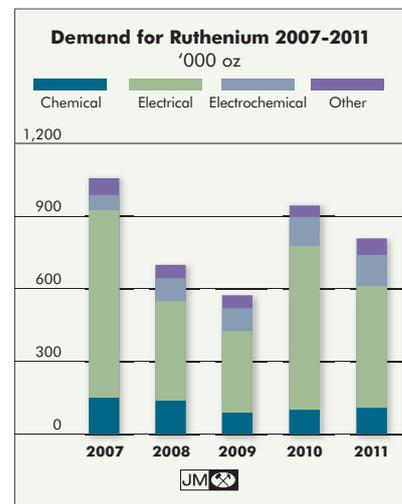
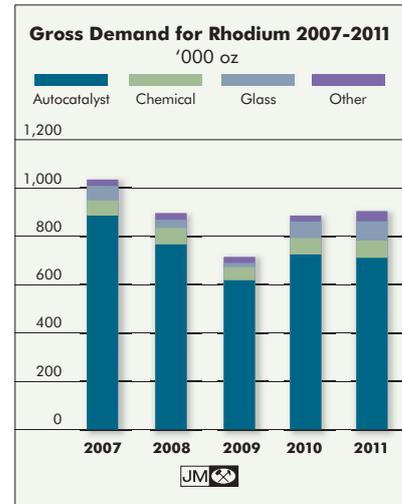
Ruthenium demand was met last year by a combination of primary mine output and releases of speculative holdings of metal. With buyers in the electrical and chemical sectors staying away from the market in the second half of 2011, there was downward pressure on the price and ruthenium lost \$70 to reach a two-year low of \$110 by the close of 2011. This followed an eight-month period from December 2010 when the price remained unchanged as selling was met by a steady stream of industrial buying.

## Iridium

**Iridium demand moderated slightly compared with 2010, but remained at elevated levels due to strong purchasing of crucibles in the early part of last year.**

Offtake by the electrical sector declined by 18% year-on-year to 165,000 oz; this was still the second highest level of demand we have recorded in this sector and represented more than half of the iridium market. Fabrication of iridium crucibles was once again the largest single application area, with strong demand coming from Japan for the manufacture of light-emitting diodes (LEDs).

Iridium's price reflected the strong demand fundamentals by reaching a high of \$1,075 in February last year. It remained close to this level until September when further buying in electrical and electrochemical applications helped the price to achieve a new record high of \$1,085. Industrial purchases of iridium once again exceeded primary mined supply and metal was drawn from above-ground stocks in order to balance the market.



# OUTLOOK

- We anticipate the platinum market will be in oversupply once again in 2012.
- Supplies of platinum are forecast to fall this year as a result of disruption to mine production as well as less flexibility to supplement supplies from stocks.
- More moderate purchasing in industrial applications is expected to result in a fall in gross demand for platinum in 2012.
- The palladium market is forecast to swing back into deficit this year as a result of lower shipments of Russian state stocks and an increase in demand.
- Gross demand for palladium in autocatalysts is expected to rise with higher gasoline vehicle output and greater use of the metal in light duty diesel emissions control.
- Rhodium demand will increase but we forecast that rising supplies and recycling will keep the market in surplus.

## OVERVIEW

Following a period of economic uncertainty, anaemic growth in developed markets and a slowing of growth in emerging economies late last year, there has been evidence in 2012 of slightly improved conditions. By the end of the first quarter, there was cautious optimism regarding the outlook for the global economy, such as signs of falling unemployment and rising consumer spending in the USA. A restructuring of Greek debt appeared to mark the end of a difficult chapter in the ongoing eurozone crisis, although a mild European recession is still thought to be likely. There are also growing signs that Japan is recovering from the natural disasters of the previous year. Although China faces weak demand for its exports, growing domestic demand and government stimuli appear to have resulted in a 'soft landing' for the economy. Inflationary pressures still remain in many emerging markets; together with high interest rates and tight credit, these may act as a brake on consumer spending. However, inflation-adjusted growth in China, India and Brazil is still likely to outpace that in many other regions this year.

Some risks to the downside remain. Despite conditions in the eurozone being less negative than previously thought, the region is in general still suffering from high debt, high unemployment and low growth. With continuing economic uncertainty, asset prices are likely to remain volatile and at the mercy of external shocks. In particular, geopolitical tensions surrounding Iran and the possible impact of higher oil prices pose a threat to the economic recovery this year.

Although these macro-economic trends will undoubtedly play a part in influencing demand for platinum and palladium, we foresee that supply and demand fundamentals will have a greater influence on the pgm markets in 2012 than they have had for some time. There will be constraints on sales of platinum

from South Africa this year, leading to a reduction in global supplies. Gross demand for platinum is also likely to decline, due to lower purchasing for cyclical industrial applications, notably in the glass sector. Reduced sales of Russian state stocks of palladium will impact the market balance in 2012; along with growth in auto and industrial purchasing, they point to a palladium market heading back into deficit.

## PLATINUM

The balance of the platinum market is expected to be similar overall to that in 2011. Supplies will be lower due to a decline in output from South Africa, while more moderate levels of purchasing for industrial applications will lead to a slight fall in gross demand.

Developments in the South African platinum mining industry in the last year have begun to challenge the ability of the sector to increase supplies year-on-year. So far in 2012, strikes have reduced mine production and safety stoppages have continued to interrupt output. Although it remains possible that overall mine production could increase if safety stoppages moderate from the levels of late 2011, lower levels of in-process and refined inventories after last year's drawdowns means that there is less flexibility for producers to supplement supplies from stocks in 2012. Since there is not enough production capacity in other regions to make up for a reduction in South African supplies, we expect global supplies of platinum to decline this year.

An illegal strike at Impala Platinum's Rustenburg lease area led to the shutdown of the underground mining complex for six weeks in the first quarter of 2012, resulting in the loss of an estimated 120,000 oz of platinum production. African Rainbow Minerals and Anglo American Platinum's joint venture Modikwa mine was also closed for three weeks in the first quarter, due to a strike led by the National Union

of Mineworkers, emphasising the uncertainty in the South African mining sector and the continuing threat to production from labour disruptions.

Across the South African mining industry as a whole, safety stoppages have been a significant constraint on production; losses due to Section 54 safety stoppages at the various producers were substantial in 2011. Cost pressures are high in the country's mining industry. In addition to the double digit wage increases that much of the sector is already committed to, electricity and water price rises are running well ahead of inflation even after the state electricity utility Eskom moderated its price hikes. Subdued pgm prices and a strong rand have also squeezed producers' profits. High costs and inadequate revenues are reducing levels of new and replacement capital expenditure required to guarantee supplies in future and putting some marginal operations at risk.

A drawdown of inventory by the big producers at the end of last year means that, in 2012, mines are less able to augment underlying production with sales from pipeline and refined stocks. In conjunction with the various pressures on production, this leads us to conclude that shipments of platinum from South Africa are likely to decline this year.

In Russia, falling grades and the need to process greater amounts of ore to maintain current output levels once again constrain the degree to which supplies can expand. Although in the longer term, with significant investment, Russia has the potential to increase shipments (as discussed in our special feature beginning on page 24), output is likely to be flat or declining in 2012.

Last year, around half of the growth in global platinum supplies came from North America and Zimbabwe. Output from North America returned to normal levels as a result of the ramping up of production at North American Palladium and Vale following the reopening of their respective operations in 2010. In Zimbabwe, growth in output last year came from new and expanded operations at the Unki and Mimosa mines. With output now running at close to capacity in the two regions, there is little potential for growth in 2012.

There remains some uncertainty over the outcome of Zimbabwe's mining indigenisation plans. In early 2012, Zimplats reached agreement with the Zimbabwe government over proposals to transfer majority ownership to local investors, but the price of the assets sold was still to be determined at the end of the first quarter. It is believed that the Mimosa and Unki plans have also been accepted by the government, but details were not available at the time of writing. Over the longer term, the increase in mining royalties recently announced by the

government is likely, if implemented, to move Zimbabwe's mines up the cost curve, but costs of production are likely to remain low compared with many mines in South Africa.

In the autocatalyst and industrial demand sectors, we anticipate that the recovery in platinum purchasing seen in 2010, and to a lesser extent in 2011, will moderate this year. There will again be growth in demand in heavy duty emissions treatment systems. In the light duty sector, greater output by Japanese manufacturers as well as higher diesel car production in India and South Korea will offset lower purchasing in Europe, keeping platinum demand firm for autocatalysts. There is likely to be softer demand from the glass sector due to pre-buying of metal last year and reduced purchasing in some of the more cyclical industrial demand areas, such as petroleum refining and chemicals, where capacity is now adequate. However, as recovery from the floods in Thailand last year takes place, we expect higher purchasing of platinum for use in the hard disk drive industry. Jewellery demand is forecast to remain firm in 2012 and investment should be positive once again.

Falling sales in the non-premium sector mean that vehicle output in Europe is likely to soften this year. Lower vehicle production together with substitution of platinum by palladium in light duty diesels will result in a dampening of platinum purchasing in the region. Despite heavy discounting and incentives in Europe, vehicle sales slid in the first quarter of 2012, a trend that is likely to continue if the region suffers a recession this year.

In Japan, a rebound in vehicle production following the 2011 Great East Japan Earthquake will be positive for platinum as Japanese manufacturers still tend to use platinum in gasoline autocatalysts. In India, where two fifths of light duty vehicle sales are diesels, a subsidy on diesel fuel continues to make diesel-powered vehicles an attractive option for many consumers and we forecast further growth in the market share of diesels there. Following a slowdown last year, vehicle sales accelerated in early 2012: a large and increasingly wealthy middle-class population should continue to drive vehicle purchasing, and ultimately platinum demand.

After exceptional growth in demand from the heavy duty sector last year we anticipate the rate of increase will slow in 2012 but still be firmly positive. The first quarter of the year was reasonably robust as manufacturers continued to benefit from fleet replacements. In Europe, platinum demand is forecast to rise as higher pgm-loaded catalysts are rolled out in greater numbers by certain manufacturers in anticipation of Euro VI emissions legislation, which begins to come into

force in January 2013. The implications of Euro VI for platinum demand are discussed on page 28.

Due to the cyclical nature of many industrial applications for platinum, rather than because of weaknesses in the economy, we expect lower demand in the glass and petrochemical sectors this year. Unprecedented levels of purchasing of platinum by the glass industry last year mean that demand will be subdued in 2012 as the liquid crystal display (LCD) and glass fibre sectors remain amply supplied. In addition, purchasing by the petroleum refining industry, another market characterised by cyclical demand, is set to be in a periodic downturn due to full inventories and limited new capacity installations. An application that is likely to see higher platinum demand in 2012 is the hard disk drive sector. Following disruption to manufacturing operations from the floods in Thailand in the fourth quarter of 2011, platinum purchasing is forecast to be greater this year than last as recovery from the disaster continues, and there is further upside because production is not expected to fully return to normal until the end of the year. There will be strong growth in platinum demand in non-road emissions control as legislation governing non-road mobile machinery is enforced for different types of engine in Europe, North America and Japan.

The strength of Chinese jewellery demand will partly depend on levels of consumer pull this year as stocks built up by manufacturers and retailers in late 2011 and early 2012 are drawn down. Purchases by the trade in the first quarter of this year were slightly down on the same period in 2011 but reports from retailers suggest that sales to consumers remain robust. Partly driven by consumer demand for gold, Hong Kong jewellery brands continue to expand retail operations in mainland China, creating opportunities to increase platinum jewellery retail stocks and sales. Jewellery in China is a low-margin business, and as a result we expect to continue to see efficient buying into price dips by the trade. We anticipate further momentum for platinum jewellery in India, where rapid growth has been seen in recent years.

Investment demand will be one of the key determinants of market balance this year. In the first quarter of 2012, there was net investment of around 100,000 oz in physically-backed exchange traded funds (ETFs), although this was some 70,000 oz lower than investment in the equivalent period last year. These funds have been in existence for over five years and are now an established part of many institutional investors' portfolios. As the track record of individual funds grows, they are likely to attract further institutional, and indeed some retail, investors. Price direction has been influential;

in the first quarter of this year rising platinum prices have generally resulted in positive investment inflows into ETFs, with the opposite also typically holding true. The opportunity cost of holding non-yielding investments such as ETFs has been negligible due to historically low interest rates. Higher rates are thought to be unlikely in the major developed economies in 2012, therefore conditions for further inflows into ETFs, and positive overall investment demand this year, appear favourable.

## PALLADIUM

**Lower shipments from Russian state stocks will result in a substantial fall in palladium supplies this year. Together with an increase in demand, we anticipate the palladium market will swing back into deficit.**

The outlook for palladium supplies is somewhat different to that for platinum. Sales of palladium from South Africa were below the level of mined production last year. With a reasonable level of stocks to draw upon, supplies could be slightly higher in 2012. Palladium output from Russian mining operations is likely to decline this year in line with Norilsk's 2012 guidance; this most likely reflects changes in the ore mix and a decline in average grades.

More significantly, we expect that sales of Russian state stocks of palladium will fall sharply from over three quarters of a million ounces to a quarter of a million ounces as the bulk of the remaining government-controlled inventories are shipped. Supplies of palladium from North America are likely to remain flat as operations maintain the full production levels reached last year after being disrupted in 2009 and 2010. Zimbabwe still has some potential to increase palladium shipments this year as production ramps up at the Unki mine. Overall, the decline in Russian state stock shipments this year will mean that supplies will be more limited in 2012 and the market will be considerably tighter.

Gross demand is expected to increase on 2011 levels this year, with stronger purchasing of palladium by the autocatalyst sector and a return to positive net investment in ETFs. Capacity expansion in the chemical industry will also be positive for demand for palladium.

Global vehicle production is forecast to accelerate in 2012. With most of the growth coming from higher gasoline vehicle output, the prospects for palladium demand in the autocatalyst sector are good. Manufacturers in Japan are expected to continue to recover and make up for some of the lost production that resulted from last year's earthquake. In

China, vehicle production growth is forecast to intensify this year. Together with tighter emissions standards nationwide from the middle of last year and the adoption of more stringent China 5 regulations in certain cities from January 2012, this will be positive for palladium demand. With improved economic conditions and falling unemployment in North America, vehicle production and sales in the first quarter of 2012 increased year-on-year. Although we expect lower vehicle production in Europe, the impact on palladium demand will be more moderate than in the platinum market due to further substitution of platinum with palladium in light duty diesels.

In industrial applications, expansion of chemical manufacturing capacity in China will drive demand for process catalysts again this year. The country continues to expand its manufacturing sector to satisfy strengthening export, and growing domestic, demand by bringing new plants on-stream. In the electrical sector, where the use of palladium in components faces competition from cheaper alternatives, there is still a core of high-end applications where we forecast demand to be robust. Dental applications of palladium, which have been declining for a number of years, are expected to continue their downwards trend in the light of long-term improving dental health trends and competition from alternative treatments.

Palladium demand in the jewellery industry can be expected to fall this year if consumer awareness remains limited by a lack of effective marketing. North America may be an exception if a new trade and consumer palladium jewellery marketing campaign, which began in 2011, is successful.

After a year of heavy net disinvestment in palladium ETFs, the changing market balance this year is likely to encourage positive sentiment. In the three months to the end of March, there have already been around 250,000 oz of net inflows into the various ETF funds (in contrast with the negative net inflows in the first quarter of 2011). The evidence in the first quarter of this year suggests that growing awareness of the tight fundamentals in the palladium market has spurred interest in investing in palladium.

## OTHER PGM

**Demand for rhodium is forecast to increase this year, but the market is likely to remain in surplus.**

As with palladium, last year's rhodium shipments were below the level of underlying production in South Africa meaning that there is the potential for supplies from that country to rise in 2012. Elsewhere, sales of rhodium are

expected to remain largely flat, meaning that global rhodium supplies are likely to be steady, or even grow modestly, in 2012. Returns of end-of-life vehicle catalysts should also lead to higher volumes of rhodium being recycled this year.

With a return to full production levels by Japanese car manufacturers, there will be an increase in rhodium demand for use in three-way catalysts. Higher output by carmakers in North America and China are also expected to raise rhodium purchasing for autocatalysts.

Low prices, by recent historical standards, drove up purchasing of rhodium in late 2011 and into early 2012. Softer prices have encouraged a switch to higher rhodium-content alloys in the glass fibre industry, but adequate production capacity is likely to limit new purchasing this year. Chemical industry demand for rhodium is likely to remain strong as China continues to expand oxo-alcohol manufacturing capacity.

The physically-backed rhodium ETF investment market became a new area of demand last year, and has the potential to attract further investment in 2012 depending on prices. In the first quarter of 2012, investors appeared to be taking advantage of the lowest prices in over two years to add 6,500 oz to total volumes, or 38% on year-end 2011 holdings.

**Demand for ruthenium is forecast to increase in 2012 due to higher purchasing by manufacturers of hard disks.**

Output of hard disk media is expected to rise compared with last year as the industry recovers from the floods in Thailand in October 2011, although a full recovery is only likely to take place by the end of 2012. Some additional demand is likely in resistors and in dynamic random access memory chips.

The refurbishment of the chlor-alkali industry in China is nearing completion; we expect robust demand for ruthenium in membrane cells as the technology replaces old mercury and diaphragm-based electrochemical cells in other regions.

**Demand for iridium is expected to soften this year in line with lower purchases of crucibles used to grow sapphire for the manufacture of light-emitting diodes (LEDs).**

After a spate of capacity-building in early 2011, when companies in Japan in particular ordered large numbers of crucibles, buying moderated in the remainder of the year. Purchasing is expected to decline further in 2012 although remain elevated compared with historical levels.

We anticipate growth this year in the use of iridium in organic light-emitting diodes (OLEDs), which are beginning to see uptake in smartphones and hold great promise in the market for TVs and tablet computers. 2012 should also see greater demand for iridium in spark plugs, driven by the aerospace and high-end automotive sectors.

# SUPPLIES, MINING & EXPLORATION

- Global shipments of platinum increased by 7% to 6.48 million ounces in 2011. Supplies of palladium remained flat at 7.36 million ounces, while rhodium supplies grew by 4% to 765,000 oz.
- Supplies of platinum from South Africa increased by 5% to 4.86 million ounces as a result of inventory releases. Palladium supplies from South Africa fell by 3% to 2.56 million ounces as producers added to stocks.
- Russian mining contributed 835,000 oz of platinum and 2.71 million ounces of palladium. Palladium supplies were once again augmented by sales from state stocks, though at 775,000 oz this was the lowest since 2006.
- Supplies of platinum from North America returned to normal levels last year. Shipments of platinum increased by 75% to 350,000 oz while those of palladium rose by 53% to 900,000 oz.

## SOUTH AFRICA

In 2011, supplies of platinum from South Africa rose by 5%, or 220,000 oz. This increase was entirely due to the release of metal from in-process and refined inventories. Over 250,000 oz of the platinum supplied by the South African industry last year came from above-ground stocks.

In a year that had been expected to see a firm increase in production, underlying mine output actually fell by 3%, or around 120,000 oz. This loss was largely attributable to safety stoppages, particularly in the final quarter of the year. Illegal strikes and other forms of labour disruption added to the industry's woes. Of the three largest producers, Anglo American Platinum (Amplats) reported the loss of 109,000 oz of platinum due to Section 54 safety stoppages, while Impala Platinum lost 33,000 oz of platinum output in the last four months of the year alone. We estimate that Lonmin's output was dented by at least 25,000 oz of platinum as a direct result of Section 54 notices, while a three-week illegal strike at Karee cost the company as much as 30,000 oz of production.

Nevertheless, the picture was not uniformly gloomy. Despite the Karee stoppage, Lonmin reported higher output from its Marikana division, while Northam's Zondereinde mine recovered from a strike-hit 2010. Production continued to ramp up at Amplats' expanded Mogalakwena open pit, while there was increased output at Aquarius Platinum's Everest mine which reopened in 2010.

The potential for an increase in platinum supplies in 2012 is weak. In the first quarter, an illegal strike at Impala Platinum's Rustenburg lease area led to the shutdown of the underground mining complex for around six weeks, and resulted in the loss of around 120,000 oz of platinum production. Elsewhere, the Modikwa mine, a joint venture between African Rainbow Minerals and Anglo Platinum, was closed due to a legal strike, while safety stoppages continued to act as a significant brake on production across the industry as a whole.

With many mines operating well below capacity last year, it remains possible that overall mine output will increase modestly in 2012, although this assumes that safety stoppages do not continue at the levels seen in the fourth quarter of 2011. However, even if output increases, last year's depletion of above-ground inventories has reduced the industry's flexibility to supplement platinum supplies with metal from stocks. We conclude that overall, shipments of platinum are likely to decline this year.

The picture for the other platinum group metals is somewhat different. South African supplies of palladium fell by 80,000 oz in 2011 because producers added to stocks, while rhodium shipments were also below the level of underlying production. This means that supplies of these metals are likely to at least remain flat, and may even increase modestly, in 2012.

## Anglo American Platinum

Underlying production from Amplats' South African mines and joint ventures fell by 5%, or around 110,000 oz, to 2.28 million ounces in 2011. This number excludes both concentrate purchases from third parties, such as chrome tailings operations and Xstrata's Eland Platinum mine, and output from the company's new and highly successful Unki mine in Zimbabwe. Including third parties and Unki, the group's reported 'equivalent refined platinum production' (output in concentrate adjusted for standard smelting and refining recoveries) was down 3% to 2.41 million ounces.

PGM Supplies: South Africa '000 oz			
Supply	2009	2010	2011
Platinum	4,635	4,635	4,855
Palladium	2,370	2,640	2,560
Rhodium	663	632	641

*Although mine production at Anglo American Platinum fell, the group's smelters and refineries performed strongly.*



The most significant losses occurred at four of the group's large mines on the western Bushveld: Tumela, Bathopele, Union and the pool and share operation at Kroondal. Together, these mines accounted for nearly one million ounces of platinum production in 2010, but combined output fell to just 840,000 oz last year. Safety stoppages were the primary cause of the shortfall, although at Kroondal the principal hurdle was a shortage of drilling rigs and drilling steel required to install new underground support systems.

Amplats' joint venture and associate mines were also affected by safety stoppages, although the impact on production was generally more limited. The Modikwa mine, a joint venture with African Rainbow Minerals, saw equivalent refined platinum output drop 4% to 125,000 oz, while the Bafokeng Rasimone Platinum mine (67% owned by Royal Bafokeng Resources) reported production decreased by 2% to 180,000 oz of platinum. The Mototolo joint venture with Xstrata had a steady year, with platinum output rising to 109,000 oz.

Although overall mine production was weak, the group's smelters and refineries put in a strong performance, especially in the second half, resulting in the release of 120,000 oz of platinum from in-process stocks. Amplats also drew upon refined platinum stocks with the result that total shipments rose by 3% to 2.605 million ounces. Of this, just over 50,000 oz came from the Unki mine and is therefore counted in our estimate of Zimbabwe supplies (see page 20).

Amplats expects to produce between 2.5 and 2.6 million ounces of platinum in 2012, as those operations hit hardest by safety stoppages last year return to more normal operating conditions. The group should also benefit from additional ounces from a reopened shaft at the Khuseleka mine, and

the ramp-up of production at Unki. However, even though underlying mine output is expected to rise, it is unlikely that platinum shipments will exceed the level seen in 2011.

## Impala Platinum

Impala's Rustenburg lease area faced serious operational challenges during 2011. Operations were badly disrupted by Section 54 safety stoppages, particularly in the last four months of the year, when over half a million tonnes of ore production were lost. In addition, lack of mining flexibility remained a critical issue: delays in bringing new shafts into production have left Impala dependant on old shafts which are now reaching the end of their working lives, with a significant proportion of production being sourced from 'white areas' (unmined sections left behind in otherwise depleted parts of the mine). This has had a negative impact on mining efficiencies. As a result of these difficulties, the volume of newly-mined ore processed by the concentrators fell by 10% last year to 13.1 million tonnes.

This decline was partly offset by the treatment of surface materials such as tailings, while releases from the processing pipeline also added to refined output in 2011. Overall, refined platinum production from the lease area was little changed at 931,000 oz, while palladium output rose 4% to 522,000 oz, and that of rhodium declined by 2% to 125,000 oz.

PGM production from Impala's Rustenburg operations is likely to be sharply lower in 2012. In mid-January, rock drill operators at the mine embarked on an illegal strike and the dispute quickly spread across Impala's Rustenburg operations, bringing mining to a standstill and resulting in the dismissal of 17,000 workers. Following the resolution of the dispute, miners were rehired and operations were able to begin resumption on 5th March. The stoppage is estimated to have cost Impala around 120,000 oz of platinum production.

The Marula mine on the eastern limb produced 65,000 oz of platinum in concentrate in 2011, a drop of 11% compared with the previous year. This operation has consistently struggled to meet production targets, and a detailed strategic review has prompted Impala to reduce planned output to 70,000 oz of platinum in each of the next two years. In contrast, 2011 was a good year for the Two Rivers mine, a joint venture with African Rainbow Minerals, with output of platinum in concentrate rising by 5% to 149,000 oz.

Impala's Zimbabwe operations, Mimosa and Zimplats, once again recorded strong performances. Output from these mines is included in our estimates of Zimbabwe supplies.

## Lonmin

In contrast to its larger rivals, Lonmin recorded an improved operational performance in 2011. The total volume of ore milled at its Marikana division and the neighbouring Pandora joint venture was 12 million tonnes, up 3% on the previous year, while output of platinum in concentrate rose by 2% to 726,000 oz. Both refined platinum production and sales grew by 13%, to 754,000 oz and 747,000 oz respectively. Lonmin also shipped 354,000 oz of palladium (up 16%) and 99,000 oz of rhodium (up 5%) last year.

These gains were achieved despite significant disruptions to operations during the year. In May and June 2011, unofficial industrial action by workers at Karee resulted in the loss of over three weeks of production at the operation. Taking into account the direct and indirect effects of the stoppage, Lonmin management has estimated that it cost the company 30,000 oz of platinum output. In addition, Section 54 stoppages resulted in the loss of 440,000 tonnes of ore production during the year; we estimate that this is equivalent to around 25,000 oz of platinum production.

Lonmin expects 2012 to be a year of consolidation. The company's guidance for platinum output this year is 750,000 oz, which takes into account the high risk of disruption to mining operations due to Section 54 safety stoppages and other factors.

Beyond 2012, Lonmin's objective is to grow output from its Marikana division to 950,000 oz of platinum annually. This will be achieved via the ramp-up of production from the Saffy and Hossy vertical shafts, along with the commissioning of a third new-generation shaft, K4, due this year. In addition, the construction of tailings retreatment plants (under a joint venture with Xstrata-Merafe Chrome Ventures and ChromTech) is expected to improve overall recoveries of pgm by 2%.

## Northam

Northam's Zondereinde mine posted a much improved performance last year, as the operation recovered from a six-week strike in 2010. The plant processed 1.9 million tonnes of ore, up 15% year-on-year, although there was a decline in overall head grade due to an increase in the percentage of UG2 mined (which on Northam's property has a significantly lower pgm content than the Merensky Reef). Output of pgm in concentrate, including some production from above-ground sources, for example tailings, was up 5% at 278,000 oz.

Future output at Zondereinde will depend on the company's

ability to improve mining flexibility on the Merensky Reef, with a deepening project due to start contributing to Merensky ore volumes from the second half of this year. Overall, absent serious disruption from safety stoppages or industrial action, we expect pgm output to increase modestly in 2012.

From 2013, the new Booyssendal mine will add to Northam's pgm output. Construction of this operation continues to progress according to schedule: underground development has commenced and construction of plant and mine buildings is underway. The company has begun to accumulate a stockpile of reef ahead of the commissioning of the concentrator, which is due to take place in the first half of 2013.

Sales of refined metal, including pgm purchased in concentrate from Platmin's Pilanesberg mine, were down slightly on the previous year, at 208,000 oz of platinum, 98,000 oz of palladium and 25,000 oz of rhodium.

## Other Producers

**In this section we discuss mines which are not owned or part-owned by Anglo American Platinum, Impala Platinum, Lonmin or Northam. Almost all pgm production from these operations is processed in South Africa under concentrate offtake agreements with the major producers.**

Platmin's Pilanesberg open pit mine continued to report disappointing results in 2011. Although sales of pgm in concentrate to Northam rose to 71,000 oz, from 60,000 oz the previous year, the build-up of production continued to run well behind schedule. Both grades and recoveries remained low, while mining was disrupted for three weeks in mid-2011 due to an illegal strike during which serious damage to mining equipment occurred.

In August 2011, Xstrata suspended open pit mining at its Eland Platinum operation due to low grades. The mine is focusing instead on the development of underground mining via two declines, from which limited amounts of ore are now being sourced. Output of pgm totalled 57,000 oz in 2011, down by more than 40% on the previous year, and will remain weak in 2012. The ramp-up of underground operations is behind schedule due to poor ground conditions; the company now expects pgm output to build to around 300,000 oz of pgm annually by 2016. Platinum group metals from Eland are refined and sold by Anglo American Platinum.

Following the reopening of Aquarius Platinum's Everest mine in mid-2010, production of platinum in concentrate rose by 77% to 56,000 oz last year; this metal was processed by Impala Refining Services (IRS). Nevertheless, the operation

Progress is continuing  
at Northam Platinum's  
Booyendal mine site.



*Eastern Platinum carried out a number of improvements at its Zandfontein mine during 2011.*



was not immune to the difficulties afflicting the South African platinum sector: production, particularly in the second half of the year was negatively affected by safety stoppages, maintenance issues affecting the underground vehicle fleet, and industrial action.

In addition, the mine faces a number of geological and technical challenges related to an extended oxidised zone on the western side of the ore body which has led to poor ground conditions and low grades in this part of the mine. Aquarius is now undertaking a strategic review of the Everest mine and in the meantime, production will be limited to 10,000 oz of pgm monthly over the next twelve to eighteen months (equivalent to around 70,000 oz of platinum per annum).

Aquarius' Blue Ridge mine was closed for redevelopment in September 2010, with a planned restart date of July 2011. However, in June 2011, low rand pgm prices led Aquarius to announce the mothballing of the mine. The mine sent concentrate containing around 10,000 oz of pgm to IRS in 2011.

At Eastern Platinum's (Eastplats') Crocodile River mine, which also sends concentrate to IRS, platinum output dropped by 30% to 47,000 oz, with operations disrupted by strikes and Section 54 shutdowns. The company has invested in additional infrastructure at the Zandfontein mine and has upgraded the decline and vertical shaft. Work on the Crocette section was put on hold in December 2011 due to low pgm prices. Eastplats is continuing with the construction of its Mareesburg project on the eastern limb. This involves the development of a new open pit mine at Mareesburg and a 90,000 tonne per month concentrator plant at the nearby Kennedy's Vale site. Production could commence as early as 2013.

Strikes and safety stoppages also hampered operations at

the small Smokey Hills mine, owned by Platinum Australia. Output was flat at just 32,000 oz of pgm in 2011. The company continues to review a 2010 feasibility study of the Kalahari Platinum (Kalplats) project and intends to extract a bulk sample for treatment through a pilot plant during 2012.

One of 2011's rare success stories was Sylvania Dump Operations, which increased its pgm output by 44% to 48,000 oz. The operation consists of five chrome tailings retreatment plants, two on the western limb of the Bushveld, and three on the eastern limb, with a sixth plant currently under development. Sylvania also has a number of potential mining projects, of which the most advanced is at Vygenhoek (also known as Everest North). This project is the subject of a Heads of Agreement with Aquarius Platinum, under which Sylvania has completed a feasibility study of a potential new open cast and underground mine.

In May 2011, Wesizwe Platinum concluded a transaction with Jinchuan Group and the China Africa Development (CAD) Fund, under which it has received an injection of \$227 million in return for 732.5 million Wesizwe shares. Jinchuan and the CAD Fund have also undertaken to secure project finance of \$650 million.

Wesizwe now has access to funds to develop its Frischgewaagd-Ledig mine, which is adjacent to Royal Bafokeng Platinum's Styldrift project. Mine development officially commenced in July 2011 and shaft sinking is due to begin this year, with first production scheduled for 2018. A feasibility study, conducted in 2008, envisaged a project mining and processing some 2.76 million tonnes of ore, yielding 350,000 oz of pgm annually.

At the Nkomati Nickel mine, a joint venture between African Rainbow Minerals and Norilsk Nickel, the Large-Scale Expansion Project is ramping up towards full production, expected to be achieved in 2014. However, although nickel production improved by around 5% in 2011, pgm grades and recoveries were low, and total platinum group metal output fell by 27% to 66,000 oz.

## RUSSIA

**Output of pgm from Norilsk Nickel's Russian operations was little changed in 2011. Platinum production totalled 671,000 oz, up 1%, while that of palladium was down marginally at 2.71 million ounces. We believe that Norilsk continues to refine substantial quantities of pgm from surface sources, such as stored pyrrhotite concentrate. This has enabled the company to maintain pgm output**

**PGM Supplies: Russia**  
'000 oz

Supply	2009	2010	2011
Platinum	785	825	835
Palladium			
Primary Production	2,675	2,720	2,705
State Sales	960	1,000	775
Rhodium	70	70	72

over the last two years, despite the depletion of its richest (massive sulphide) ore reserves and increased reliance on the extraction of relatively lower-grade disseminated ore. Details of current mining operations in Russia, and potential future projects, can be found in our special feature on page 24.

Norilsk Nickel's guidance for 2012 suggests that pgm output will decline slightly this year, between 2.60 and 2.65 million ounces of palladium and 650,000 to 660,000 oz of platinum. This probably reflects planned changes in the ore mix and a continued gradual decline in average grades at the operation in the Norilsk-Talnakh area.

At the alluvial platinum mining operations in the far east of Russia, production was stable in 2011. At Kondyor, output has been maintained by the processing of additional platinum group metal-bearing sands, compensating for lower grades. Small amounts of platinum are also extracted from alluvial deposits in the Sverdlovsk region of the Urals, amounting to an estimated 10,000 oz last year.

Substantial quantities of palladium were once again sold from government-controlled inventories in 2011. However, at 775,000 oz, state stock shipments were the lowest in five years. We expect sales from this source to decline sharply to only 250,000 oz in 2012.

## NORTH AMERICA

Supplies of platinum from North America increased by 150,000 oz to 350,000 oz last year, while supplies of palladium were 310,000 oz higher, at 900,000 oz, than in 2010. Rhodium supplies doubled to 20,000 oz. The increase in output was largely attributable to the ramping up to full production at North American Palladium after restarting in 2010 as platinum and palladium prices improved as well as Vale's Sudbury operations, which resumed in 2010 following a year-long strike. During the strike, an estimated 150,000 oz of platinum were lost.

PGM output from primary mining in Russia changed little overall in 2011.



## Canada

North American Palladium's Lac des Iles (LDI) mine is Canada's only primary pgm producer. Following its reopening in April 2010, the operation has been extracting high-grade underground ore via an access ramp, and has also processed ore from lower-grade surface sources. During 2011, LDI treated 1.7 million tonnes of ore at an average grade of 3.7 grams of palladium per tonne, yielding 147,000 oz of metal. A new mine shaft is due to be commissioned at the end of this year, and palladium output is planned to increase to 250,000 oz per annum from 2015.

By-product pgm are also produced at Xstrata's and Vale's Canadian nickel mines. Xstrata reported a 28% increase in nickel production from its Sudbury operation, while copper output increased by 38%. Growth in copper reflected the high-copper content of the ore from the new Nickel Rim South mine, which is now operating at full capacity, and the extraction of copper-rich ore from the Fraser mine under an agreement with Vale. However, lower head grades at the company's Raglan mine in northern Quebec resulted in a 3% decline in production of nickel in concentrate at this operation.

At Vale's Sudbury mines, output of nickel, copper and pgm

**PGM Supplies: North America**  
'000 oz

Supply	2009	2010	2011
Platinum	260	200	350
Palladium	755	590	900
Rhodium	15	10	20

North American Palladium's Lac des Iles mine returned to normal production in 2011, following its reopening the previous year.



improved dramatically last year, as operations returned to normal following a year-long strike that ended in July 2010. The company reported output of 174,000 oz of platinum and 248,000 oz of palladium in 2011, compared with 35,000 oz and 60,000 oz respectively the previous year.

Towards the end of 2010, Stillwater Mining acquired the Marathon copper-pgm project, north of Lake Superior in Ontario, Canada. Environmental assessment and permitting is underway, a process which is expected to take around two years. Should development of the mine go ahead, construction would take a further eighteen months to two years and would cost an estimated \$550-\$650 million.

## USA

Stillwater Mining Company is currently the only significant producer of primary pgm in the USA. In 2011, its Stillwater and East Boulder mines in Montana produced 518,000 oz of pgm, up 7% on the previous year.

Stillwater believes that 500,000 oz of pgm is currently the optimal annual production rate, which it intends to maintain going forward. In order to access replacement ore reserves, it is investing in the Graham Creek project (a western extension of the East Boulder mine) and the Blitz project (east of the Stillwater mine). These projects will take four to five years to develop and are intended primarily to extend mine life.

Over the last two or three years, very small amounts of platinum have been produced by XS Platinum from a tailings retreatment operation at Platinum Creek on Goodnews Bay, Alaska. This operation exploits tailings from alluvial platinum mining which took place between the 1930s and the 1960s.

## ZIMBABWE

Supplies of platinum from the Zimbabwe platinum mines rose by 21% to 340,000 oz last year, reflecting the commissioning of Anglo American Platinum's new Unki mine. The existing mines operated by Zimplats and Mimosa continued to perform well, with output up slightly compared to 2010.

Anglo's Unki mine was commissioned in January 2011, and the ramp-up exceeded expectations: the mine reached nameplate milling capacity of 120,000 tonnes of ore per month in the third quarter of 2011, and output of platinum in concentrate in its first year exceeded 50,000 oz. The mine is expected to operate at steady-state levels of around 60,000 oz of platinum annually in 2012. Anglo believes that the Unki project area could support a larger mine, and studies are being undertaken to evaluate the optimal level of output.

The Mimosa mine (a 50:50 joint venture between Aquarius Platinum and Impala) continued to perform well during 2011, with platinum output exceeding 100,000 oz for the first time. Following a series of incremental expansions, the mine is operating at capacity and production should be flat this year.

Zimplats produced around 185,000 oz of platinum in 2011, following the completion of the Phase I expansion. Work on the Ngezi Phase II expansion is now underway: Zimplats intends to construct a new two million tonne per annum underground mine and a second concentrator at Ngezi, lifting platinum output to 270,000 oz per annum once the project has been completed in 2014.

Zimplats has reached agreement with the Zimbabwe government over proposals to comply with the Indigenisation Act, which requires the transfer of 51% ownership to local investors. The company will sell a 31% stake to the National Indigenisation and Economic Empowerment Fund, while a community trust and an employee share ownership scheme will take a further 10% each. It is believed that the Mimosa and Unki mine indigenisation plans have also been accepted by the Zimbabwe government, but details were not yet available at the time of writing.

PGM Supplies: Zimbabwe			
	'000 oz		
Supply	2009	2010	2011
Platinum	230	280	340
Palladium	180	220	265
Rhodium	19	19	29

*Production at Anglo  
American Platinum's Unki  
mine in Zimbabwe ramped  
up in 2011.*



# RECYCLING

- ‘Open loop’ recycling in the autocatalyst, electrical and jewellery sectors reached record high levels for platinum and palladium, in excess of two million ounces, in 2011.
- Recycling of platinum rose by 12% in 2011 to reach 2.05 million ounces, driven principally by higher returns of end-of-life vehicle catalysts.
- Palladium recycling increased by 27% to 2.35 million ounces last year as a result of growth in metal recovery from autocatalysts and the jewellery trade.
- Throughput of gasoline vehicle catalysts in the recycling stream drove rhodium recovery levels up by 16% to 280,000 oz in 2011.

Recycling in ‘open loop’ applications – autocatalyst, electrical and jewellery – rose once again in 2011. PGM from these applications, where the metal is sold back into the market after refining, acts as an additional source of metal, supplementing supplies from primary mining. This contrasts with ‘closed loop’ applications where metal in a spent product does not change ownership but is recycled and re-used in the same application, such as pgm gauze in the nitric acid industry.

## AUTOCATALYST

Total pgm recovered from end-of-life autocatalysts rose by 20% to reach 3.16 million ounces in 2011 due to higher numbers of scrapped vehicles worldwide. Of the three metals recycled in the autocatalyst sector, palladium showed the greatest rate of year-on-year increase, rising by 26% to 1.66 million ounces, reflecting more highly-loaded gasoline car catalysts being returned for recycling, particularly in North America.

Recovery of platinum from European autocatalysts outpaced that of palladium once again in 2011. Relatively higher yields of platinum compared with palladium reflect the changing profile of end-of-life vehicles (ELVs). Many cars scrapped in 2011 were manufactured some ten years previously when diesel-powered vehicles were gaining popularity, and also when Euro 3 legislation came into force requiring higher platinum loadings. On contemporary gasoline vehicles, loadings of palladium also increased in response to tighter legislation; this too was reflected in growing palladium

recoveries from ELVs last year. Although rhodium loadings also rose at the turn of the century, they remained flat in the mid-2000s, and were thrifted subsequently. Recovery of rhodium from European ELVs therefore grew less strongly.

As a result of disruption from the earthquake in Japan, new vehicle sales and scrap vehicle collection rates fell there during 2011. The disaster and its aftermath reduced the availability of new cars and also dissuaded customers from spending on big-ticket items. In consequence, the second-hand vehicle market declined, with used car registrations falling by 4% to a record low according to the Japan Automobile Dealers Association. This in turn affected the ELV market as older vehicles were kept on the road for longer.

Lower sales of new vehicles during the economic downturn had the effect of increasing the average age of vehicles on the road in the USA to over 11 years by mid-2011. With pent-up demand and modest economic growth, new car and truck sales picked up last year, stimulating scrappage of ageing vehicles and raising pgm recovery rates. Due to most vehicles in North America being gasoline-fuelled, the majority of pgm recovered is palladium. Recovery of palladium from ELV catalysts climbed by a third to just over one million ounces in 2011, while recovery of platinum rose by 10% to 640,000 oz. Around half of vehicles scrapped last year were originally sold between 1996 and 2007. Sales of vehicles were strong in this period, which was a time when catalyst loadings increased due to tightening emissions standards and use of palladium in gasoline catalysts outpaced platinum. Manufacturers at that time were substituting platinum with palladium but typically had to use more palladium by volume than platinum, therefore palladium loadings increased at a faster rate than platinum use fell. The scrapping of many vehicles from this era helps explain why palladium recycling grew quicker than platinum recycling last year. Almost all vehicle catalysts scrapped in North America are now recycled, through an established, efficient network of collection and refining.

Recycling of vehicle catalysts in other regions generally remains low by the standards of Europe, North America and

	Recycling '000 oz					
	Platinum		Palladium		Rhodium	
	2010	2011	2010	2011	2010	2011
Autocatalyst	(1,085)	(1,225)	(1,310)	(1,655)	(241)	(280)
Electrical	(10)	(10)	(440)	(480)	0	0
Jewellery	(735)	(810)	(100)	(210)	0	0
<b>Total</b>	<b>(1,830)</b>	<b>(2,045)</b>	<b>(1,850)</b>	<b>(2,345)</b>	<b>(241)</b>	<b>(280)</b>

Japan. However, recycling volumes in China and particularly the Rest of the World region are increasing as older models are scrapped from a growing vehicle fleet. The pgm content of scrapped vehicle catalysts is also rising in line with legislation that has required the use of pgm aftertreatment in many countries in the last decade.

**ELECTRICAL**

Palladium recovery in the electronics sector increased by 9% to reach 480,000 oz in 2011, a new record high.

In Europe, stimulated by the Waste Electronic Equipment recycling directive, recovery of palladium from the electronics sector reached 190,000 oz. New product releases led to the scrapping of older electronic items, which added to palladium recycling volumes. In North America, as a number of cities and states adopted legislation governing electronic waste, palladium recycling also increased.

Recycling of platinum in the electronics sector remains low compared with palladium, mainly due to the difficulty in extracting tiny volumes of platinum from individual devices in an economically viable way. Nonetheless, legislation in Europe and elsewhere is stimulating recycling of platinum in electronic scrap.

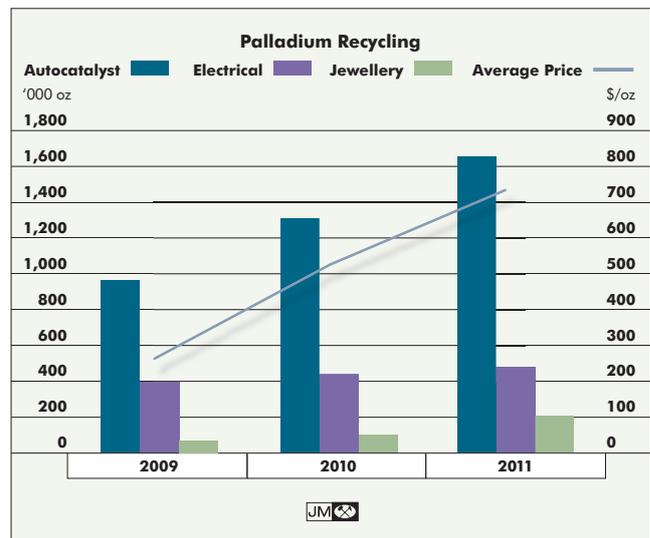
**JEWELLERY**

Open loop recycling of platinum jewellery rose by 10% in 2011 to 810,000 oz, while palladium recycling in this sector more than doubled, to 210,000 oz.

In the Chinese jewellery sector, 455,000 oz of platinum was returned for recycling last year, a similar level to that in 2010. Generally higher prices in 2011 compared to the previous year were supportive of recycling, but strong retail demand minimised the level of redundant stocks being scrapped by manufacturers and retailers.

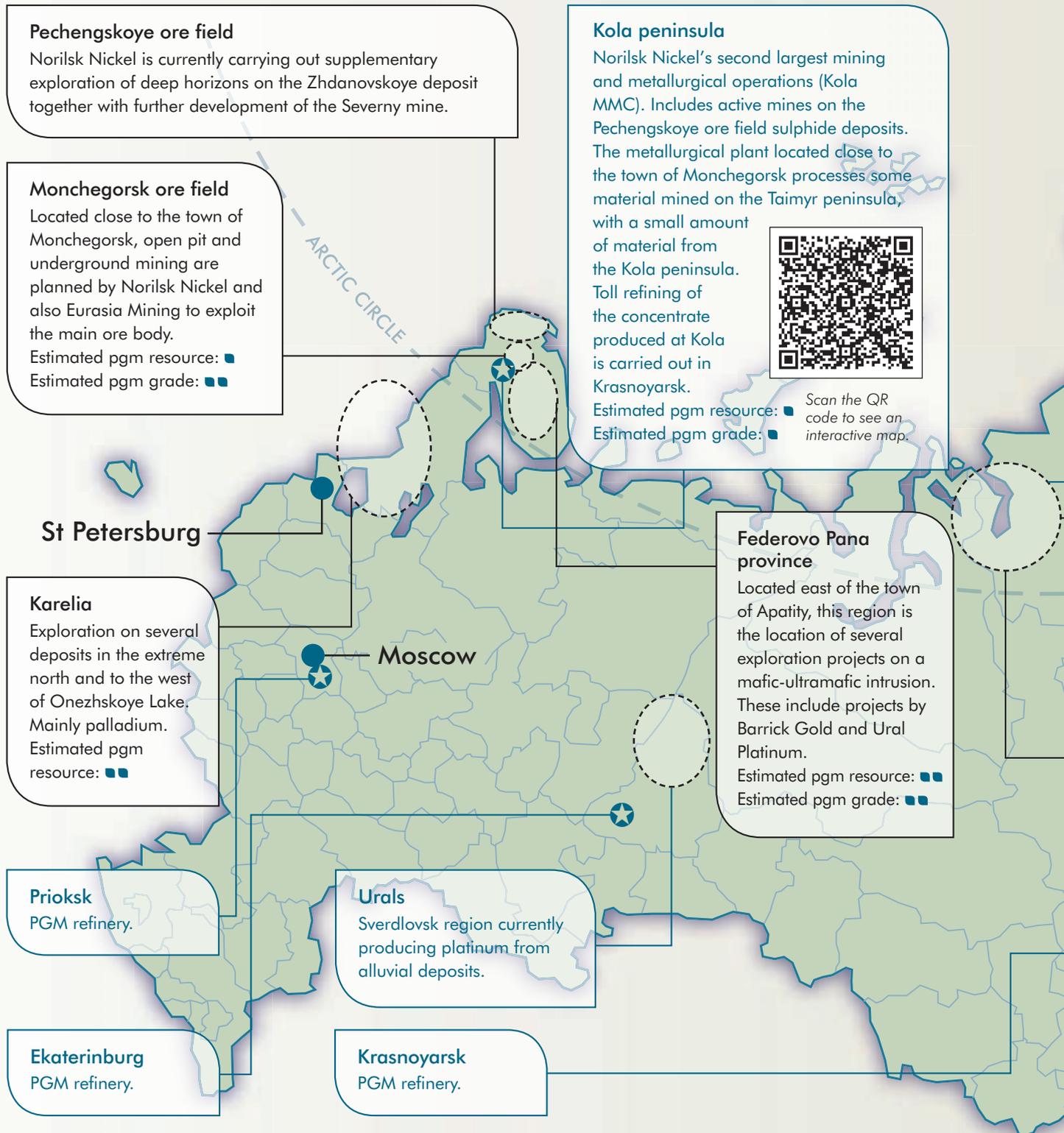
Palladium jewellery recycling in China more than doubled last year to 190,000 oz. Compared to platinum, a higher proportion of palladium recycling tended to come from unsold retailer stock and manufacturers' inventories.

In Japan, recycling of platinum increased by 70,000 oz to 350,000 oz last year. There was a spike in returns of old jewellery by Japanese consumers in August and September of 2011 as record high gold prices encouraged the trade-in of a range of precious metal jewellery. This drove up platinum jewellery recycling to the highest level since 2008. Recycling levels moderated in the final quarter as prices fell.



Recycling of platinum jewellery in Japan was encouraged by high precious metal prices.

# THE RUSSIAN PGM MINING INDUSTRY



Russia is the second largest supplier of pgms after South Africa. PGM output, which is mainly a by-product of nickel and copper extraction, is strongly dependent on the economics of base metal mining. Supplies from the dominant producer, Norilsk Nickel, have been maintained by exploiting increasing volumes of disseminated ore as well as tailings and stored pyrrhotite

### Taimyr peninsula

This is the main location for Norilsk Nickel's mining and processing operations (Polar Division) and is where the vast majority of Russia's pgm supplies are being mined. The Oktyabrsky, Talnakh and Norilsk-1 ore bodies are currently being mined primarily to produce nickel and copper with pgm as a by-product. PGM grades vary by ore type. Enrichment at metallurgical facilities in the Norilsk-Talnakh area results in nickel, copper and pyrrhotite concentrates which are then converted to high-grade matte. Precious metals produced by the Polar Division are refined under tolling agreements at Krasnoyarsk.

Estimated pgm resource: ■■■■  
Estimated pgm grade: ■■■■



Scan the QR code to see an interactive map.

### KEY

Currently producing

Projects, previous production, or known deposits

Estimated resources:

■ 1-100 t  
■■ 100-1,000 t  
■■■ >1,000 t

Estimated grades:

■ 0-3 g/t  
■■ 3-6 g/t  
■■■ >6 g/t

### Koryak-Kamchatka platinum belt

Alluvial deposits producing around 20,000 oz of platinum per year.

### Chernogorskoye

Russian Platinum is currently exploring disseminated deposits at Chernogorskoye, close to Norilsk-Talnakh.

Estimated pgm resource: ■■  
Estimated pgm grade: ■■

### Kondyor deposit

Russian Platinum alluvial deposits producing around 120,000 oz of platinum per year.

### Verkhne Kingash deposit

The disseminated sulphide copper-nickel ores of this project are low in pgm content. Estimated mined volume of ore is 10 million tonnes per year. Work is planned on those deposits using two open pits: Verkhne Kingashsky and Kuevsky.

Estimated pgm resource: ■  
Estimated pgm grade: ■

### Maslovskoye deposit

This deposit is being explored by Norilsk Nickel. The main ore body extends along the central axis of the Norilsk intrusion. There are also seven smaller ore bodies, which account for 2 to 3% of the total deposit. By volume, the Maslovskoye deposit is comparable to the Norilsk-1 ore body.

Estimated pgm resource: ■■■■  
Estimated pgm grade: ■■■■

concentrate in recent years. Operational and environmental challenges mean that the capacity to increase pgm output is limited and, without substantial investment in new mines and processing capability, we anticipate that output will remain largely flat in the near term. This special feature looks at what might fill the void in Russian pgm supplies in future.

## TAIMYR PENINSULA

Norilsk Nickel's main mining and metallurgical operations (Polar Division) are located on the Taimyr peninsula, north of the Arctic Circle. Nickel-copper-pgm sulphide ores are being mined, and can be broadly categorised into three types: massive ore; copper-rich (cuprous) ore; and ore where the minerals are dispersed through the rock (disseminated ore). The majority of pgm is currently mined from the five underground operations on the Oktyabrsky and Talnakh deposits, while the balance of ore production comes from the Norilsk-1 deposit. Massive ore from this body, which was first developed in the 1930s, has now largely been mined out, leaving mainly disseminated ore which is currently being mined via the Zapolyarny mine and Medvezhy Ruchey open pit. Mine production is supplemented by the processing of tailings from previously mined ores, particularly from the Norilsk-1 deposit. In addition, a stockpile of pyrrhotite from previous operations is being drawn down.

The company is planning to increase the output of disseminated ore at its Polar Division in the short term in order to maintain current levels of production. However, refined pgm output is likely to be constrained by falling ore grades and limited concentrator capacity, as well as concerns over sulphur emissions from ore processing. Throughput of tailings and stored pyrrhotite could also be limited by processing capacity over the next few years.

The Norilsk-1, Talnakh and Oktyabrsky deposits still offer large reserves. Following the upgrade of the Talnakh concentrator, scheduled for 2015, output could increase as massive ores are processed from the Skalisty and Taimyrsky mines on the Talnakh deposit. Recent exploration has shown that there are further massive and cuprous ores on the flanks and deep horizons of the Talnakh ore field which could contribute to future supplies. Longer term, the Maslovskoye deposit, a large platinum-copper-nickel deposit, may also provide massive ores but needs significant investment.

The Chernogorskoye deposit, close to the Norilsk-Talnakh ore field, may have the potential to substantially contribute to supplies in future. Additional resources are being explored on this deposit by Russian Platinum Plc.

## KOLA PENINSULA

Norilsk Nickel's mining operations on the Kola peninsula in north west Russia (Kola MMC) include the Pechengskoye ore field as well as substantial metallurgical operations for copper, nickel and pgm production. At present only a small amount of pgm comes from material mined by Kola MMC. Further exploration of the deep horizons of the currently mined

Zhdanovskoye deposit is taking place, and development of the Severny-Glubokoy mine is continuing. In future, this mine is likely to be exploited in order to maintain production levels following the closure of the Tsentralny open pit. In addition, exploration is also taking place on the Vuruchuaivench deposit close to Norilsk's Monchegorsk metallurgical operations which could bring fresh ounces. For the longer term, Norilsk Nickel is exploring new deposits on the Kola peninsula containing up to 120 tonnes of pgm, which could make a contribution to supplies in future.

Other possible projects on the Kola peninsula include those being explored by Eurasia Mining in three license areas close to Monchegorsk. The Federovo Pana province is another promising area of exploration east of Monchegorsk. There, a number of companies are carrying out exploration and development projects: the Federova Tundra deposit is planned to be exploited by Barrick Gold via two open pits plus a concentrator. Further south of Kola, in Karelia, Norit is said to be awaiting operation of Barrick Gold's planned concentrator before beginning production.

## OTHER REGIONS

Just under a fifth of Russia's platinum output currently comes from alluvial deposits. These deposits occur as platinum grains in river sediment that can be enriched by washing and gravity separation. They were historically mined in the Urals region and were the most important source of pgm before the start of operations on the Taimyr peninsula. Most of the alluvial production today is located in the Russian far east, on the Kondyor deposit and the Koryak-Kamchatka platinum belt, however these operations have limited remaining life. Another area of alluvial pgm production is in the Sverdlovsk region of the Ural mountains. New alluvial projects and the restart of old suspended operations could add to production in future.

## SUMMARY

Several development and exploration projects are currently taking place in Russia. Some of these are intended to replace existing capacity at Norilsk Nickel's operations, others offer new production potential by junior producers. However, the timescale for these projects is uncertain and they are unlikely to offset declining pgm output at the more established underground and open pit operations in the near term. With significant investment, including in some cases a complete development of local infrastructure, there are a small number of new projects which have the potential to add reasonable volumes to current pgm output.

# PLATINUM

- **Gross demand for platinum in autocatalysts increased by 1% to 3.11 million ounces in 2011. Purchasing in the heavy duty diesel sector grew strongly but this was partly offset by substitution with palladium in light duty diesels. Depressed levels of output by Japanese vehicle manufacturers also affected platinum demand.**
- **Physical investment demand for platinum was positive at 460,000 oz last year but at a lower level than in 2010.**
- **Demand for platinum in the global jewellery industry increased by 2% to 2.48 million ounces last year. China and India were the main growth areas, demand was stable in other regions.**
- **Industrial demand for platinum reached a new high of 2.05 million ounces in 2011 led by strong purchasing in the glass manufacturing sector and new catalyst installations in the petrochemical industry.**

## AUTOCATALYST

The bulk of growth in demand for platinum in autocatalysts last year came from higher production of heavy duty diesel trucks. Globally, 515,000 oz of platinum was purchased in this sector, an increase of some 27% on 2010, with most of the increase in the USA and Mexico. Fleet operators, which delayed replacing vehicles during the recession, returned to the market last year to replace older trucks and as a result manufacturers reported full order books in 2011 and into the first quarter of 2012.

Light duty vehicle production in Europe was resilient despite the economic uncertainty that prevailed in the region for much of the year. Although the share of diesel vehicles sold in Europe rose again in 2011 as buyers chose more fuel-efficient engines, total demand for platinum declined slightly as it was increasingly substituted by palladium.

Japanese vehicle production and demand for platinum was disrupted as a result of the Great East Japan Earthquake in March 2011. The manufacture of vehicles at plants overseas was also affected by interruptions to the component supply chain. In North America, pent-up demand for vehicles and better economic conditions helped raise production levels for domestic manufacturers. In the Rest of the World region, platinum demand grew strongly.

## Europe

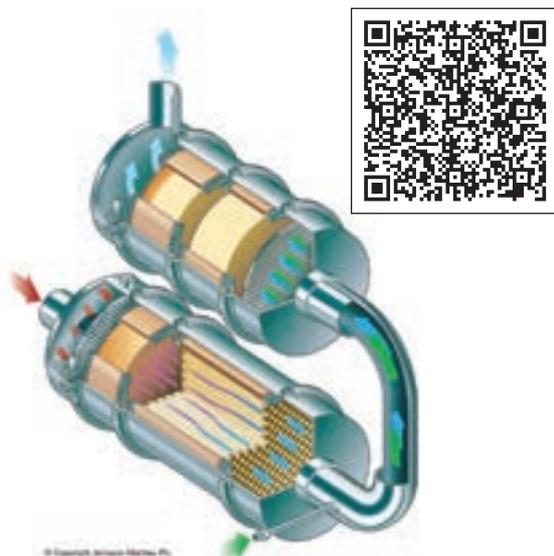
Diesel vehicles took a 52% share of European light duty production last year but continuing efforts to further substitute platinum with palladium in diesel emissions systems led to declining platinum demand in the light duty sector. Despite a rise in purchases of platinum by the heavy duty sector due to higher truck output, platinum demand in the European autocatalyst sector fell last year to 1.47 million ounces.

For light duty vehicle sales, there was something of a north-south divide, with registrations in Germany growing healthily while sales in Italy and Spain tumbled as austerity measures curbed consumer spending. Manufacturers of premium vehicles fared extremely well, with strong domestic demand and increased exports. A rise in the market share of diesel light duty vehicles, largely due to higher fleet sales in Europe as older vehicles were replaced with more efficient new models, was generally positive for platinum demand. This effect was mostly offset by the greater use of palladium in diesel autocatalyst formulations which accounted for, on average, almost a third of the pgm in a European diesel autocatalyst in 2011.

In the heavy duty sector, just over 600,000 vehicles were produced in Europe in 2011, 120,000 more than in 2010, driven by replacement of older trucks. Some European manufacturers began to release small numbers of Euro VI-compliant vehicles, which have higher pgm loadings, in order to meet the more stringent oxides of nitrogen (NOx) and particulate matter (PM) limits which are due to come into force from 2013. The introduction of Euro VI technology is positive for platinum demand as most manufacturers will fit platinum-containing diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs) as well as selective catalytic reduction (SCR) to meet the new standards.

Platinum Demand: Autocatalyst '000 oz						
	Gross		Recycling		Net	
	2010	2011	2010	2011	2010	2011
Europe	1,495	1,465	(375)	(445)	1,120	1,020
Japan	550	500	(65)	(60)	485	440
North America	405	380	(580)	(640)	(175)	(260)
China	100	110	(10)	(10)	90	100
Rest of the World	525	650	(55)	(70)	470	580
<b>Total</b>	<b>3,075</b>	<b>3,105</b>	<b>(1,085)</b>	<b>(1,225)</b>	<b>1,990</b>	<b>1,880</b>

Upcoming Euro VI legislation requires the control of various regulated pollutants. Scan the code to see an animation of how pgms are used in a typical system.



There is always a trade-off between NO<sub>x</sub> and PM; if engine-out emissions of one are reduced, then the other will rise. At Euro V, the majority of heavy duty diesel vehicles use engine calibration to lower PM emissions, then use SCR to clean up the resultant NO<sub>x</sub> emissions. In a few cases, exhaust gas recirculation (EGR) is used to reduce NO<sub>x</sub> which comes out of the engine, followed by a filter to control PM emissions.

At Euro VI, with limits of both PM and NO<sub>x</sub> tightening, and with the introduction of a particulate number limit, the use of a pgm-containing filter will become widespread. Heavy duty manufacturers are increasingly moving to a full system of EGR and DOC, DPF, and SCR plus a catalyst to convert any ammonia released from the SCR, known as an ammonia slip catalyst (ASC). These systems are currently used in North America to meet US2010 limits and employ platinum in every catalyst brick apart from the SCR. The move from Euro V to Euro VI means, in general terms, the addition of three new catalyst components, each containing platinum.

## Japan

Total Japanese vehicle production fell by 13% to 8.1 million units in 2011 as auto manufacturers and component suppliers alike struggled with factory closures and power shortages in the aftermath of the Great East Japan Earthquake. Although some carmakers were also hit by component shortages resulting from flooding at suppliers in Thailand in the final quarter, by the end of the year production in Japan had largely recovered to pre-earthquake levels. Overall, platinum demand in the Japanese auto sector fell by 9% to 500,000 oz in 2011.

Exports of light duty vehicles from Japan fell by 8% in 2011 as production capacity remained constrained for much of the year. By the time manufacturers had begun to resume normal output levels in the second half of the year, a near-record high yen:dollar exchange rate was affecting the competitiveness of Japan-built vehicles. Economic uncertainty and slower growth in several export markets also had the effect of lowering vehicle demand.

Although deferred buying in 2010 meant there was upside potential for heavy duty truck production in Japan last year, the effects of the March disaster meant that output remained at around 415,000 units. Domestic sales of trucks were of course affected by the disaster and fell by around 8%, while the strong yen put pressure on truck exports. Demand for platinum in the heavy duty sector therefore remained largely flat.

## North America

Pent-up demand for heavy duty vehicles, as well as a renewed appetite for diesel pickup trucks, helped raise vehicle output in North America in 2011. Although a significant amount of platinum demand was added, the reclassification of some production to Mexico means that it is mostly counted in our Rest of the World region. Improving economic conditions, cheap credit and competitive pricing pushed up sales of light duty vehicles in North America to 14.4 million, the highest since 2008. Due to lean vehicle inventories following the recession, higher sales translated into greater manufacturing levels, and overall production rose by almost 10% to 10.9 million vehicles. Lower production of vehicles in North America by Japanese manufacturers following the March disaster contributed to a decline in platinum demand in light duty gasoline autocatalysts.

Commercial buyers of light duty diesel pickups and delivery trucks returned to the market in 2011 after deferring purchases during the recession. Better fuel economy in new vehicles and government stimulus measures also helped tempt these buyers. The consequent growth in light duty diesel truck output helped raise the diesel share of light duty vehicle production to 5%, which increased demand for platinum in diesel catalysts.

The heavy duty diesel sector continued to benefit from improved economic conditions as fleet operators bought both replacement and additional vehicles. With fuel economy being crucial in the heavy duty sector, passive regeneration systems are typically used (which consist of a DOC, DPF and SCR, often in conjunction with an ASC). This is positive for platinum, which is used in the DOC, DPF and ASC components. Purchasing of platinum by the heavy duty diesel sector rose to 150,000 oz.

*Most of the growth in purchasing of platinum in autocatalysts came from the heavy duty diesel sector.*



### China

There was a slowdown in the rate of growth in light duty vehicle production in China to around 5% as the government attempted to cool down an overheating car market by the removal of subsidies and the imposition of limits on new car registrations in some cities. Gross demand for platinum in the Chinese autocatalyst sector rose, however, to 110,000 oz.

The slowing of the Chinese car market mainly affected production of smaller gasoline models by Chinese domestic manufacturers, which tend to be fitted with palladium–rhodium three-way catalysts (TWCs). Demand for platinum, which is used by some of the joint venture manufacturers in China, was less affected, although some platinum-using Japanese joint ventures experienced disruption to production caused by parts shortages in the aftermath of the Great East Japan Earthquake. The nationwide implementation of China 4 emissions regulations for light duty gasoline vehicles, which came into effect in mid-2011, also accounted for some additional platinum demand. Due to the lack of availability of low-sulphur diesel fuel, the authorities postponed by one year the introduction of China 4 light duty diesel emissions standards, which were due to come into force in July 2012.

### Rest of the World

In the Rest of the World region, manufacturers in Mexico experienced a good year of exports to the USA and Canada as well as sales domestically. Our reclassification of some diesel manufacturing from North America to Mexico has further raised our estimate of platinum demand.

In India, high interest rates, which have made consumer credit more expensive, as well as rising fuel prices have together dampened vehicle sales. Rising raw material costs have added to the cost of new vehicles, further deterring buyers. In spite of this, the auto industry in India still experienced healthy growth in 2011, with total light duty vehicle output expanding by over 10% to 3.5 million units. Sales of diesel vehicles in India grew rapidly in 2011, in response to the growing price differential between gasoline and diesel (which is subsidised by the government). Diesel vehicles have typically accounted for a third of vehicle production in the country but this share rose throughout 2011, spurred by acceleration in diesel vehicle output as carmakers struggled to keep up with demand. Bharat III (Euro 3 equivalent) standards are currently in force nationwide, while Bharat IV (Euro 4 equivalent) applies in Delhi and other major cities. Both of these standards require

the fitment of a platinum DOC on diesel vehicles.

In South Korea, expansion of the diesel share in the light duty market helped platinum demand, as did improved heavy duty truck output. Overall, platinum demand in the Rest of the World region was 650,000 oz in 2011.

### JEWELLERY

**Gross demand for platinum in the global jewellery sector increased by 60,000 oz to 2.48 million ounces driven mainly by growth in the Chinese market, with good growth from a low base in India.**

### Europe

Consumer confidence remained low in many parts of Europe in 2011, and indeed deteriorated as the year progressed. While purchases of platinum in the bridal sector were resilient, spending on other jewellery items generally decreased. The number of British-made platinum jewellery pieces being hallmarked at the four UK assay offices declined by 7% in 2011. Hallmarked weight fell by closer to 18% as the trade continued to target particular price points in the market with smaller, lighter pieces. This trend was not confined to platinum; the number and weight of gold jewellery pieces being hallmarked declined by around a fifth in the same period, mainly due to the elevated price of gold. Jewellers reported that gold's price premium over platinum in the fourth quarter of last year encouraged some consumers to 'trade up' to platinum for a smaller price differential than is normally the case, particularly for wedding and engagement rings.

The number of platinum jewellery pieces hallmarked in Switzerland grew by 24% in 2011 as the luxury goods sector continued its slow recovery from recession. Driven by growth in the sale of top-end branded watches in the international market, the weight of hallmarked platinum increased by 17%

Platinum Demand: Jewellery						
'000 oz						
	Gross <sup>1</sup>		Recycling <sup>2</sup>		Net <sup>3</sup>	
	2010	2011	2010	2011	2010	2011
Europe	175	175	(5)	(5)	170	170
Japan	325	315	(280)	(350)	45	(35)
North America	175	185	0	0	175	185
China	1,650	1,680	(450)	(455)	1,200	1,225
Rest of the World	95	125	0	0	95	125
<b>Total</b>	<b>2,420</b>	<b>2,480</b>	<b>(735)</b>	<b>(810)</b>	<b>1,685</b>	<b>1,670</b>

NOTES TO TABLE

- <sup>1</sup> Gross demand is equivalent to the sum of platinum jewellery manufacturing volumes and any increases in unfabricated metal stocks within the industry.
- <sup>2</sup> Recycling represents the amount of retailer stock and consumer jewellery recycled whether the metal is re-used within the jewellery industry or sold back to the market.
- <sup>3</sup> Net demand is the sum of these figures and therefore represents the industry's net requirement for new metal.

last year. While the number of hallmarked platinum watch cases increased by 9% to just over 9,000, this was less than half the level in 2008. Platinum's position in the watch sector has been challenged recently by competition from 'rose' gold.

Apart from international brands, which continued to do very well at the high end of the market, elsewhere in Europe economic concerns led to lower spending on jewellery items. Overall, demand for platinum in the European jewellery market remained flat in 2011 at 175,000 oz.

### Japan

Gross demand for platinum in the Japanese jewellery sector declined by 10,000 oz to 315,000 oz in 2011, impacted by the consequences of the March earthquake and tsunami together with long-term population and social trends.

Jewellery sales were subdued in the weeks immediately following the earthquake. In April, May and June, sales picked up, with some manufacturers and retailers reporting an increase in wedding and engagement ring sales, particularly to the Tohoku area of Japan which was most impacted by the disaster. This was widely attributed to more couples making a commitment to each other, as well as lost jewellery being replaced. Since most bridal jewellery is made in platinum, this was positive for demand. Sales reverted to more normal levels in the second half, reinforcing long-term trends towards later and fewer marriages that have resulted in bridal jewellery offtake declining in recent years. Provisional marriage statistics indicate a total of 680,000 marriages in Japan in 2011, a 3% reduction on 2010.

### North America

Platinum demand in the jewellery sector in North America increased by 6% in 2011 to 185,000 oz due to greater levels of purchasing by high-end manufacturers. This part of the market continued to be very busy meeting export as well as domestic demand. The expansion of brand-name jewellery retail outlets overseas, particularly in fast-growing emerging markets, was positive for purchases of platinum by the trade in North America. In terms of domestic demand, successful marketing of platinum engagement and wedding rings to young couples helped sales of bridal jewellery against an overall backdrop of falling marriage rates.

Platinum did far less well in the middle market, where consumer demand suffered from the continuing squeeze on household disposable income despite a modest improvement

*Platinum jewellery demand in Europe was resilient in the bridal sector.*



in the US economy. Manufacturers developed lower weight items to meet retail price points, while the elevated price of diamonds also had the effect of eroding manufacturing margins, making it less attractive to make gem-set pieces in platinum. The price of gold relative to platinum in the latter part of the year had little effect on sales, with domestic sales of precious metal jewellery being subdued.

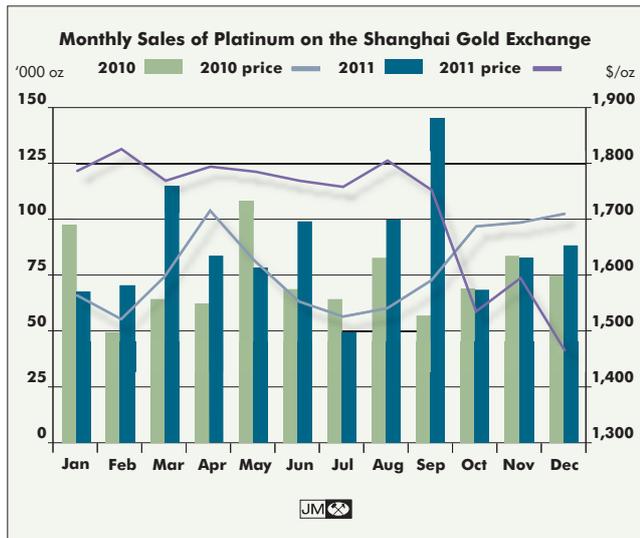
### China

Gross platinum jewellery demand in China increased by 2% in 2011 to 1.68 million ounces. Purchases by manufacturers were robust in the first half despite higher year-on-year prices. The second half saw a surge in buying as the trade took advantage of falling prices, both in absolute terms and relative to gold.

Chinese manufacturers once again purchased very efficiently into price dips – there was a strong association of periods of heavy buying during and immediately after platinum fell sharply in price. Purchases of platinum on the Shanghai Gold Exchange (SGE), the majority of which is used by the jewellery industry, reached historic highs of 58,000 oz in the last week of September, when manufacturers took advantage of the recent near-\$250 price drop. When the price continued to fall, elevated demand levels were not always maintained as manufacturers who bought on the initial dips had already fulfilled their metal requirements. Overall, however, there was a rather strong end to the year.

Following months of a narrowing platinum:gold spread, the establishment of a price premium by gold in the final quarter also worked to the advantage of platinum demand at

Purchasing of platinum on the Shanghai Gold Exchange reached record levels in late September 2011 as jewellery manufacturers bought into a price dip.



manufacturer level. Anticipating a return to the long-term trend of a platinum premium, manufacturers bought the metal at a discount to gold in the run-up to the traditionally busy Chinese New Year period. Downward movement in the platinum price helped improve margins for manufacturers and partly offset rising labour costs and tight credit, making it more attractive to produce platinum jewellery.

Unusually, the platinum price at retail level went below that of gold in some stores, but not until several weeks after gold had established a premium over platinum. Neither did the discount fully reflect the spread in spot prices. Nevertheless, the relative weakness of the platinum price exposed it to a perception among consumers that platinum does not hold its value as well as gold. Despite some evidence that sales of platinum jewellery suffered as a result of the popularity of gold, overall the relationship was fairly neutral for platinum purchasing at retail level. Plain platinum jewellery continued to be popular in the bridal sector. This was augmented by sales of gem-set platinum jewellery for bridal wear and also plain jewellery for self-purchase by young female consumers.

**Rest of the World**

Platinum demand by the jewellery trade in India benefitted from brisk consumer sales in 2011 and increased by almost a third to 80,000 oz. Consumer sales in the first half of the year were impressive. In the second half sales were slower, as high gold prices dampened sales of jewellery in general. However, some retailers took advantage of platinum's subdued price relative to gold in the third and fourth quarters to raise their platinum stock levels. Although India remains overwhelmingly

a gold market due to a long cultural and historic association with the metal, from a low base platinum is becoming more popular with the middle classes. Several retailers are opening new stores in key Indian cities and are actively promoting platinum jewellery collections. Rings still account for the majority of sales, mainly in the relationship sector but there is also strong interest in both men's and women's chains, pendants and bracelets. Overall, platinum jewellery demand in the Rest of the World region rose by 30,000 oz to 125,000 oz.

**CHEMICAL**

Growth in the global chemical industry was led by China last year as the country continued to increase manufacturing capacity for a range of feedstocks. Rapid expansion in this and other emerging markets, together with recovery from recession in developed markets, helped raise demand. The chemical sector in Japan was quick to get over disruptions caused by the March earthquake, although the strong yen and a flat domestic demand outlook discouraged investment in new capacity. Overall, driven by expansion in various sectors, platinum demand in the worldwide chemical industry increased by 7% to 470,000 oz in 2011.

The market for platinum curing catalysts used in the manufacture of silicones, the biggest demand area for platinum in the chemical industry, showed good growth last year supported by increased capacity in China. Silicones are widely used in coatings for applications as diverse as vehicle airbags, baking paper and wound dressings, as well as in elastomers, such as those used to make dental impressions, and in some sealants. In these applications, silicone's properties of thermal stability, chemical and electrical resistivity, and water repellency are valued. China has been rapidly catching up in terms of installed silicone production capacity to meet domestic demand in construction, automotive and consumer products. Elsewhere in Asia, platinum purchasing in this area

Platinum Demand: Chemical			
	'000 oz		
	2009	2010	2011
Europe	70	110	120
Japan	45	50	30
North America	65	100	95
China	40	80	105
Rest of the World	70	100	120
<b>Total</b>	<b>290</b>	<b>440</b>	<b>470</b>

has been increasing in line with rising vehicle output and growing demand from the construction sector.

Demand for polyester fibre used in the manufacture of clothing continued to be strong in 2011, driven by emerging market growth and tight supplies of cotton. Together with high demand for polyethylene terephthalate (PET), used in food packaging and plastic bottles, this drove upstream demand for paraxylene, and therefore the use of platinum in catalysts used to synthesise paraxylene. New plants opened in Pakistan and South Korea in order to expand manufacturing capacity to meet domestic demand.

Production of nitric acid using platinum-containing catalyst gauze grew in 2011 as soaring agricultural commodity prices incentivised the use of nitrogen-based fertilisers, synthesised from nitric acid, to improve crop yields. Extreme weather conditions in 2010 led to a fall in cereal production worldwide, which also resulted in greater fertiliser use last year. Production of renewable fuels to help meet transport emissions targets also led to higher demand for fertilisers used to grow biofuels.

## GLASS

Sales of platinum into the glass sector increased by 44% to 555,000 oz in 2011 as liquid crystal display (LCD) glass manufacturing capacity was expanded in Asia. There was a good deal of pre-buying of metal in anticipation of future expansions which added to demand last year. Lower purchasing in the glass fibre sector resulted from overcapacity in the composites market. Metal being sold back to the market from old marble melt and cathode ray tube glass facilities, mainly in China, also offset demand.

Purchasing of platinum for use in glass manufacturing reached record levels last year. With firm demand for display glass coming from the electronics sector, the number of new manufacturing lines constructed in 2011 increased by 10% with an aggressive rate of expansion in China, Japan and South Korea. Strong sales of TVs, monitors and mobile devices (laptops, tablets and phones) which use LCD displays helped drive this capacity expansion. A more important factor for platinum demand was pre-buying of metal in anticipation of future expansions, even though the LCD glass sector was in overcapacity in 2011. This overcapacity was partly as a result of recent construction of Chinese TV manufacturing plants.

Production of glass fibre composites, used as lightweight, high-strength reinforcements in the construction and transport sectors, saw a rise in production in 2011 as markets continued to recover from recession and spending on infrastructure

**Platinum Demand: Glass**  
'000 oz

	2009	2010	2011
Europe	5	10	30
Japan	40	90	140
North America	(35)	10	(5)
China	(90)	130	40
Rest of the World	90	145	350
<b>Total</b>	<b>10</b>	<b>385</b>	<b>555</b>

increased. Output was greatest in Asia, although capacity utilisation rates generally remained below pre-recession levels. Overcapacity in the glass fibre industry in China meant that several expansions in Asia were cancelled or postponed in 2011. Together with recycling of metal from old marble melt manufacturing facilities in China, demand for the platinum alloy bushings used to channel and form molten glass fibre was subdued.

## ELECTRICAL

Gross demand for platinum in electrical applications remained robust at 230,000 oz in 2011. Stimulated by new product releases, last year was a positive one for the electronics sector despite difficult economic conditions for many consumers. Semiconductor manufacturers in Japan which were affected by the disaster in March returned to production in a relatively short time. The subsequent rebound in domestic demand gave something of a boost to the Japanese electronics sector. However in the fourth quarter, the Thailand flooding disaster affected production of hard disk drives and reduced purchasing of platinum for hard disk media.

Consumer purchases of hard disk drives saw only modest growth last year as the desktop and laptop computer market faced competition from tablet computers, which typically use

**Platinum Demand: Electrical**  
'000 oz

	Gross		Recycling		Net	
	2010	2011	2010	2011	2010	2011
Europe	15	20	(5)	(5)	10	15
Japan	30	25	0	0	30	25
North America	25	25	0	0	25	25
China	30	30	0	0	30	30
Rest of the World	130	130	(5)	(5)	125	125
<b>Total</b>	<b>230</b>	<b>230</b>	<b>(10)</b>	<b>(10)</b>	<b>220</b>	<b>220</b>

non-pgm solid state memory. However, consumer purchases of external hard drives for data storage gave some momentum to hard disk demand, as did growth in sales of digital recording equipment for TVs and stereos (which account for around a third of the total hard drive market).

Producers of hard disk media experienced interruptions as a result of supply shortages emanating from the Japanese earthquake in March. Although these were rapidly overcome, the industry faced much more serious disruption in October when the Thai floods led to a decrease in disk output. This temporary fall was on top of long-term trends in greater production efficiency and a reduction of the number of platters per disk, which have lowered platinum demand per drive in recent years.

### PETROLEUM REFINING

**Emerging economies continued to add refining capacity to meet strong growth in demand for fuels and to manufacture more high-margin petrochemical products. Developed countries were responsible for most of the growth, however, as fuel plants were constructed in North America and Europe. Overall, demand for platinum in catalysts used in petroleum refining increased by 24% to 210,000 oz in 2011.**

China added new refining capacity for the production of vehicle fuel in 2011, driven by greater domestic demand despite a temporary slowdown of growth in vehicle output. New projects to expand refining capacity in the Rest of the World region included a large plant being constructed in Abu Dhabi to manufacture lubricant oil. Several countries are



Construction of renewable fuel plants last year led to new demand for platinum catalysts.

Platinum Demand: Petroleum Refining '000 oz			
	2009	2010	2011
Europe	25	20	35
Japan	10	5	5
North America	15	25	50
China	10	15	15
Rest of the World	150	105	105
<b>Total</b>	<b>210</b>	<b>170</b>	<b>210</b>

expanding capacity to produce higher-margin products such as this and thereby add value to their refining industries. These trends helped demand for platinum-containing reforming and isomerisation catalysts used to convert heavy oil fractions into lighter, more useful ones.

Planned increases in capacity in North America took place last year, driving new demand for platinum even as some older refineries were closed or mothballed. Legislation in Europe and North America that calls for a certain proportion of vehicle fuel to be blended with renewable fuels from waste and biofuel sources continued to drive expansions in biofuel processing capacity. A large renewable diesel plant opened in Europe in 2011 stimulating demand for platinum.

### INVESTMENT

**Net physical investment demand for platinum was positive in 2011, at 460,000 oz, but was 195,000 oz lower than the previous year. Japanese investors piled into the large bar market during price dips, offsetting concurrent disinvestment in exchange traded funds (ETFs).**

Total ETF holdings grew in the first eight months of 2011, reaching record cumulative levels of 1.63 million ounces in the middle of September. Net investment tended to coincide with periods of rising platinum prices, while downward corrections in the price, such as that which followed the Japanese earthquake, tended to provoke liquidation of holdings, perhaps as a result of distressed selling. From the third week in September onwards, there was a fall in net holdings coincident with a plunge in the platinum price by more than \$200. Despite a modest price recovery, platinum ETF holdings continued their downward trend for the remainder of the year, shedding 170,000 oz (10%) compared with the September high point. Net investment for the full year of 2011 was in positive territory at almost 190,000 oz, although this was 68% lower than the net investment in the previous year.

All physically-backed platinum ETF investment funds

There was net investment in the Japanese large bar market in 2011.

Platinum Demand: Investment '000 oz			
	2009	2010	2011
Europe	385	140	155
Japan	160	45	250
North America	105	465	10
China	0	0	0
Rest of the World	10	5	45
<b>Total</b>	<b>660</b>	<b>655</b>	<b>460</b>

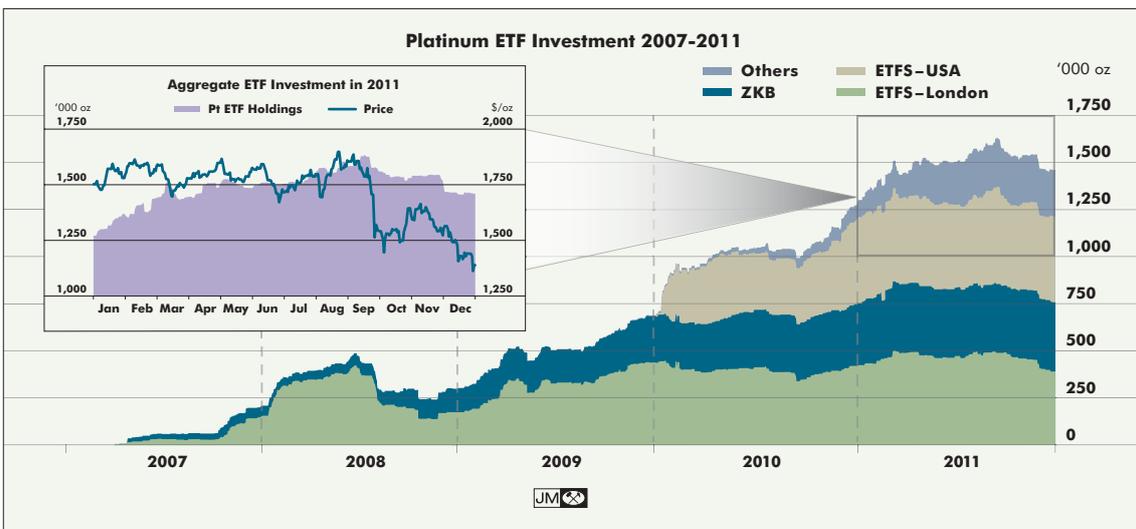


showed positive net investment in 2011 apart from ETF Securities' London fund. This ETF, which has been operational since April 2007, saw net liquidation of 30,000 oz. In the largest fund by volume, ETFs' US fund, there was net investment in the first and third quarter of the year, which was mostly offset by a steady sell-off later on as the price was declining. In contrast with the strong performance in 2010, the year the fund launched, when net investment totalled over 440,000 oz, last year net investment was just 15,000 oz. There was net buying into the Swiss funds in 2011, with less pronounced liquidation during price drops. Two new ETF funds, from iShares and Source, were launched in 2011. The Source fund attracted new investment as the price rose in July, at one point reaching over 37,000 oz. There was rapid liquidation as the price fell in the final quarter, leaving net platinum demand in the two new funds at under 9,000 oz for the full year.

investment between May and the year-end as prices declined each month apart from November. Although prices rose for the first time in six months, investment remained positive in November as the price remained well below its April level. There was steady net buying into platinum accumulation plans which accelerated in the last quarter in response to sharply falling prices.

For the year as a whole, there was net investment inflows of 235,000 oz in the Japanese large bar market, the highest since 2008. This sector generally saw net investment in a declining price environment (in yen terms) and disinvestment during periods of rising prices. As such, there was steady net

The coin sector was relatively quiet in 2011 with a lack of manufacturing of bullion coins and consumer demand generally satisfied by a vibrant secondary market. The US Mint continued to release single ounce Platinum Eagle proof coins, while the Royal Canadian Mint also produced one-ounce proof coins. The Perth Mint launched a single ounce 'Platinum Platypus' bullion coin in 2011, the mintage of which added 30,000 oz to platinum demand.



Platinum ETF holdings have grown considerably since the first ETFs were launched in 2007. Total platinum holdings fell in September 2011 onwards in response to declining prices but net investment remained positive for the year as a whole.

# PALLADIUM

- Gross demand for palladium in autocatalysts reached a record level of 6.03 million ounces in 2011 as a result of higher global vehicle production and greater use of palladium in light duty diesel emissions control.
- Gross demand for palladium in the jewellery sector fell once again in 2011, to 505,000 oz.
- Rising demand in China for chemical catalysts lifted palladium purchasing in industrial applications to 2.48 million ounces in 2011.
- Investment demand for palladium turned negative last year by 565,000 oz, becoming in essence a source of supply to the market.

## AUTOCATALYST

Palladium demand in the autocatalyst sector reached 6.03 million ounces in 2011 as it benefitted from rising vehicle output in most regions and higher levels of usage in diesel autocatalyst formulations as a partial substitute for platinum. Although vehicle production was robust in most markets, the disruption caused to supply chains around the world by the Great East Japan Earthquake and later by the flooding disaster in Thailand was responsible for lower output by Japanese manufacturers. The slowdown in the hitherto spectacular rates of year-on-year growth in vehicle production in China had less impact on palladium purchasing due to the advent of new legislation requiring higher catalyst loadings per vehicle. Imports of large high-end vehicles into China remained strong and benefitted palladium demand in Europe and North America. There was also slower growth in vehicle production in India and Brazil as carmakers there felt the effects of tighter credit. Russia and South Korea saw a substantial increase in vehicle production which, due to the dominance of gasoline vehicle production in those countries, was positive for palladium.

## Europe

Production of light duty vehicles in Europe was 17.8 million units in 2011, a better than expected performance considering the economic uncertainty that troubled the region for much of the year. Premium manufacturers had another strong year, exporting large numbers of vehicles to the USA and China. In the domestic market, although northern European sales remained robust, manufacturers sold fewer vehicles into southern Europe than previously, as Italy, Spain and Greece grappled with debt issues, credit restrictions and rising unemployment, which all served to depress consumer confidence. With some exceptions, non-premium European carmakers struggled,

particularly in the second half, with overcapacity and sluggish sales. Overall, sales remained more or less flat on 2010 but production levels were boosted by increased exports.

Purchases of palladium by the European auto industry were well ahead of 2010 levels, rising by 110,000 oz to 1.44 million ounces. The full introduction of Euro 5 emissions standards raised average pgm loadings on both gasoline and diesel vehicles. Palladium demand benefitted from higher sales of diesel vehicles throughout 2011, as diesel share continued to rebound from the 2009 lows caused by various national scrappage schemes. Palladium is being used in greater amounts to substitute platinum – its use in light duty diesel autocatalyst formulations climbed to around 30% of total pgm content on average as manufacturers sought to reduce costs.

## Japan

Gross demand for palladium from the Japanese automotive sector fell by 155,000 oz to 665,000 oz in 2011. Disruption to vehicle production and component supplies, as a result of the March earthquake, tsunami and nuclear disaster, was particularly marked in the light duty sector, where passenger car production dropped by 14%. The relative decline in palladium purchasing was greater than that for platinum, reflecting palladium's greater use in gasoline autocatalysts and the dominance of gasoline engines in the domestic market.

	Palladium Demand: Autocatalyst					
	'000 oz					
	Gross		Recycling		Net	
	2010	2011	2010	2011	2010	2011
Europe	1,330	1,440	(335)	(385)	995	1,055
Japan	820	665	(80)	(70)	740	595
North America	1,355	1,475	(790)	(1,050)	565	425
China	1,005	1,115	(30)	(35)	975	1,080
Rest of the World	1,070	1,335	(75)	(115)	995	1,220
<b>Total</b>	<b>5,580</b>	<b>6,030</b>	<b>(1,310)</b>	<b>(1,655)</b>	<b>4,270</b>	<b>4,375</b>

Standard-sized passenger cars (engine size of two litres or greater), which have the highest catalyst loadings, saw the biggest fall in sales (20%).

Light duty vehicle sales in Japan were already on a downward trend year-on-year in the first two months of 2011 as consumer confidence remained weak. In the aftermath of the March disaster, purchases slumped and remained depressed until October. Thereafter, as confidence began to return, monthly sales ran ahead of their 2010 levels. By the year-end, sales of passenger cars had fallen by 16%, to just over 3.5 million units, compared with the year before. As most light duty vehicles sold in Japan are gasoline fuelled, the decline had a sharp effect on palladium demand.

Japanese manufacturers, like those elsewhere, continue to develop engine and catalyst technology with the aim of both improving the fuel economy of vehicles and thrifting pgm. Increasing engine efficiency to reduce fuel consumption often means that the temperature of exhaust gases is reduced. Higher pgm loadings can therefore be required to process engine-out emissions. Manufacturers are also looking to further substitute platinum with palladium in order to realise cost savings; a long-term driver of palladium demand in both gasoline and especially diesel formulations.

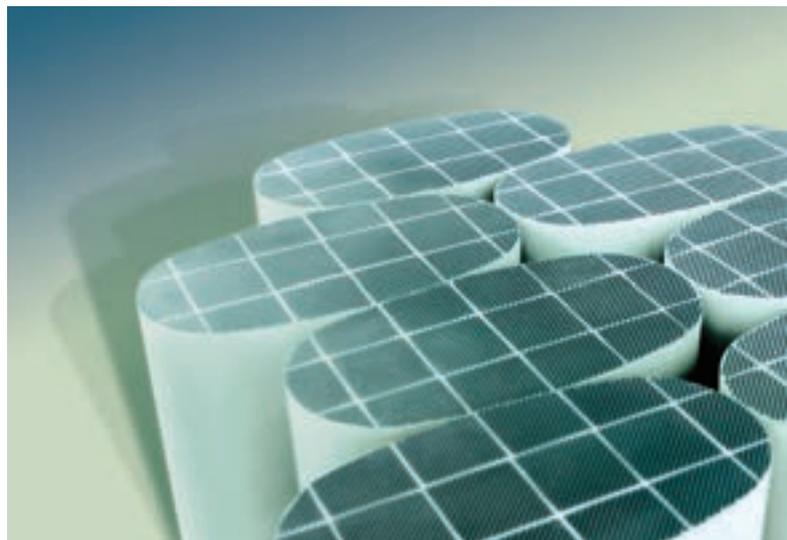
### North America

Vehicle production in North America in 2011 reached the highest level since 2007 driven by strong sales. Palladium demand grew in line with vehicle output, rising by 9% to reach 1.48 million ounces, reflecting its dominance in gasoline aftertreatment systems and its increasing use as a substitute for platinum in light duty diesel catalysts. Detroit's big three all gained domestic market share in 2011, for the first time in 23 years, leading to greater production of palladium-containing gasoline three-way catalysts (TWCs). Japanese manufacturers in North America made up for lost production in the final quarter of the year despite disruption to supply chains from flooding in Thailand.

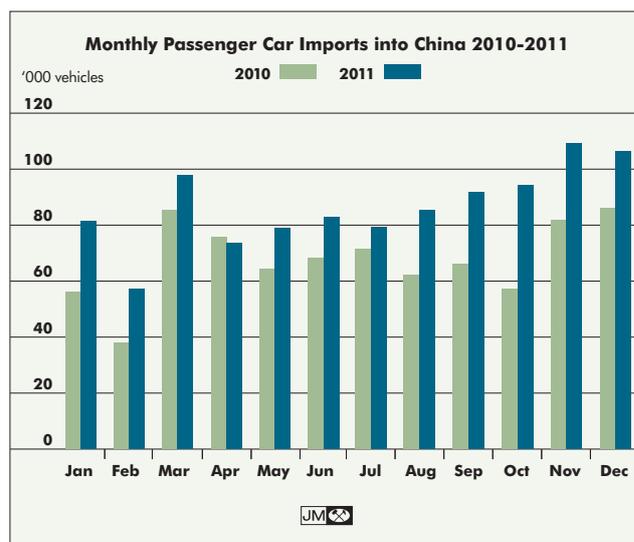
Falling gasoline prices in the middle part of 2011 stimulated a partial return to buying pickup trucks and SUVs by the public, although this phenomenon was relatively short-lived as oil prices crept back up towards the end of the year. Overall, growth in sales of trucks and SUVs in the light duty market exceeded that of cars.

In spite of this, tighter corporate average fuel economy standards, which came into force for 2011 model year vehicles, have recently led to a greater focus on smaller cars

*Palladium is being used in greater amounts to substitute platinum in light duty diesel autocatalysts.*



and engine downsizing by manufacturers. Together with rising gasoline prices in the second half, this resulted in a 35% rise in the number of cars and trucks produced with an engine capacity of less than two litres. Manufacturers have begun rolling out more vehicles with technologies such as direct-injection engines and turbochargers, which allow a reduction in engine size without compromising power. Smaller engines typically require less pgm in aftertreatment because the volume of exhaust gas to be treated is lower. However, the need for rapid 'light-off' of the catalyst to convert the gases as soon as possible after the engine starts means that catalyst loadings do not fall in proportion with reduced engine size. Furthermore, turbochargers have the effect of reducing engine-out temperatures, meaning that more catalyst may be required to perform the same reaction. Similarly, certain



*2011 was another strong year for imports of vehicles into China, principally of large luxury cars and SUVs.*

*Light duty vehicle  
production grew in  
most regions last year,  
boosting palladium  
demand.*



hybrids may require more pgm because of more frequent light-off as the engine takes over from the battery.

## China

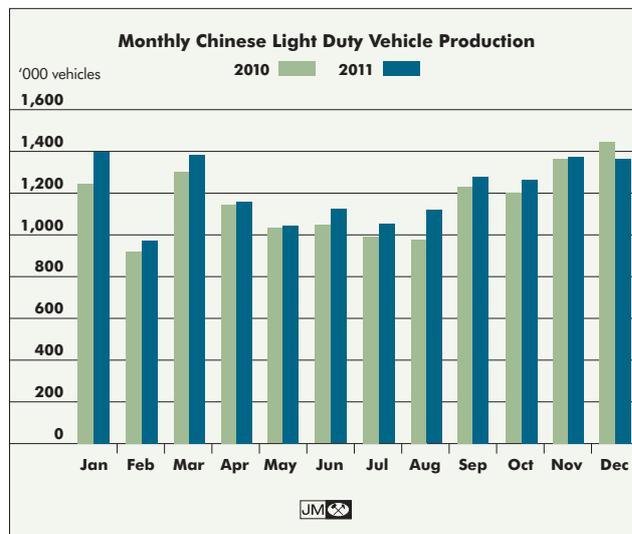
Various government measures designed to dampen vehicle demand were implemented in China last year in order to harness more sustainable rates of economic growth and help reduce congestion. Together with disruption to the supply chains of Japanese joint venture manufacturers, these measures had the effect of reducing the rate of expansion in vehicle production. Restrictions to the number of new vehicle registrations, for example the Beijing city authorities' limit of 20,000 new vehicle licenses per month, contributed to vehicle sales increasing at only around 5% in 2011, down from double digit rates in 2010. Cheap credit, which had previously fuelled car purchasing by the Chinese public, also became more restricted in 2011 as a way of controlling inflation, which alongside rising fuel prices and lack of parking spaces, led potential buyers to defer purchases. The end of government subsidies to rural buyers of vehicles and higher taxes on small cars disproportionately affected sales of small, domestic brands of passenger and light commercial vehicles.

Palladium demand rose by 11% to 1.12 million ounces – more than double the rate of growth in the vehicle market – as the enforcement of China 4 emissions legislation nationwide from July 2011 led manufacturers to raise pgm loadings in gasoline autocatalysts. Loadings on China 4 compliant passenger cars tend to be lower than those on comparable vehicles that were manufactured to meet Euro 4 emissions standards in Europe between 2005 and 2009. This is not due to any major differences in the Chinese and European legislation (which is similar) but rather to thrifting. When a new standard is first introduced, pgm loadings tend to be relatively high so that vehicle manufacturers can be certain of meeting it. As time goes on, manufacturers are able to fine-tune the catalyst to meet the standard with lower loadings. China 4 catalysts, which were first developed to meet Euro 4 standards in 2005, have had several years of fine-tuning based on operational experience and technology advances.

## Rest of the World

2011 saw palladium demand in autocatalysts in the Rest of the World region reach record levels of 1.34 million ounces as emerging markets experienced strong growth. Automakers in South Korea benefitted from exporting small, inexpensive

Light duty vehicle production in China grew last year, but at a slower rate than previously.



vehicles for sale to budget-conscious consumers in the European, North American and Rest of the World markets. Demand for palladium in these primarily gasoline vehicles therefore grew. The Russian auto industry had another good year as it continued to benefit from the government-sponsored scrappage scheme and improved access to credit. Last year saw record vehicle output as foreign carmakers continue to ramp up production in the country. However, there were signs of strain in some emerging markets – in Brazil, a sharp slowing of consumer spending slowed the rise in vehicle sales while a stronger currency encouraged imports, eroding domestic manufacturers' market share.

## JEWELLERY

**Worldwide gross demand for palladium in the jewellery sector softened by 90,000 oz to 505,000 oz due to a combination of higher prices and lower consumer interest last year. Purchasing of palladium by the Chinese jewellery sector fell for the third year running, while demand elsewhere also reduced.**

## Europe

Palladium jewellery demand in Europe weakened by 5,000 oz to 60,000 oz in 2011. Hallmarking of British-made palladium jewellery pieces in the UK remained almost flat at just under 102,000 items last year as rising prices and reduced spending on luxury goods impacted the jewellery sector in general. The weight of hallmarked palladium fell by 20% as manufacturers moved to lower weights of individual pieces to offset the

increase in the palladium price. Higher prices in 2011 also led to a rise in the use of lower fineness alloys, particularly Pd500. British-made pieces hallmarked in this alloy increased from just a few hundred in 2010 to over 5,500 in 2011, while the number of pieces hallmarked in the more established Pd950 alloy decreased by roughly the same amount. Palladium continues to be popular in men's wedding bands where it is being positioned by manufacturers and retailers in the UK as an alternative to white gold. In Switzerland, palladium continued to struggle with a lack of differentiation from other white metals. For manufacturers and consumers alike, palladium is unfamiliar and has higher costs than white gold. With the jewellery market still relatively depressed, it remains difficult for a new jewellery metal to gain a toehold. As a result, the number of Swiss pieces of palladium jewellery hallmarked in that country in 2011 declined by 34% while total hallmarked weight fell by 48%.

### Japan

Despite some disruption in the jewellery sector in the aftermath of the March earthquake, the use of palladium as an alloying agent in platinum and some white gold jewellery was robust, and demand softened by just 5,000 oz to reach 70,000 oz. In the months after the March disaster, consumers took advantage of power shortage-induced reduced working hours to spend more time with their families and on leisure pursuits. This was encouraged by the government and media as a way to increase spending in order to help the country's recovery. There was a temporary rise in sales of jewellery as consumers made purchases of white gold and platinum



Palladium has found a niche in men's jewellery, such as these cufflinks.

See notes to table on page 30.

Palladium Demand: Jewellery '000 oz						
	Gross <sup>1</sup>		Recycling <sup>2</sup>		Net <sup>3</sup>	
	2010	2011	2010	2011	2010	2011
Europe	65	60	0	0	65	60
Japan	75	70	(20)	(20)	55	50
North America	65	45	0	0	65	45
China	360	305	(80)	(190)	280	115
Rest of the World	30	25	0	0	30	25
<b>Total</b>	<b>595</b>	<b>505</b>	<b>(100)</b>	<b>(210)</b>	<b>495</b>	<b>295</b>

pieces. Consumer demand for various types of precious metal jewellery remained largely impervious to the elevated gold price for much of 2011 since retailers tend to adjust their prices relatively infrequently.

### North America

Gross demand for palladium in the jewellery sector in North America fell by 31% to 45,000 oz. High unemployment and subdued economic growth meant that 2011 was a difficult time for the jewellery market. For much of the year, sales of palladium were on the decline as elevated prices affected consumer demand. Palladium was challenged in its stronghold, the men's jewellery market, by cheaper non-precious alternatives. The launch of a consumer and trade advertising campaign for palladium in the US gave some impetus from the middle of the year onwards, although elevated prices continued to prove to be a challenge. Use of palladium as an alloying agent in white gold declined as the record price of gold led to a drop in demand for gold jewellery. Along with high diamond prices, this helped to drag down sales of gem-set white gold pieces.

### China

Palladium jewellery demand in China softened by 55,000 oz to 305,000 oz last year. Due to low volumes, some manufacturers and retailers have been reluctant to work with palladium. Together with a lack of sustained marketing efforts, this has led to a vicious circle of scarce market push and limited consumer pull. Palladium demand has in addition been susceptible to price volatility; prices were on average 33% higher in RMB terms than the previous year, further eroding interest in the metal. There is still interest at consumer level in certain regions, but even there little differentiation from other white metals has depressed palladium's market share.

Seeing lower consumer demand, manufacturers have generally reduced the volume of palladium pieces they produce or exited the market altogether, in some cases moving their staff over to gold production. New metal requirements have been further depressed by a higher volume of unsold stock and consumer pieces being returned for recycling, reducing our net demand figure to 115,000 oz (see page 23).

### ELECTRICAL

**Demand for palladium salts and pastes used in the manufacture of electrical components softened slightly in 2011 as substitution with non-pgm alternatives continued to take place. Although the electronics industry remained in a recovery phase as it shook off the effects of recession with increased output and recovered well from disruption in Japan, overall palladium demand declined by 2% to 1.38 million ounces.**

The largest single application for palladium in the electronics sector remains in multi-layer ceramic capacitors (MLCCs). MLCCs consist of alternating layers of an insulating material (the ceramic) and metal electrodes, and are ubiquitous in electronic circuit boards. Miniaturisation of MLCCs in recent years has resulted in capacitors with dimensions of only fractions of a millimetre – as the average size has decreased, so too has metal demand per capacitor. The increasing complexity of electronic equipment has offset this effect somewhat, and has resulted in a higher number of capacitors per device. Over the past two decades, the use of palladium and palladium alloy electrodes in MLCCs has declined as palladium has been displaced primarily by nickel, a cheaper alternative. However, in certain applications which depend on superior reliability and durability, such as automotive and military electronics systems, palladium is still used. Overall, palladium demand in this application declined by 7% last year to 655,000 oz.

*There was increased output of consumer electronics last year, however palladium demand in this sector declined.*



The growth of popular consumer gadgets such as smartphones and tablet computers has expanded the market for plating applications and hybrid integrated circuits. The rising price of gold has encouraged substitution with palladium in some of these applications. Palladium has the extra advantage of having a lower density than gold therefore less weight of metal is required for the same application. A factor that is helping maintain the use of palladium in certain applications is a move by the electronics industry to remove lead from plating and soldering alloys. The high temperature required for lead-free plating and soldering is enabled by the use of palladium in the alloy, which also allows reliability to be maintained.

### CHEMICAL

**Demand for palladium in the production of chemical intermediates in 2011 rose by 20% to 445,000 oz. New plants, particularly in China, were brought on-stream stimulating purchases of catalyst.**

Palladium is used in catalysts for the production of purified terephthalic acid (PTA) from paraxylene (which itself employs platinum in its manufacture). PTA is then used to make polyester and polyethylene terephthalate (PET), these products in turn are widely used in textiles and packaging, for which demand is growing very rapidly in emerging markets. Expansion of the downstream polyester market has resulted in rapid growth of PTA manufacturing capacity and several new PTA plants came on-stream in 2011. China also increased its vinyl acetate monomer production capacity in order to satisfy anticipated domestic demand for products such as paints,

Palladium Demand: Electrical '000 oz						
	Gross		Recycling		Net	
	2010	2011	2010	2011	2010	2011
Europe	195	185	(175)	(190)	20	(5)
Japan	295	310	(55)	(55)	240	255
North America	160	145	(80)	(85)	80	60
China	360	270	(35)	(45)	325	225
Rest of the World	400	470	(95)	(105)	305	365
<b>Total</b>	<b>1,410</b>	<b>1,380</b>	<b>(440)</b>	<b>(480)</b>	<b>970</b>	<b>900</b>

Palladium Demand: Chemical '000 oz			
	2009	2010	2011
Europe	85	105	80
Japan	20	20	20
North America	50	65	80
China	75	65	150
Rest of the World	95	115	115
<b>Total</b>	<b>325</b>	<b>370</b>	<b>445</b>

adhesives and coatings, which also stimulated purchases of palladium for catalysts. The move to re-orientate Chinese manufacturing towards domestic consumption, in addition to exports, has generally been positive in terms of pgm demand by requiring capacity expansions. Delays in constructing new plants in 2009 and 2010, when export markets were suffering recession, meant that there was pent-up demand for catalyst last year which boosted palladium purchasing.

### DENTAL

**Dental demand for palladium fell by 8% to 550,000 oz as long-term population and dental health trends continued to be felt in the market for reconstruction work.**

As preventative dental treatments in developed markets have reduced the need for restorations such as bridges and crowns, the use of dental alloys is on a continuing downwards trend. Competition from base metals, which are cheaper to produce, and ceramics, which are popular aesthetically, has further eroded palladium's market share. The high price of gold allowed palladium to gain some market share in dental alloys, but ultimately this remains a market which is undergoing long-term decline. Purchasing of palladium for use in Kinpala alloy in the Japanese dental sector, the largest market, softened once again in 2011 to 230,000 oz. In North America the use of palladium-containing porcelain-fused-to-metal treatments also contracted last year.

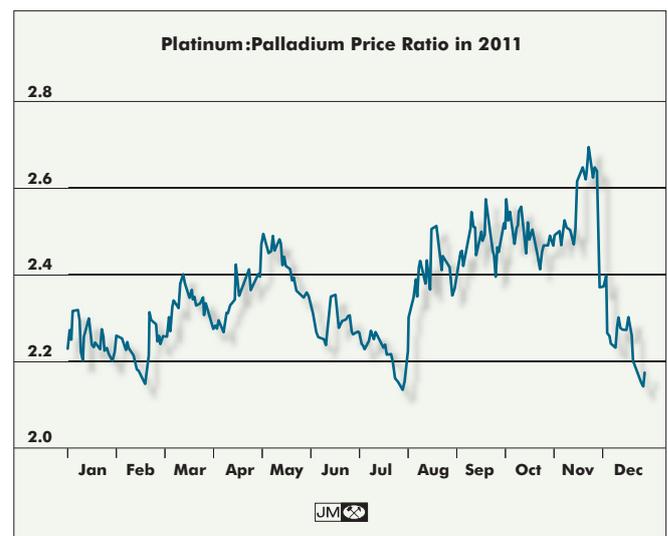
Palladium Demand: Dental '000 oz			
	2009	2010	2011
Europe	65	80	80
Japan	295	250	230
North America	260	250	225
China	0	0	0
Rest of the World	15	15	15
<b>Total</b>	<b>635</b>	<b>595</b>	<b>550</b>

### INVESTMENT

**In contrast to the remarkable performance of the physical investment sector in 2010, last year palladium investment demand moved sharply into negative territory due to liquidation in the exchange traded fund (ETF) market. The investment sector in effect supplied 565,000 oz of palladium back to the market in 2011.**

With net disinvestment in the ETF market from late February onwards, investor sentiment for palladium was clearly negative in 2011. Total holdings went from a record high of 2.45 million ounces in February to the lowest point since April 2010 by year-end, losing 530,000 oz of total cumulative holdings during the year.

Demand for palladium in ETFs was a major contributory factor to the market being in deficit in 2010. In contrast, net negative demand from the investment sector last year is, along with sales of Russian state stocks, one of the key reasons that the palladium market was in a large surplus in 2011. The explanation for the large swing in demand, and market balance, lies in investor perception of the fundamentals. In 2010, rising metal prices, the launch of a much-anticipated US fund and the anticipation of future supply shortfalls added to positive sentiment in the palladium market. Last year, the possibility of lower Russian state stock sales had largely been priced in, demand fell in Japan as a result of the March disaster and economic conditions in Europe remained weak. The crucial factor was that many investors were in a position to sell at a profit in 2011. Others liquidated their holdings during periods of falling price, perhaps as a result of distressed selling as asset prices crashed.



The platinum:palladium price spread moved in palladium's favour in the middle and late part of 2011. However, over the year as a whole palladium investment was negative.

A major sell-off accompanied the steep drops in price in March and August, with the deepest liquidation in late September and early October when palladium's price lost almost a third of its value. Palladium ETF volumes held relatively steady at over two million ounces in the first three weeks of September, perhaps as investors anticipated that prices would recover fairly quickly, but holdings fell by 7% between 21st September and 4th October. Some of this may have been automated stop-loss selling, or selling as investors sought to cover their losses elsewhere in what became a fire sale across many asset classes. Investor appetite continued to wane in the final quarter, with steady liquidation bringing total holdings down to 1.75 million ounces by the year-end.

The largest disinvestment occurred in ETF Securities' London and US Funds, with a smaller amount of disinvestment in the ZKB fund. The London fund saw liquidation of 132,000 oz – continuing a trend of net redemption seen in 2010. As the oldest ETF product, having launched in April 2007, this might be expected as longer-term investors booked profit. The US Fund, which launched in January 2010, saw even larger redemptions last year of 498,000 oz, almost half of the

total volume which was held in January 2011. By September 2010, net holdings had reached three quarters of a million ounces – investors who bought into this fund in the first nine months of its operation would have been in a position to take profit throughout 2011, even amid the price corrections. The ZKB fund, the second-longest established fund, continued for much of the year on a trend seen since mid-2009 of steady redemptions. Two new palladium ETF products, from iShares and Source, were launched in 2011. The Source product performed strongly, attracting 95,000 oz of investment.

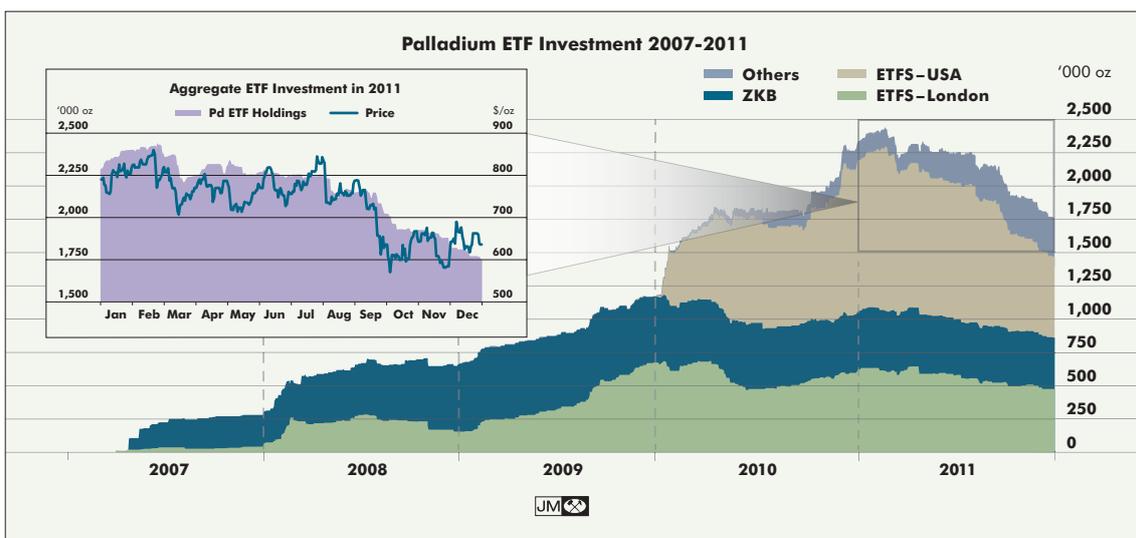
There was no primary production in the palladium coin market in 2011. A busy secondary market saw some coins being sold back to fabricators.

### OTHER DEMAND

Palladium demand in our 'Other' category increased by 17% last year to 105,000 oz. Much of the growth came from the non-road emissions control sector, which in 2011 saw the introduction of Tier 4 Interim and Stage IIIb emissions legislation in North America and Europe respectively.

Palladium Demand: Investment '000 oz			
	2009	2010	2011
Europe	525	(5)	(35)
Japan	0	10	5
North America	95	1,090	(535)
China	0	0	0
Rest of the World	5	0	0
<b>Total</b>	<b>625</b>	<b>1,095</b>	<b>(565)</b>

Palladium Demand: Other '000 oz			
	2009	2010	2011
Europe	20	30	30
Japan	10	10	10
North America	15	25	35
China	10	10	10
Rest of the World	15	15	20
<b>Total</b>	<b>70</b>	<b>90</b>	<b>105</b>



Investor sentiment for palladium was clearly negative in 2011. Many investors were in a position to take profit last year following a period of generally rising prices since late 2008.

# OTHER PLATINUM GROUP METALS

- Rhodium demand grew by 2% to 906,000 oz in 2011 led by strong purchasing in the glass manufacturing sector and in a new physically-backed ETF.
- Mined supplies of rhodium increased by 31,000 oz to 765,000 oz. Recycling of rhodium in scrapped autocatalysts rose to 280,000 oz.
- Ruthenium purchasing softened by 14% to 809,000 oz with lower demand for metal in the manufacture of hard disk drives.
- Demand for iridium, at 301,000 oz, was more restrained in 2011 than the previous year due to less stock building in the market for crucibles.

## RHODIUM

Despite lower demand for rhodium from the auto industry in 2011, gross demand for the metal grew overall last year due to elevated levels of purchasing in the glass manufacturing sector and inflows into the first-ever physically-backed rhodium ETF. Increased supplies and recycling more than offset the rise in demand and as a result the rhodium market surplus grew to 139,000 oz.

### Autocatalyst Demand

Demand for rhodium in automotive emissions control weakened by 15,000 oz to 712,000 oz in 2011, mainly due to the impact of lower vehicle production by Japanese manufacturers in the wake of the Great East Japan Earthquake in March.

Rhodium is used in gasoline catalysts to reduce NOx emissions. Japanese light duty vehicle manufacturers tend to be the heaviest users of rhodium and decreased production from Japanese plants in 2011 had a significant impact on rhodium demand. Programmes to thrift rhodium from TWCs by carmakers around the world continued last year in the light of previously high rhodium prices and contributed to overall lower rhodium purchasing from the auto sector.

### Other Demand

In the glass industry, rhodium demand increased by 15% to 78,000 oz as new LCD glass manufacturing capacity was installed. Driven by strong demand for LCD glass in TVs and mobile devices, over a dozen new platinum-rhodium melting tanks were installed worldwide. In addition, rhodium benefitted from at least one company purchasing metal in advance of future demand. Over half of TVs worldwide are made in China, and manufacturers there opened four new LCD glass manufacturing lines. These were installed despite the global market being in overcapacity in 2011, and represent part of the drive to supply domestic TV panel production with

domestically produced LCD glass.

The glass fibre manufacturing sector continued to suffer from excess capacity in 2011, and new demand was offset by the closure of antiquated marble melt facilities in China. The lowest rhodium prices since 2009 throughout much of last year prompted some producers to switch to higher rhodium content alloys which give greater durability to the bushings used to make glass fibre.

In the chemical industry, demand for rhodium was supplemented by sales of catalyst to Chinese plants. China continued to expand oxo-alcohol manufacturing, to around two million tonnes annually (approximately an eighth of worldwide capacity). Chinese acetic acid production capacity also expanded rapidly in 2011, reaching over six million tonnes out of a global total of some 16 million tonnes. New plant builds were driven mainly by consumer demand for paints and adhesives. Overall, purchasing of rhodium by the chemical sector increased by 5,000 oz to 72,000 oz.

A wholly new demand area for rhodium in 2011 was physically-backed ETF investment. A rhodium ETF was launched by Deutsche Bank in May and attracted steady net investment throughout the year. By the year-end it was responsible for 17,000 oz of new demand. The rhodium investment market remains relatively small and niche, although looked at another way, rhodium investment accounted for almost all of the growth in rhodium demand.

Rhodium Demand by Application			
	'000 oz		
	2009	2010	2011
Autocatalyst	619	727	712
Chemical	54	67	72
Electrical	3	4	5
Glass	19	68	78
Other	21	21	39
<b>Total Gross Demand</b>	<b>716</b>	<b>887</b>	<b>906</b>
<b>Autocatalyst Recycling</b>	<b>(187)</b>	<b>(241)</b>	<b>(280)</b>
<b>Total Net Demand</b>	<b>529</b>	<b>646</b>	<b>626</b>

## Supplies

Rhodium sales by primary producers increased by 31,000 oz to 765,000 oz in 2011. This was due to a combination of higher refined output in South Africa, following a building of pipeline stocks the previous year, as well as a ramping up to full production in North America following disruptions in 2009 and 2010. Zimbabwe also contributed some additional supplies as new capacity came on-stream. Taken together with metal recovered from open loop recycling, supplies of rhodium comfortably exceeded demand again in 2011.

## RUTHENIUM & IRIIDIUM

**Ruthenium demand was relatively subdued in 2011 at 809,000 oz, a decline of 14% compared with the previous, strong year. Demand for iridium last year remained at a historically high level of 301,000 oz.**

## Demand

Although demand in the hard disk industry, the biggest single user of ruthenium, was robust in the first half of 2011, it declined in the second half of the year. A focus on inventory management by hard disk manufacturers, as well as a move by some to re-press targets rather than refine them, led to lower new metal purchases. In the fourth quarter of 2011, purchasing was also hit by floods in Thailand. In total, demand in electrical applications softened by 26% to 502,000 oz.

In the chemical sector, purchases of ruthenium as a process catalyst were particularly strong in the first half of the year, as a number of production campaigns came to an end, generating orders for new catalyst charges.

Both ruthenium and iridium are employed in the electrochemical industry to produce chlorine and sodium hydroxide. As ruthenium-iridium membrane cell technology gradually replaces older mercury and diaphragm-based technology for environmental reasons globally, we continue to see purchasing in this sector. This is despite a softening in demand for downstream chemical products such as PVC, due to a slowdown in the construction sector.

The highest demand for iridium was once again in the electrical sector, which accounted for 165,000 oz; 18% lower than in 2010 but still over half of total global purchasing of the metal. The primary application for iridium in the electrical sector is the fabrication of crucibles used to grow single crystal sapphire, which in turn is used as a substrate to produce

### Ruthenium Demand by Application

	'000 oz		
	2009	2010	2011
Chemical	89	100	109
Electrical	336	679	502
Electrochemical	95	124	130
Other	54	42	68
<b>Total Demand</b>	<b>574</b>	<b>945</b>	<b>809</b>

gallium nitride, the inorganic semi-conductor material used in blue and green light-emitting diodes (LEDs). Iridium crucibles are used to contain the molten salts from which the crystal is pulled – iridium has good properties for this application including a high melting point and resistance to chemical attack. As LED displays have increased in popularity, especially in the TV, smartphone, and tablet computer markets, Japanese manufacturers in particular have continued to build manufacturing capacity. There was some purchasing of iridium for use as phosphorescent emitter materials in organic light-emitting diodes (OLEDs) in 2011. OLED displays remain a promising future technology which are beginning to see uptake in some consumer devices such as smartphones.

Use of iridium in other applications also remained strong, such as in the automotive sector, where it is used in electrodes for high-performance spark plugs, and in the medical sector, where platinum-iridium alloys are widely used in devices designed to be implanted into the human body.

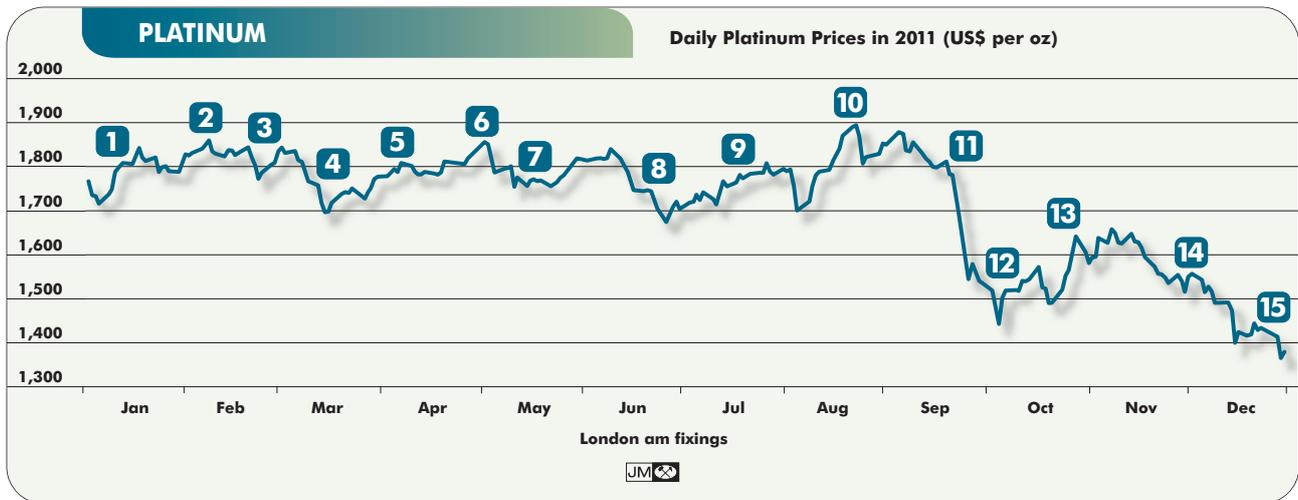
## Supplies

Mined production of ruthenium and iridium declined in 2011 in line with lower mine output of platinum in South Africa. Ruthenium demand for the year was met by a combination of primary mine production, significant releases of speculative metal holdings and the probability of some sales from Russian state stocks. Industrial purchases of iridium once again exceeded primary mined supply and metal was drawn from above-ground stocks in order to balance the market.

### Iridium Demand by Application

	'000 oz		
	2009	2010	2011
Chemical	11	18	19
Electrical	7	201	165
Electrochemical	33	79	76
Other	30	40	41
<b>Total Demand</b>	<b>81</b>	<b>338</b>	<b>301</b>

# PRICES



Despite the prevailing economic uncertainty, platinum traded largely between \$1,700 and \$1,900 in the first eight months of 2011 with strong physical demand helping to put a floor under the price. After reaching a three-year high in August, from September onwards platinum suffered a spate of severe downward price corrections as a deteriorating economic outlook led investors to turn sharply away from risk assets. In the ensuing market turmoil, high levels of physical purchasing occurred but gave little upward momentum to the price and overall, platinum lost \$387 (22%) between the beginning and end of the year. Nonetheless, the average daily price was at a new record high of \$1,721 in 2011, some 7% above the average price for the previous year. For much of the year, platinum benefitted from an association with gold, the traditional 'safe haven' asset. Economic uncertainty led gold to reach historic highs and establish a premium over platinum in the last quarter of the year. However, even gold was not immune to the general commodity sell-off and a falling gold price removed crucial support for platinum, leaving the price at a two-year low by the end of 2011.

Average PGM Prices in \$ per oz			
	2010	2011	Change
Platinum	1,611	1,721	7%
Palladium	526	733	39%
Rhodium	2,458	2,022	(18%)
Ruthenium	197	166	(16%)
Iridium	642	1,036	61%

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

**1** Platinum opened 2011 at \$1,768 on the morning fix of 4th **January**, taking strength from the exuberance of speculative investors and a weaker US dollar. An earlier Chinese interest rate increase led to a slumping of the dollar and a surge in commodity prices which spilled over into the New Year with crude oil trading at a two-year high, copper at an all-time high, and gold and silver testing their recent high levels. Although fears over sovereign debt and its contagion were to be dominant features of the commodity markets in 2011, as they were in 2010, January's successful auction of Portuguese, Spanish and Italian debt helped support the euro, weaken the dollar and consequently boost pgm prices. The price rose to over \$1,800 on the 14th, a level not seen since July 2008.

**2** In **February**, platinum prices were buffeted by political tensions in the Middle East and North Africa. A popular uprising in Egypt threatened to disrupt oil supplies through the Suez Canal, causing crude oil prices to rise to three-year highs. This had the effect of lifting other industrial commodities, at least initially. Together with further signs of recovery from European carmakers and an increase in Japanese consumer confidence, platinum reached \$1,863 on 9th February. Strong buying on NYMEX saw net long futures positions rise to almost 2.30 million ounces in the week beginning 8th February, in what was to be the high point for the year.

**3** While oil prices tracked ever higher, investors began to fear a slowdown in global economic growth. This helped precipitate a faltering of confidence by investors in industrial commodities, with platinum correcting downwards to \$1,772 on 24th February, even as gold continued to rise. Some investors sensed an opportunity in this and piled into platinum ETFs,

reversing the trend for profit-taking seen earlier in the month, and bringing holdings to a new record level of 1.44 million ounces. The declining price in late February was accompanied by a fall in net long positions in the futures markets.

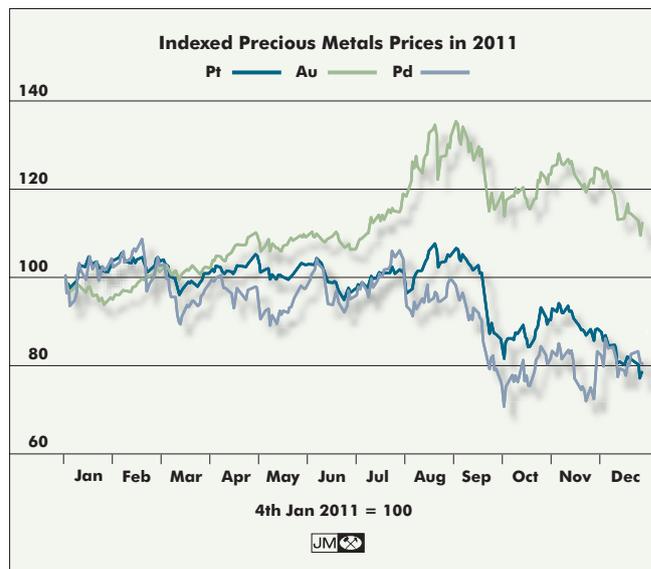
**4** As uncertainty over industrial demand and political turmoil in the Middle East continued, the platinum price was in retreat just before the triple disasters of the Great East Japan Earthquake, tsunami, and subsequent nuclear meltdown on 11th **March**. Much of Japan's industrial capacity was shut down immediately after the earthquake and as a result there was a great deal of nervousness over the prospects for industrial demand. Platinum fell steeply, shedding 8% of its value between 7th and 16th March. At the sub-\$1,700 level, physical demand picked up setting the price on a rising trend for much of the remainder of the month. ETF holdings declined by around 77,000 oz (5%) between 11th and 24th March before recovering slightly by month-end. Platinum futures positions declined by 37% in the two weeks after 8th March.

**5** The lingering effects of the Japanese earthquake continued to weigh on the minds of investors in **April** as Toyota announced suspensions to vehicle production in North America and Europe due to parts shortages. However, platinum was given some upwards momentum from physical buying and fixed at \$1,810, the highest level for a month, on 8th April. Concerns from the supply side also re-emerged; Zimbabwe announced in late March that it would implement a mining indigenisation law that would require all foreign-owned mining companies to sell majority stakes to locals within six months. Two new platinum ETF products were launched in April, from Source and iShares, and attracted a combined total of over 20,000 oz of new investment in the first few weeks.

**6** In late April and early **May**, platinum made further gains, reaching \$1,858 on 3rd May – the highest level since February. This was mainly due to a weakening of the dollar in the wake of indications that the US Federal Reserve would continue its loose monetary policy. Adding to this was further upwards pressure from the supply side as it became increasingly clear that South African producers had suffered a poor first quarter due to stoppages and low productivity.

**7** A rise in the margin requirements for silver contracts led platinum to be sold off along with other precious metals as investors struggled to cover the increase in payments. NYMEX platinum positions declined by 23% between 3rd and 24th May,

Gold traded at a premium to platinum in the fourth quarter of 2011. Palladium was relatively subdued throughout the year.



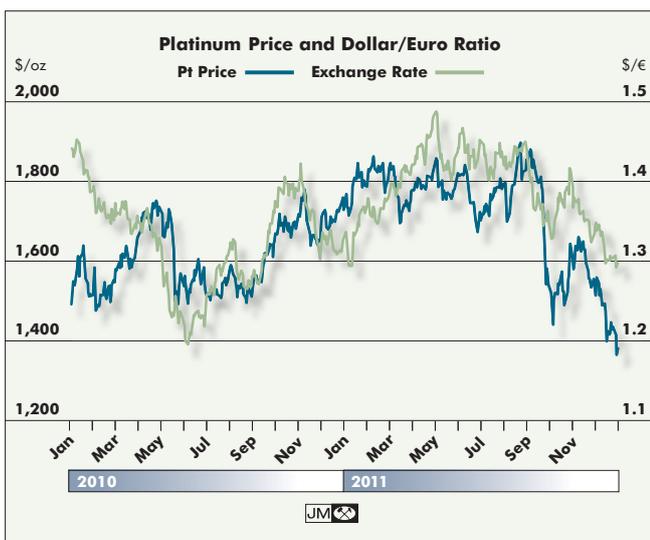
during which time platinum's price fell by \$97. TOCOM positions increased by 72% in the same period as Japanese investors bought into the falling price. There was net liquidation in total ETF holdings of around 30,000 oz, although positions in the recently-launched Source ETF grew strongly.

**8** US carmakers estimated that their year-on-year sales of cars and trucks declined by 200,000 units in May, while the big three Japanese manufacturers all reported lower sales figures for May, as the industry continued to experience component shortages following the March earthquake. The effect of this on platinum was lessened by a weak dollar which supported the price generally above \$1,800 in the first half of **June**. Following confirmation that the US would not be engaging in a third round of quantitative easing, the dollar rallied and commodity prices plunged with platinum losing another \$101 between 14th June and 1st **July**. This was exacerbated by fears over economic recovery in Greece after the country's credit rating was downgraded.

**9** Concerns over sovereign debt spread beyond the eurozone in July as US policymakers struggled to reach agreement on a raising of the national debt ceiling. As annual wage negotiations between pgm miners and unions in South Africa continued, worries on the supply side also helped provide some support to platinum. While no official strikes took place at mines, tough talk on wage negotiations and a coal miners' strike raised fears that electricity supplies may be affected. ETF holdings reached a new record high of just under 1.55 million ounces in late July as investors bought into the rising price.

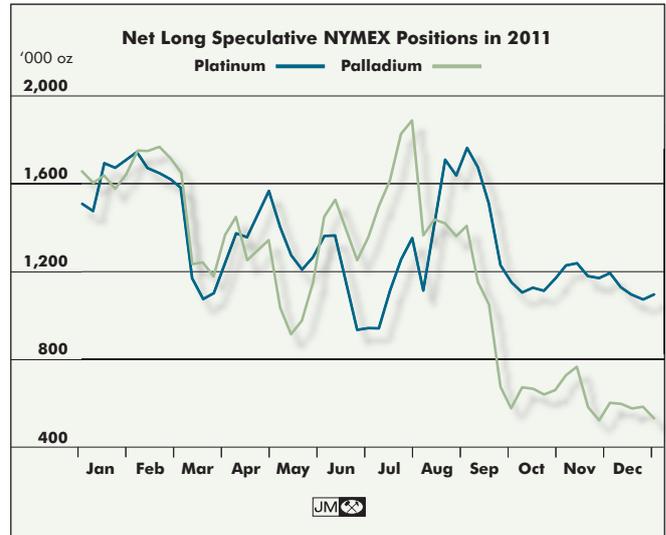
**10** In early **August**, the US suffered a credit rating downgrade – despite an eleventh-hour agreement to raise the debt ceiling – and the gold price soared to unprecedented highs of almost \$1,900. Platinum followed and, after a brief downwards correction as the prospects of lower industrial demand from the US were digested, reached a three-year high and a high point for 2011 of \$1,899 on the 23rd. With a great degree of uncertainty in the markets, gold began to trade at a premium to platinum in August for the first time since December 2008, remaining close to parity for much of the month. South African labour negotiations came to the fore as the National Union of Mineworkers (NUM) continued its pay dispute with the biggest producers. Although Anglo American Platinum arranged a two-year pay rise deal of between 8% and 10%, the rejection of a new offer from Impala, and ongoing negotiations with Lonmin and Northam Platinum continued to be of concern to investors.

**11** Gold benefitted from risk aversion in early **September** trading roughly in tandem with platinum in both upwards and downwards movements. After platinum briefly reasserted itself over gold on the 16th, the platinum:gold spread remained in gold's favour for the rest of 2011. Platinum gained some support from continuing supply concerns, with Impala remaining in wage talks with the NUM, as well as strong auto sales in Europe. Following the rising price, mid-September saw the high point for ETF investment for 2011, with cumulative holdings reaching a record 1.63 million ounces on the 16th. A resurgent dollar saw platinum's price begin to slide in mid-September, dropping through the \$1,800 level, accompanied by liquidation in the ETF market.



*In the second half of 2011, the dollar gained some strength at the expense of the euro, adding to the downward pressure on platinum.*

*A substantial sell-off of both platinum and palladium positions occurred during the September price crash.*



**12** A Federal Reserve plan, Operation Twist, to increase bank lending was announced on 21st September. Following this, the dollar strengthened considerably and investors liquidated any assets considered risky as the economic outlook seemed increasingly gloomy. The seemingly unstoppable fall saw platinum's price drop rapidly through \$1,700 on the 23rd and thence through the \$1,600 and \$1,500 levels in late September and early **October**. This drop to the lowest price since late 2009 prompted record levels of purchasing on the Shanghai Gold Exchange (SGE), which amounted to 58,000 oz in the week of 26th September. There was also good physical demand elsewhere as buyers took advantage of lower prices. The flight from risk continued as platinum slumped to \$1,442 on 5th October, losing \$439, or 23% of its value since 5th September. Accompanying the precipitous drop in price, the futures markets shed 756,000 oz (34%) between 6th September and 4th October. ETF holdings came off their mid-September highs of 1.63 million ounces, falling to 1.56 million ounces by the end of September – a modest decline considering the depth of the price crash.

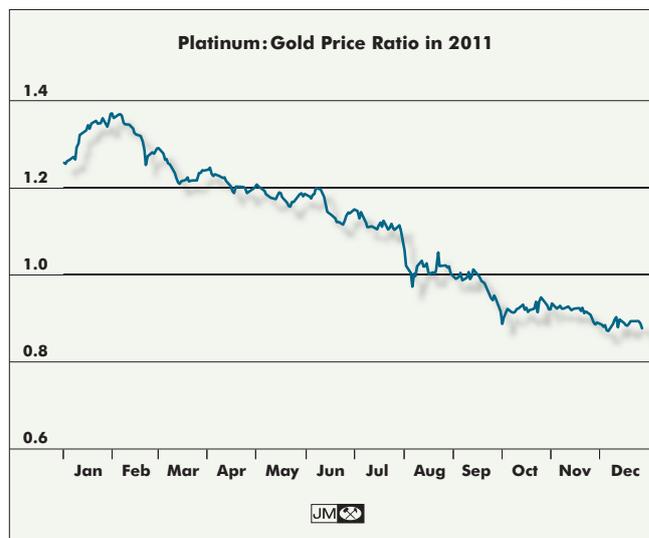
**13** Platinum gained some ground over the following days as risk appetite appeared to return after an announcement that the EU would recapitalise Europe's vulnerable banks. However, in the wake of a downgrade of Spain's debt and a dispute over increasing the EU bailout fund, investor sentiment remained negative. In the last week of October, platinum rallied, reaching \$1,645 on the 28th on the back of optimism over the EU finding a way to manage the sovereign debt crisis. Platinum futures positions declined by almost 200,000 oz in the month to 25th October with the heaviest liquidation in early

October. Platinum ETF positions remained roughly steady between October and late **November** as aggregate holdings consolidated at around 1.55 million ounces.

**14** The apparently diminishing risk of a disorderly debt default by Greece, together with lower eurozone interest rates, saw platinum regain the \$1,600 level in early November after a brief dip. Attention turned to Italy the following week, which saw its borrowing rates surge to over 7% on concerns over its high levels of sovereign debt. As the European Commission cut its growth forecast for the eurozone in 2012 from 1.8% to 0.5%, equities slumped causing some investors to liquidate precious metal positions to cover their losses elsewhere. News of disappointing export growth in China and a slowdown in car sales in India added to the negative sentiment for platinum and the price slid to a new low for the year of \$1,515 on 30th November. In the ETF market, there was a sharp sell-off which accompanied the price drop, bringing cumulative ETF holdings to the lowest level since April. As November gave way to **December**, there was a marked turnaround in investor sentiment as the world's largest central banks announced coordinated plans to inject liquidity into the global financial system and China announced an easing of bank reserve requirements. Platinum's price recovered as investor sentiment returned briefly to risk assets.

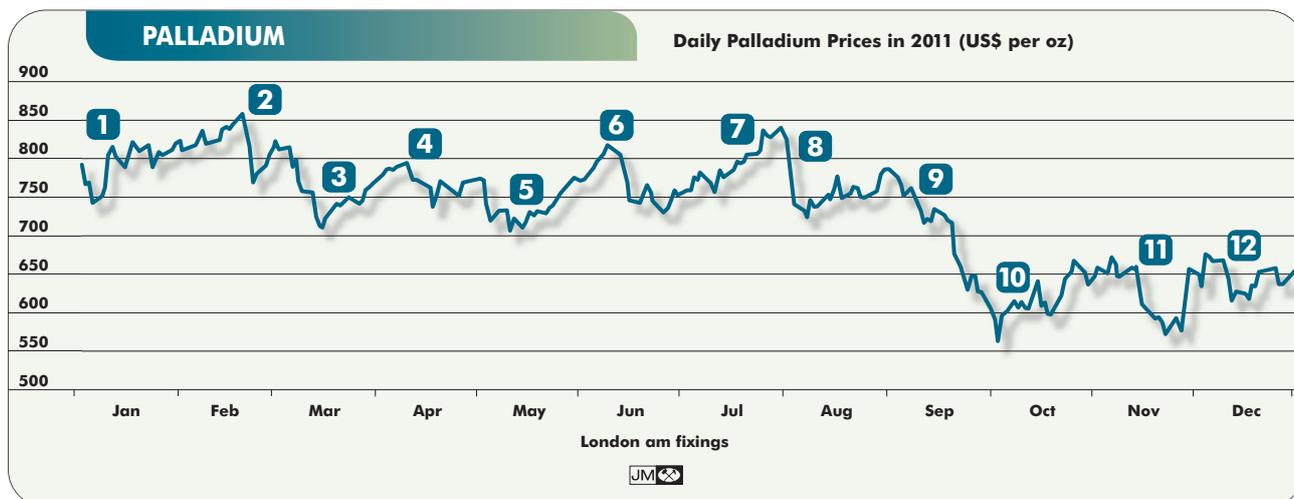
**15** In a substantial sell-off reminiscent of the darkest days of 2008, sustained liquidation in the platinum market saw the price drop below \$1,400 to fix at \$1,398 on 15th December.

The platinum:gold spread moved in gold's favour in 2011 as investors looked for a safe haven.



Supported by good physical demand from Asia, platinum found some stability above \$1,400. On the supply side, Lonmin finalised wage agreements with the NUM and various other unions, bringing to an end the threat of widespread industrial action. In Zimbabwe, meanwhile, there was tough talk from the government that it may bring in laws to stop exports of unprocessed platinum concentrate to South Africa, which continued to add to upside pressure. Despite this, the price slid beneath \$1,400 once again in late December, fixing at \$1,364 on the 29th – the lowest level since November 2009. Total ETF positioning by the year-end was 1.46 million ounces. Net long platinum futures shrank to 1.20 million ounces, the lowest level since September 2009.

Platinum Prices in 2011 London am and pm fixings, \$ per oz				Palladium Prices in 2011 London am and pm fixings, \$ per oz				Rhodium Prices in 2011 Johnson Matthey Base Prices, \$ per oz			
	High	Low	Average		High	Low	Average		High	Low	Average
January	1,846.00	1,716.00	1,787.00	January	824.00	741.00	793.13	January	2,500.00	2,425.00	2,436.25
February	1,863.00	1,772.00	1,825.95	February	859.00	767.00	820.98	February	2,500.00	2,425.00	2,476.25
March	1,846.00	1,696.00	1,769.08	March	823.00	700.00	761.85	March	2,425.00	2,375.00	2,396.74
April	1,835.00	1,772.00	1,794.25	April	798.00	736.00	771.22	April	2,375.00	2,275.00	2,346.05
May	1,858.00	1,750.00	1,785.90	May	777.00	706.00	736.08	May	2,275.00	1,950.00	2,113.10
June	1,842.00	1,674.00	1,770.02	June	817.00	724.00	770.74	June	2,350.00	1,950.00	2,075.00
July	1,814.00	1,703.00	1,758.48	July	842.00	750.00	788.13	July	2,000.00	1,950.00	1,984.52
August	1,899.00	1,700.00	1,805.15	August	842.00	722.00	763.41	August	1,975.00	1,825.00	1,880.43
September	1,881.00	1,511.00	1,751.92	September	786.00	614.00	710.84	September	1,875.00	1,675.00	1,828.41
October	1,645.00	1,442.00	1,535.26	October	667.00	549.00	616.15	October	1,675.00	1,600.00	1,628.57
November	1,661.00	1,515.00	1,596.51	November	673.00	570.00	627.07	November	1,675.00	1,650.00	1,661.36
December	1,561.00	1,354.00	1,465.99	December	681.00	613.00	643.04	December	1,625.00	1,400.00	1,485.00
<b>Annual</b>	<b>1,899.00</b>	<b>1,354.00</b>	<b>1,721.22</b>	<b>Annual</b>	<b>859.00</b>	<b>549.00</b>	<b>733.20</b>	<b>Annual</b>	<b>2,500.00</b>	<b>1,400.00</b>	<b>2,021.95</b>



Palladium's price reflected a lack of investor exuberance compared with the previous year, shedding \$156 (20%) over the course of 2011. Despite this the palladium price was on average 39% higher, at \$733, than in 2010 and many investors in ETFs and the futures market took the opportunity to book profit. The first eight months of the year saw palladium trade at ten-year highs, supported by a bullish fundamental picture. Due to the more industrial nature of the palladium market, negative investor sentiment weighed on palladium to perhaps a greater extent than platinum. This was particularly evident in the greater relative price declines in March and September.

**1** Palladium reached \$792 on the morning fix of 4th **January**, slightly up on the level at the end of the previous year. After a brief dip related to liquidation in the gold market, palladium continued the upward trend seen in the final quarter of 2010, surging to a ten-year high of \$823 on 19th January amid anticipated lower Russian state stock levels and dollar weakness. Palladium ETF positions reached new record high levels of 2.40 million ounces by the end of the month, while palladium futures positions declined by 5% between the week commencing 28th December and the start of **February**.

**2** Data showing that US vehicle sales rose 17% in January provided a boost to palladium in early February and the price tracked ever higher above \$800. General Motors and Chrysler were the main drivers of this increase with sales rises of 22% and 23% respectively, while Ford sales met expectations with a 13% increase. The price reached a new ten-year high, and what was to be the highest level of 2011, of \$859 on 21st February as rising oil prices gave some support to pgms. However, this support

fell away shortly after as investors became nervous about the impact of higher commodity prices on economic growth, and palladium suffered a steep fall of \$92 between 21st and 24th February. Cumulative palladium ETF investment holdings reached an all-time record high of 2.45 million ounces on 24th February. This was also to be the high-watermark of palladium ETF volumes in 2011 and there was net disinvestment for much of the remainder of the year.

**3** Palladium was perhaps even more acutely affected by the earthquake in Japan on 11th **March** than platinum. Japan typically accounts for around a sixth of total global palladium demand; with key electronics and vehicle manufacturing plants closed after the disaster, palladium lost 6% of its value between the 11th and 17th compared to platinum shedding 4% in the same period. ETF holdings declined by 5% between the 11th and the end of March, with periods of heavy liquidation during steep price drops immediately after the disaster. These sell-offs took year-to-date fund holdings into negative territory. Futures positions also fell, by 26% in total, in the week commencing 15th March, with the biggest sell-off of 44% unsurprisingly on TOCOM.

**4** News of continuing disruption to vehicle production appeared to negatively affect palladium more than platinum, with the palladium price sliding mid-month following reports of stoppages by Japanese OEMs in Europe and North America. Although Chinese passenger car sales reportedly grew in March, the numbers came in below analysts' expectations following the end of government-backed incentives and higher fuel prices. For the remainder of March the price tracked generally upwards towards \$800 as the earlier selling began to appear overdone. Early **April** saw steady investment inflows

into ETFs which brought total year-to-date holdings back into positive territory following a period of net liquidation from mid-March onwards. Palladium futures positions during the first half of April recovered well following significant month-long liquidation in March.

**5** The price sank to \$717 on 6th **May** in a sell-off prompted by a rise in silver margins that affected the whole precious metals complex. Palladium lost 7% of its value between the 3rd and 6th, compared with 4% for platinum. The price recovered the following week as it followed gold's upward momentum but once again fell victim to a general commodity sell-off. Net long positions also suffered, dipping to a two-year low of under one million ounces in the week commencing 17th **May**. In the ETF market, significant net investment of around 50,000 oz in the new Source palladium fund was largely offset by liquidation elsewhere.

**6** Although the Chinese auto industry reported a decline in year-on-year sales of 4% for **May** 2011, the first such drop in over two years, the subsequent announcement of a 'cash for clunkers' plan was generally supportive of palladium's fundamentals and the price tracked upwards, reaching a month-high of \$817 on 10th **June**. At this point there was another sharp downwards correction as palladium came under selling pressure in the wake of sovereign debt concerns in Europe. Year-to-date ETF investment remained in marginal negative territory in **June** as inflows into the Source product were netted off by significant disinvestment in the more well-established London, US and ZKB funds.

**7** Palladium's price broadly tracked platinum throughout **July** on a generally upwards trend. Mixed news from the global automotive industry, with Renault reporting disappointing European sales but record half-year global sales for VW and higher production from Nissan's Japanese operations, was on the whole bullish for palladium. Growing concerns over a possible US debt default saw palladium benefit from some buying of gold. The price rallied to \$840 in the fix of 1st **August**, just shy of the ten-year high reached in **February**.

**8** The bubble finally burst in early **August**. In the space of a week, palladium lost over \$100, dragged down by speculative liquidation as investors struggled to cover their losses in the wake of a US credit downgrade and a plummeting gold market. Reaching a resistance level at \$722 on the 9th, thereafter it remained fairly volatile for the rest of the month despite news

that the Japanese economy contracted by a smaller amount than had been assumed and reassurances from carmakers that domestic production was recovering well.

**9** Palladium prices plunged in **September** as wavering confidence over the state of the world economy led investors to flee from any assets considered risky. The announcement of Operation Twist, a plan to increase US bank lending, led to a strengthening of the dollar and panic selling of equities and commodities. Although it gained some benefit from being less closely linked with the gold price than platinum, palladium's status as primarily an industrial metal saw it come under heavy selling pressure as the economic outlook appeared increasingly dim and commentators competed to give deeply gloomy predictions on the inevitability of a new worldwide recession. Palladium was helpless in the ensuing flight from risk and lost \$219 between 31st **August** and 5th **October**, when the price bottomed out at a low for the year of \$561. The peak to trough fall during this time (28%) was deeper than for platinum (22%). Despite the price plunge, ETF investment held relatively steady at around 2.15 million ounces for the first three weeks of **September**. However, as the price went below \$700 in late **September**, liquidation began – lowering total holdings by around 7% between 21st **September** and 4th **October**, with almost all of the disinvestment in the US fund. Net long speculative positions also declined dramatically, falling by more than half from the end of **August** to just 598,000 oz in the week commencing 4th **October**, the lowest net speculative long position since **March** 2009.

**10** The end of the 'washout' in early **October** gave some relief to palladium. Physical buying, which had surged as industrial users took advantage of the falling price during the dip, began to generate some upward pressure. Reports out of Russia that the last 9 tonnes of palladium from state stockpiles will be shipped in 2012 and 2013 also gave some support to the price in **October**, although perception of future supply shortfalls appeared to have largely been priced in by the market. Like platinum, palladium benefitted from more positive sentiment regarding the eurozone as the new bailout plan was revealed. Together with news from Norilsk Nickel of a fall in year-on-year palladium production in the nine months to **September**, the price strengthened to a month-high of \$667 on 28th **October**.

**11** In **November**, palladium largely followed the platinum price, losing ground amid eurozone turmoil as markets gave their response to a decision by Greece to hold a referendum

on their latest EU bailout package. The Greek decision was subsequently reversed, prompting a change of government and, together with a European Central Bank (ECB) interest rate cut, drove a small relief rally. As attention turned to Italy's economic woes, palladium benefitted from the rising gold price, driven by risk aversion. Prices slid mid-month as an avalanche of gloomy economic data, including rating downgrades for US and European banks, weighed on investor confidence and palladium once again dropped below \$600, fixing at the lowest level for almost two months, at \$570, on the 25th. After holding steady for some weeks in October and November, ETF holdings suffered another major bout of liquidation from the end of November onwards.

**12** As **December** began, the price briefly soared as a surprise loosening of monetary policy in China and an announcement of coordinated global action by central banks to increase liquidity caused the dollar to retreat and commodities to rally. Positive news also came from the auto industry as US car sales were reported to have risen by 14% in November to the highest level for two years. However, palladium proved to be just as susceptible to negative investor sentiment surrounding the eurozone as platinum, giving up some of its gains on the 6th, and more substantially on the 15th, amid speculative liquidation as investors sought to raise cash as the end of the year approached. News of increased shipments of palladium from Russia in November indicated, as expected, that further state stock sales were being made. Despite this, and the anticipation of further shipments before the year-end, sentiment in the market remained positive towards palladium and the price buoyed around the \$650 level, in contrast to platinum's price which was on a distinctly downward trend. In the dying days of the year, palladium was thinly traded and struggled to gain much momentum. In the risk-off investor climate, by year-end ETF holdings declined to a new low of 1.75 million ounces, leaving year-to-date investment in negative territory by over half a million ounces. Net long futures positioning also declined to a low for the year of barely 600,000 oz, almost three times lower than the net long position at the end of 2010.

## OTHER PGM

**Rhodium lost \$1,025 (42%) during 2011 and the price was on a downward trend for much of the year, trading 18% lower than the average daily price in 2010. The slump in vehicle production following the Japanese earthquake affected rhodium prices negatively as Japanese buying of**

**rhodium was relatively subdued. A brief price spike in early June resulted from investors and industrial users moving to cover their requirements just after a physically-backed rhodium ETF was launched. Prices generally softened in the second half of the year, affected to an extent by the negative market sentiment that dragged down platinum and palladium, particularly in the last quarter. By the year-end, rhodium was trading at the lowest level since the middle of 2009 at \$1,400.**

Rhodium began the year at the Johnson Matthey Base Price of \$2,425 and continued the upward trend seen since late 2010, firming to \$2,500 on 31st **January** in what was to be the highest level all year. The price remained there for the next fortnight with steady two-way trade. Turmoil in the Middle East began to affect confidence in the economic recovery and although rhodium remained less heavily traded than its sister metals, it too was sold off, contributing to a falling price in the second half of **February**.

The price continued to be affected by negative market sentiment, but a fresh burst of buying from Asia helped support rhodium at \$2,425 in early **March**. Following the Japanese earthquake, rhodium softened to \$2,375 on 22nd March as auto companies stayed away from the market. Although rhodium's price softened further in the weeks and months after the disaster, it was not affected to the same degree as platinum and palladium in its immediate aftermath.

Rhodium's price drifted in **April** as speculative selling took place, losing \$100 over the course of the month. With generally more offers than bids, the price continued to slide in **May**, reaching an 18-month low of \$1,975 on 18th May. On 23rd May, Deutsche Bank launched a new rhodium ETF, backed by physically-allocated rhodium sponge. This sent the price rocketing upwards, causing traders and speculators to cover their positions. Overall the tightness of the market resulted in the price gaining \$400 (21%) between 25th May and 1st **June**. After the initial panic, the price came down almost as fast as it went up, returning to \$1,950 by 15th June by which time the new fund had attracted 6,000 oz of net investment. By the end of 2011, rhodium ETF holdings stood at just under 17,000 oz, having grown steadily throughout the year.

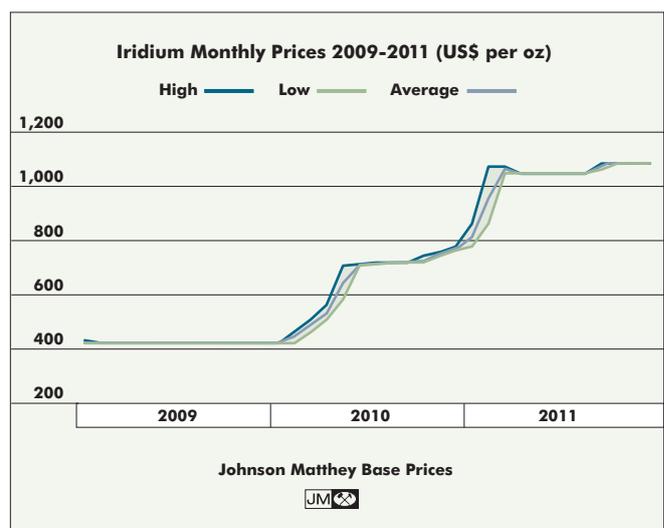
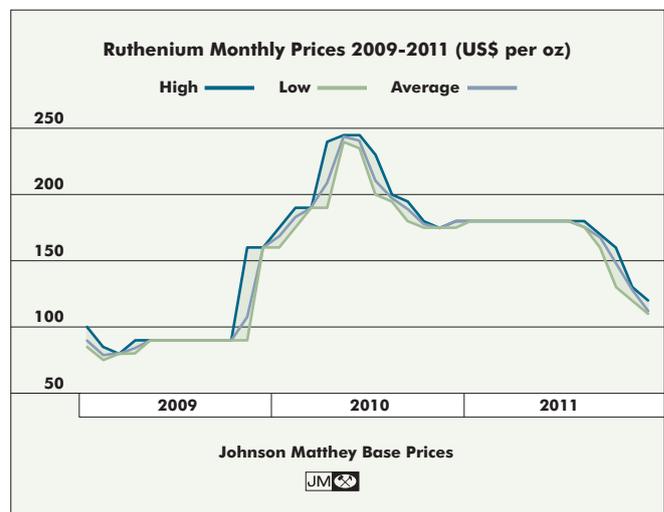
The rhodium price firmed to \$2,050 on 20th June on the back of resurgent buying interest before settling at \$2,000, where it remained from 27th June to 19th **July**. With limited buying interest, the price fell beneath \$2,000 again and it was not to return to this level for the remainder of the year. Physical demand from Asia arrested a further fall, and rhodium went into **August** at \$1,975. During August, rhodium was not

immune from the wider volatility in the pgm markets, falling to \$1,825 on the 11th with a dominance of offers in the market. This then gave way to steady purchasing as industrial users took advantage of the lowest prices since late 2009, which helped push the price back to \$1,875. Rhodium remained at this level for the first two weeks of **September** before it too succumbed to the collapse in investor confidence in industrial commodities, falling to \$1,600 by 6th **October** amid heavy selling. The price recovered somewhat in the remainder of October but failed to regain the \$1,700 level.

The price was less affected by movements in the wider market than platinum or palladium during **November**, gaining then losing \$25 over the course of the month as it responded to light buying and selling pressure. In the first two weeks of **December**, liquidation of risk assets as investors struggled to maximise cash positions, together with an increasingly gloomy economic outlook in Europe led rhodium to plunge in price, losing \$225 to reach a two-and-a-half-year low of \$1,400. With Asian buyers taking advantage of the low price to rebuild inventories, rhodium flatlined thereafter as buying interest was met by the weight of selling in Europe and North America.

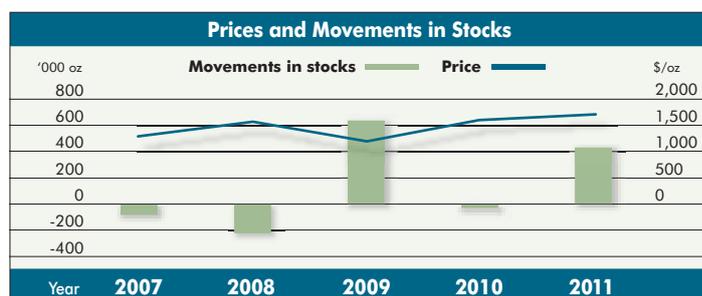
**Ruthenium** shed \$70 (39%) of its value to reach a two-year low of \$110 by the end of 2011. Between **January** and early **August**, the market was adequately supplied as selling was met by a steady stream of buying, and the price remained at the Johnson Matthey Base Price of \$180. In the months following, a softening of industrial purchasing led the price to drift downwards.

**Iridium** gained \$305 (39%) between the beginning and end of 2011, reaching record highs in excess of \$1,000. The price marched rapidly upwards in **January** and **February**: from an opening Johnson Matthey Base Price of \$780, iridium traded ever higher on the back of strong demand from the electrical and electrochemical sectors, in particular for iridium crucibles used to grow single crystal sapphire for LEDs. With a surfeit of buyers in a thin market, the price surged to a new high of \$1,075 by 22nd February. The price softened slightly to \$1,050 in **March** and remained at this level until **September**, with demand for a range of applications matched by adequate supply to the market. In September, the price began to rise again on the back of renewed industrial demand. Although demand for crucibles was relatively stable due to higher prices, purchasing of iridium for electrical and electrochemical applications helped drive the price to the new record level of \$1,085 on 21st September. At this level, iridium held its ground for the remainder of the year supported by strong industrial buying, and unperturbed by the broad liquidations elsewhere in the pgm markets.



# SUPPLY AND DEMAND TABLES

Platinum Supply and Demand							
		'000 oz	2007	2008	2009	2010	2011
<b>Supply<sup>1</sup></b>	South Africa		5,070	4,515	4,635	4,635	4,855
	Russia <sup>2</sup>		915	805	785	825	835
	North America		325	325	260	200	350
	Zimbabwe <sup>3</sup>		170	180	230	280	340
	Others <sup>3</sup>		120	115	115	110	100
<b>Total Supply</b>			<b>6,600</b>	<b>5,940</b>	<b>6,025</b>	<b>6,050</b>	<b>6,480</b>
<b>Gross Demand by Application<sup>4</sup></b>	Autocatalyst <sup>4</sup>		4,145	3,655	2,185	3,075	3,105
	Chemical		420	400	290	440	470
	Electrical <sup>4</sup>		255	230	190	230	230
	Glass		470	315	10	385	555
	Investment		170	555	660	655	460
	Jewellery <sup>4</sup>		2,110	2,060	2,810	2,420	2,480
	Medical & Biomedical <sup>5</sup>		230	245	250	230	230
	Petroleum		205	240	210	170	210
	Other <sup>5</sup>		265	290	190	300	355
	<b>Total Gross Demand</b>			<b>8,270</b>	<b>7,990</b>	<b>6,795</b>	<b>7,905</b>
<b>Recycling<sup>6</sup></b>	Autocatalyst		(935)	(1,130)	(830)	(1,085)	(1,225)
	Electrical		0	(5)	(10)	(10)	(10)
	Jewellery		(655)	(695)	(565)	(735)	(810)
<b>Total Recycling</b>			<b>(1,590)</b>	<b>(1,830)</b>	<b>(1,405)</b>	<b>(1,830)</b>	<b>(2,045)</b>
<b>Total Net Demand<sup>7</sup></b>			<b>6,680</b>	<b>6,160</b>	<b>5,390</b>	<b>6,075</b>	<b>6,050</b>
<b>Movements in Stocks<sup>8</sup></b>			<b>(80)</b>	<b>(220)</b>	<b>635</b>	<b>(25)</b>	<b>430</b>



Average Price (US\$ per oz) <sup>9</sup>				
2007	2008	2009	2010	2011
1,304	1,576	1,205	1,611	1,721

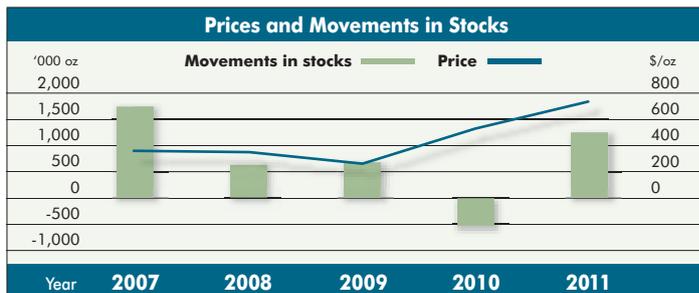
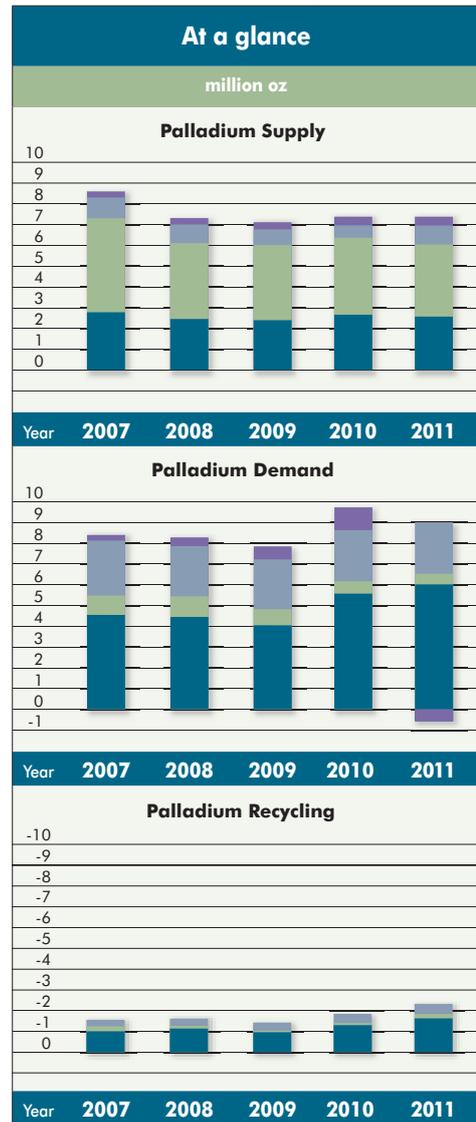
## Gross Platinum Demand by Region

		'000 oz	2007	2008	2009	2010	2011
Europe	Autocatalyst		2,055	1,970	970	1,495	1,465
	Chemical		110	105	70	110	120
	Electrical		15	20	20	15	20
	Glass		15	(25)	5	10	30
	Investment		195	105	385	140	155
	Jewellery		200	205	185	175	175
	Medical & Biomedical		110	115	115	90	90
	Petroleum		25	30	25	20	35
	Other		75	85	55	100	105
	<b>Total</b>		<b>2,800</b>	<b>2,610</b>	<b>1,830</b>	<b>2,155</b>	<b>2,195</b>
Japan	Autocatalyst		610	610	395	550	500
	Chemical		55	55	45	50	30
	Electrical		35	35	30	30	25
	Glass		85	65	40	90	140
	Investment		(60)	385	160	45	250
	Jewellery		540	530	335	325	315
	Medical & Biomedical		15	20	20	20	20
	Petroleum		5	10	10	5	5
	Other		30	25	15	40	45
	<b>Total</b>		<b>1,315</b>	<b>1,735</b>	<b>1,050</b>	<b>1,155</b>	<b>1,330</b>
North America	Autocatalyst		850	505	370	405	380
	Chemical		95	95	65	100	95
	Electrical		55	30	25	25	25
	Glass		25	(5)	(35)	10	(5)
	Investment		30	60	105	465	10
	Jewellery		225	200	135	175	185
	Medical & Biomedical		80	85	90	90	90
	Petroleum		30	25	15	25	50
	Other		135	150	90	105	130
	<b>Total</b>		<b>1,525</b>	<b>1,145</b>	<b>860</b>	<b>1,400</b>	<b>960</b>
China	Autocatalyst		175	145	85	100	110
	Chemical		70	60	40	80	105
	Electrical		20	30	20	30	30
	Glass		180	85	(90)	130	40
	Investment		0	0	0	0	0
	Jewellery		1,070	1,060	2,080	1,650	1,680
	Medical & Biomedical		10	10	10	10	10
	Petroleum		10	10	10	15	15
	Other		5	10	10	25	30
	<b>Total</b>		<b>1,540</b>	<b>1,410</b>	<b>2,165</b>	<b>2,040</b>	<b>2,020</b>
Rest of the World	Autocatalyst		455	425	365	525	650
	Chemical		90	85	70	100	120
	Electrical		130	115	95	130	130
	Glass		165	195	90	145	350
	Investment		5	5	10	5	45
	Jewellery		75	65	75	95	125
	Medical & Biomedical		15	15	15	20	20
	Petroleum		135	165	150	105	105
	Other		20	20	20	30	45
	<b>Total</b>		<b>1,090</b>	<b>1,090</b>	<b>890</b>	<b>1,155</b>	<b>1,590</b>
<b>Total Gross Demand</b>		<b>8,270</b>	<b>7,990</b>	<b>6,795</b>	<b>7,905</b>	<b>8,095</b>	

## At a glance

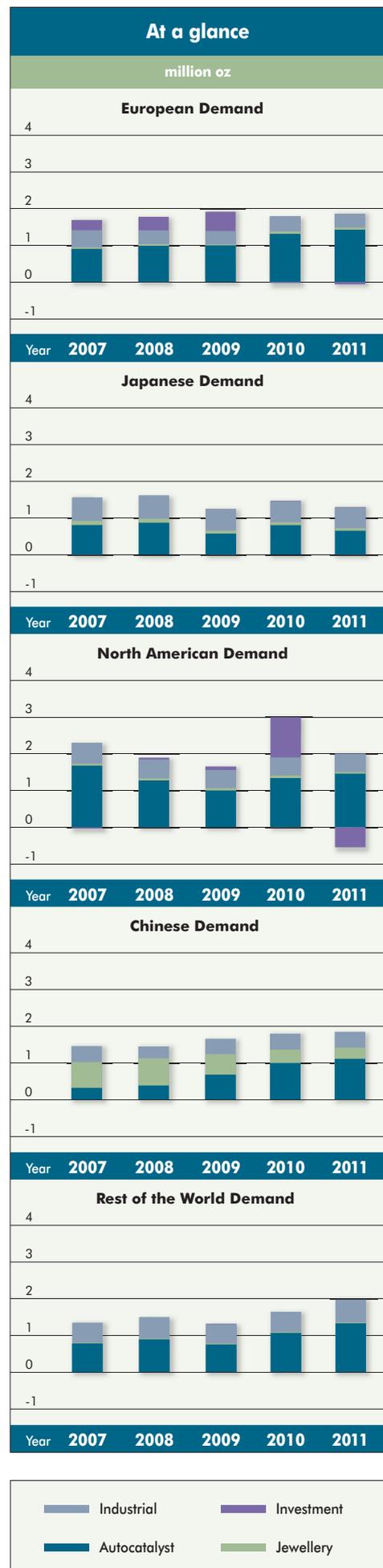


Palladium Supply and Demand							
		'000 oz	2007	2008	2009	2010	2011
Supply <sup>1</sup>	South Africa		2,765	2,430	2,370	2,640	2,560
	Russia <sup>2</sup>						
	Primary		3,050	2,700	2,675	2,720	2,705
	Stock Sales		1,490	960	960	1,000	775
	North America		990	910	755	590	900
	Zimbabwe <sup>3</sup>		135	140	180	220	265
	Others <sup>3</sup>		150	170	160	185	155
	<b>Total Supply</b>		<b>8,580</b>	<b>7,310</b>	<b>7,100</b>	<b>7,355</b>	<b>7,360</b>
	Gross Demand by Application <sup>4</sup>	Autocatalyst <sup>4</sup>		4,545	4,465	4,050	5,580
Chemical			375	350	325	370	445
Dental			630	625	635	595	550
Electrical <sup>4</sup>			1,550	1,370	1,370	1,410	1,380
Investment			260	420	625	1,095	(565)
Jewellery <sup>4</sup>			950	985	775	595	505
Other			85	75	70	90	105
<b>Total Gross Demand</b>			<b>8,395</b>	<b>8,290</b>	<b>7,850</b>	<b>9,735</b>	<b>8,450</b>
Recycling <sup>6</sup>	Autocatalyst		(1,015)	(1,140)	(965)	(1,310)	(1,655)
	Electrical		(315)	(345)	(395)	(440)	(480)
	Jewellery		(235)	(130)	(70)	(100)	(210)
	<b>Total Recycling</b>		<b>(1,565)</b>	<b>(1,615)</b>	<b>(1,430)</b>	<b>(1,850)</b>	<b>(2,345)</b>
<b>Total Net Demand<sup>7</sup></b>		<b>6,830</b>	<b>6,675</b>	<b>6,420</b>	<b>7,885</b>	<b>6,105</b>	
<b>Movements in Stocks<sup>8</sup></b>		<b>1,750</b>	<b>635</b>	<b>680</b>	<b>(530)</b>	<b>1,255</b>	

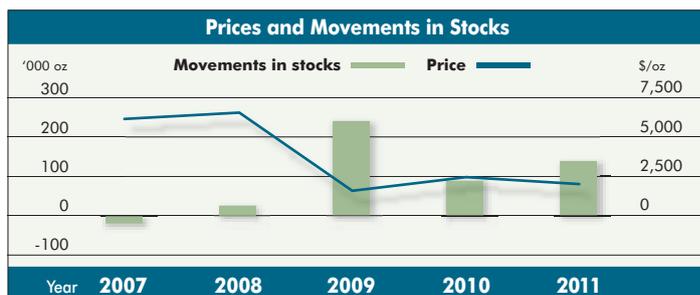
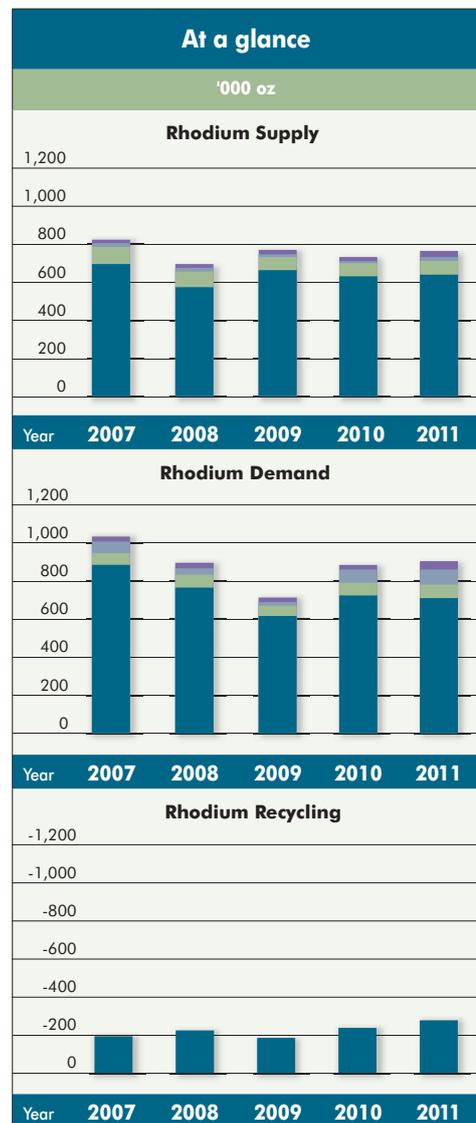


Average Price (US\$ per oz) <sup>9</sup>				
2007	2008	2009	2010	2011
355	352	264	526	733

Gross Palladium Demand by Region							
		'000 oz	2007	2008	2009	2010	2011
Europe	Autocatalyst		920	1,005	995	1,330	1,440
	Chemical		95	100	85	105	80
	Dental		70	65	65	80	80
	Electrical		280	190	195	195	185
	Investment		280	370	525	(5)	(35)
	Jewellery		40	45	50	65	60
	Other		20	20	20	30	30
	<b>Total</b>		<b>1,705</b>	<b>1,795</b>	<b>1,935</b>	<b>1,800</b>	<b>1,840</b>
Japan	Autocatalyst		820	885	590	820	665
	Chemical		25	20	20	20	20
	Dental		275	275	295	250	230
	Electrical		325	320	270	295	310
	Investment		0	0	0	10	5
	Jewellery		125	115	80	75	70
	Other		10	10	10	10	10
	<b>Total</b>		<b>1,580</b>	<b>1,625</b>	<b>1,265</b>	<b>1,480</b>	<b>1,310</b>
North America	Autocatalyst		1,695	1,290	1,020	1,355	1,475
	Chemical		75	55	50	65	80
	Dental		265	270	260	250	225
	Electrical		195	170	170	160	145
	Investment		(20)	50	95	1,090	(535)
	Jewellery		55	60	60	65	45
	Other		30	20	15	25	35
	<b>Total</b>		<b>2,295</b>	<b>1,915</b>	<b>1,670</b>	<b>3,010</b>	<b>1,470</b>
China	Autocatalyst		325	390	685	1,005	1,115
	Chemical		80	55	75	65	150
	Dental		5	0	0	0	0
	Electrical		340	255	335	360	270
	Investment		0	0	0	0	0
	Jewellery		705	740	560	360	305
	Other		10	10	10	10	10
	<b>Total</b>		<b>1,465</b>	<b>1,450</b>	<b>1,665</b>	<b>1,800</b>	<b>1,850</b>
Rest of the World	Autocatalyst		785	895	760	1,070	1,335
	Chemical		100	120	95	115	115
	Dental		15	15	15	15	15
	Electrical		410	435	400	400	470
	Investment		0	0	5	0	0
	Jewellery		25	25	25	30	25
	Other		15	15	15	15	20
	<b>Total</b>		<b>1,350</b>	<b>1,505</b>	<b>1,315</b>	<b>1,645</b>	<b>1,980</b>
<b>Total Gross Demand</b>		<b>8,395</b>	<b>8,290</b>	<b>7,850</b>	<b>9,735</b>	<b>8,450</b>	



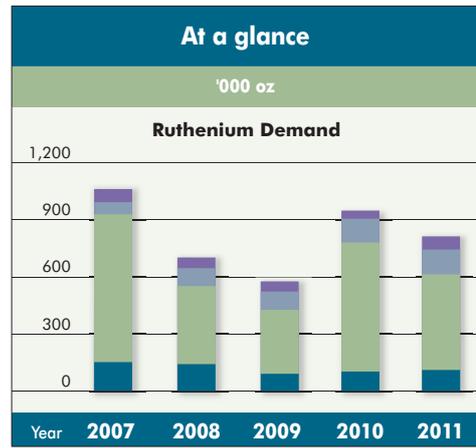
Rhodium Supply and Demand							
		'000 oz	2007	2008	2009	2010	2011
Supply <sup>1</sup>	South Africa		696	574	663	632	641
	Russia <sup>2</sup>		90	85	70	70	72
	North America		20	18	15	10	20
	Zimbabwe <sup>3</sup>		14	15	19	19	29
	Others <sup>3</sup>		4	3	3	3	3
<b>Total Supply</b>			<b>824</b>	<b>695</b>	<b>770</b>	<b>734</b>	<b>765</b>
Gross Demand by Application <sup>4</sup>	Autocatalyst <sup>4</sup>		887	768	619	727	712
	Chemical		63	68	54	67	72
	Electrical <sup>4</sup>		3	3	3	4	5
	Glass		59	34	19	68	78
	Other		24	24	21	21	39
<b>Total Gross Demand</b>			<b>1,036</b>	<b>897</b>	<b>716</b>	<b>887</b>	<b>906</b>
Recycling <sup>6</sup>	Autocatalyst		(192)	(227)	(187)	(241)	(280)
	<b>Total Recycling</b>		<b>(192)</b>	<b>(227)</b>	<b>(187)</b>	<b>(241)</b>	<b>(280)</b>
<b>Total Net Demand<sup>7</sup></b>			<b>844</b>	<b>670</b>	<b>529</b>	<b>646</b>	<b>626</b>
<b>Movements in Stocks<sup>8</sup></b>			<b>(20)</b>	<b>25</b>	<b>241</b>	<b>88</b>	<b>139</b>



**Average Price (US\$ per oz)<sup>9</sup>**

2007	2008	2009	2010	2011
6,191	6,564	1,592	2,458	2,022

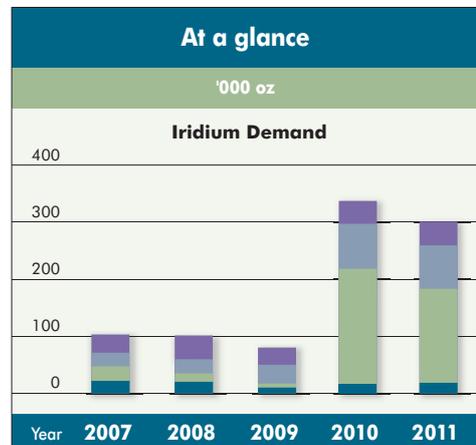
Ruthenium Demand							
		'000 oz	2007	2008	2009	2010	2011
Demand by Application	Chemical		151	139	89	100	109
	Electrical		776	410	336	679	502
	Electrochemical		62	95	95	124	130
	Other		69	55	54	42	68
<b>Total Demand</b>			<b>1,058</b>	<b>699</b>	<b>574</b>	<b>945</b>	<b>809</b>



**Average Price (US\$ per oz)<sup>9</sup>**

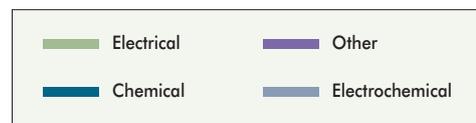
Year	2007	2008	2009	2010	2011
Average Price	580	323	95	197	166

Iridium Demand							
		'000 oz	2007	2008	2009	2010	2011
Demand by Application	Chemical		23	21	11	18	19
	Electrical		25	15	7	201	165
	Electrochemical		24	25	33	79	76
	Other		32	41	30	40	41
<b>Total Demand</b>			<b>104</b>	<b>102</b>	<b>81</b>	<b>338</b>	<b>301</b>



**Average Price (US\$ per oz)<sup>9</sup>**

Year	2007	2008	2009	2010	2011
Average Price	447	450	425	642	1,036



## NOTES TO TABLES

<sup>1</sup>**Supply** figures represent estimates of sales by the mines of primary pgm and are allocated to where the initial mining took place rather than the location of refining. Additionally, we continue to report sales of metal which we believe has not previously been priced, principally sales of Russian state stocks, as supplies.

<sup>2</sup>Our **Russian supply** figures represent the total pgm sold in all regions, including Russia and the ex-CIS. Demand in Russia and the ex-CIS states is included in the Rest of the World region. **Russian supply** figures for palladium have been split into sales from primary mining and sales of stocks.

<sup>3</sup>Supplies from **Zimbabwe** have been split from **Others' supplies**. Platinum group metals mined in Zimbabwe are currently refined in South Africa, and our supply figures represent shipments of pgm in concentrate or matte, adjusted for typical refining recoveries.

<sup>4</sup>**Gross demand** figures for any given application represent the sum of manufacturer demand for metal in that application and any changes in unrefined metal stocks in that sector. Increases in unrefined stocks lead to additional demand, reductions in stock lead to a lower demand figure.

<sup>5</sup>Our **Medical and Biomedical** category represents combined metal demand in the medical, biomedical and dental sectors.

<sup>6</sup>**Recycling** figures represent estimates of the quantity of metal recovered from open loop recycling (i.e. where the original purchaser does not retain control of the metal throughout). For instance, autocatalyst recycling represents the weight of metal recovered from end-of-life vehicles and aftermarket scrap in an individual region, allocated to where the car is scrapped rather than where the metal is finally recovered. These figures do not include warranty or production scrap. Where no recycling figures are given, open loop recycling is negligible. In our recycling charts, we label recovery of electrical scrap as 'industrial' recycling.

<sup>7</sup>**Net demand** figures are equivalent to the sum of gross demand in an application less any metal recovery from open loop scrap in that application, whether the recycled metal is reused in that industry or sold into another application. Where no recycling figure is given for an application, gross and net demand are identical.

<sup>8</sup>**Movements in stocks** in any given year reflect changes in stocks held by fabricators, dealers, banks and depositories but excluding stocks held by primary refiners and final consumers. A positive figure (sometimes referred to as a 'surplus') reflects an increase in market stocks. A negative value (or 'deficit') indicates a decrease in market stocks.

<sup>9</sup>**Average price** figures for platinum and palladium are the mean of all daily fixing values in a given year. Average price figures for rhodium, ruthenium and iridium are based on Johnson Matthey European Base Prices.

## GLOSSARY

ASC	Ammonia Slip Catalyst	pgm	Platinum Group Metal(s)
CAD	China Africa Development	Platreef	A platiniferous ore body in South Africa
CIS	Commonwealth of Independent States	PM	Particulate Matter
CO	Carbon Monoxide	ppm	Parts Per Million
CO <sub>2</sub>	Carbon Dioxide	ppt	Parts Per Thousand
DOC	Diesel Oxidation Catalyst	PTA	Purified Terephthalic Acid
DPF	Diesel Particulate Filter	SCR	Selective Catalytic Reduction
EGR	Exhaust Gas Recirculation	SGE	Shanghai Gold Exchange
ELV	End-of-Life Vehicle	SO <sub>x</sub>	Oxides of Sulphur
ETF	Exchange Traded Fund	SUV	Sports Utility Vehicle
g	Gram	TOCOM	Tokyo Commodity Exchange
GDP	Gross Domestic Product	tonne	1,000 kg
HC	Hydrocarbons	TWC	Three-Way Catalyst
JV	Joint Venture	UG2	A platiniferous ore body in South Africa
kg	Kilograms	VAM	Vinyl Acetate Monomer
LCD	Liquid Crystal Display		
LED	Light-Emitting Diode		
Merensky	A platiniferous ore body in South Africa		
MLCC	Multi-Layer Ceramic Capacitor		
NO <sub>x</sub>	Oxides of Nitrogen		
NUM	National Union of Mineworkers		
NYMEX	New York Mercantile Exchange		
OLED	Organic Light-Emitting Diode		
oz	Ounces Troy		
PET	Polyethylene Terephthalate		

### NOTE ON PRICES

All prices are quoted per oz unless otherwise stated.

R	South African Rand
£	UK Pound
\$	US Dollar
¥	Japanese Yen
€	Euro
RMB	Chinese Renminbi

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