Global Autocatalyst Demand for Platinum and Palladium by Vehicle Type

Palladium

- Gross demand for palladium in the autocatalyst sector is forecast to grow by 7% this year and reach a record high of 6.48 million ounces. Use of palladium in exhaust aftertreatment is set to benefit from an acceleration of growth in vehicle production. Most of this growth will come from higher numbers of gasoline vehicles being manufactured for sale in the USA, Japan and China where palladium makes up the largest share of pgm in aftertreatment systems. Continuing substitution of platinum with palladium in both light and heavy duty diesel systems is anticipated to result in further demand growth in 2012.

- A return of positive investor sentiment is forecast to result in net physical palladium investment demand of 385,000 oz in 2012, compared with negative net investment demand last year.

- We anticipate softer industrial demand overall due to substitution in the electrical sector. Gross palladium jewellery demand is also set to decline.

- We forecast a 15% increase in palladium purchasing in the Japanese automotive sector this year, to 765,000 oz, as output of vehicles, driven by resurgent domestic demand, rebounds strongly from the disruption of 2011.

- In the first eight months of 2012, passenger car production in Japan increased by 42% year-on-year, to just under 6 million vehicles, with the strongest growth seen in the smallest vehicle category, that of mini-vehicles. Domestic sales of passenger cars grew by 50% year-on-year, also with the greatest increase in the mini-vehicle category. Sales of these small cars were boosted by a government subsidy for eco-friendly vehicles as part of a scheme that has now ended.

- The use of palladium in gasoline aftertreatment is well established. Palladium is now making inroads in diesel emissions control.
The number of Japan-made vehicles which are exported suffered a sharp drop in the first half of last year following the Great East Japan Earthquake. In January to August 2012 the volume of exports rose by 24% year-on-year as manufacturers fulfilled orders delayed from 2011, with higher shipments to all regions apart from Europe. Exports to the biggest overseas market, North America, grew by over 40% to around 1.3 million vehicles in the first eight months. With an overwhelmingly gasoline vehicle fleet in Japan, and the majority of exports also going to gasoline markets, higher output strongly favoured growth in palladium demand.

### North America

A combination of pent-up demand following the recession, cheap credit and gradually improving economic conditions is expected to drive rising consumer demand for light duty vehicles in North America this year. Propelled by these factors, US car sales in the first half of 2012 reached a four-year high of over 7 million units.

Light vehicle production is forecast to grow by 14% to 12.1 million units. This remarkable rise is set to be more than twice the pace that car production is increasing in China, until recently the world’s fastest-growing auto market. We predict an associated rise in palladium demand in North America this year of 14% to a new level of 1.68 million ounces.

In the first half of 2012, a strong performance by Detroit’s big three and the recovery of automotive production at Japanese plants in North America helped raise purchasing of palladium. With new fuel economy and emissions standards on the horizon, automakers’ efforts continued to be focused on developing smaller, more powerful engines and optimising catalyst systems. For gasoline vehicles, this has generally meant thrifting palladium although the effect of this will be offset by rises in production volumes this year. In the diesel sector, there has been further substitution of platinum by palladium, adding to palladium demand.

### China

Prospects for a return to double-digit increases in vehicle production this year have been muted as a result of expectations of lower GDP growth and continuing efforts in some provinces to limit new car sales. Light duty vehicle production in China is forecast to grow at 6% in 2012 to 16.9 million units for the year as a whole. This represents an acceleration on the anaemic rate seen in the previous year but is still considerably below the growth seen in the years prior to 2011.

Following a poor first quarter of this year, new passenger car production accelerated year-on-year in the period May through to August, growing 5% overall on a cumulative basis for the first eight months of the year. Joint venture manufacturers continued to do brisk business in China, particularly in sales of medium-sized and large cars, which tend to have higher catalyst loadings, while domestic brands and smaller vehicles sold less well.

Palladium demand is forecast to be augmented by the anticipated introduction of Euro 5 equivalent emissions legislation (China 5) in Beijing during 2012, although the standard remains to be finalised. Many automakers now supply Euro 5-compliant gasoline models to the Beijing area. The catalysts on these vehicles contain an estimated 10-20% more pgm than those intended to meet China 4 regulations. The Chinese government has not yet confirmed a date for the nationwide implementation of China 5 and cars sold outside of Beijing still use China 4 aftertreatment systems.
PALLADIUM

2012 Interim Review

Palladium Demand: Industrial

\[ \text{Chemical} \quad 370 \quad 445 \quad 530 \\
\text{Dental} \quad 595 \quad 545 \quad 540 \\
\text{Electrical} \quad 1,410 \quad 1,380 \quad 1,210 \\
\text{Other} \quad 90 \quad 95 \quad 130 \\
\text{Total} \quad 2,465 \quad 2,480 \quad 2,410 \]

Palladium Demand: Jewellery

<table>
<thead>
<tr>
<th></th>
<th>Gross¹</th>
<th>Recycling²</th>
<th>Net²</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
<td>2012</td>
<td>2011</td>
</tr>
<tr>
<td>Europe</td>
<td>60</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>Japan</td>
<td>70</td>
<td>70</td>
<td>(20)</td>
</tr>
<tr>
<td>North America</td>
<td>45</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>China</td>
<td>305</td>
<td>240</td>
<td>(190)</td>
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<tr>
<td>Rest of the World</td>
<td>25</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>505</td>
<td>450</td>
<td>(210)</td>
</tr>
</tbody>
</table>

Rest of the World

Another strong year for vehicle production in Mexico, where vehicles are mainly built for the US market, is forecast to result in higher demand for palladium in both gasoline and diesel emissions control. Confounding expectations of a dip in production following the end of the scrappage scheme in 2011, the Russian car industry looks set for another splendid year. Registrations of new vehicles were higher in each of the first eight months of this year compared with 2011, and locally-produced vehicles dominated the top-selling models. In this mainly gasoline market, palladium demand is predicted to rise in response, helping raise demand in the Rest of the World region as a whole by 30,000 oz to 1.37 million ounces.

JEWELLERY

Gross palladium jewellery demand is forecast to dampen by 11% this year to 450,000 oz. Once again, this is expected to be mainly the result of lower purchasing by the jewellery trade in China, where palladium continues to suffer generally from a lack of positioning and effective marketing, as well as increasing competition from alternatives at similar price points.

China

We forecast another decline in gross palladium jewellery demand in China this year, of 21% to 240,000 oz, with most of the purchasing that remains being for the manufacture of plain jewellery. The number of palladium jewellery manufacturers in China continues to decline, with even those remaining in the business reducing their output in response to weak retail pull. The RMB price was on average 18% lower in the first three quarters compared with the same period last year. With concerns that palladium jewellery pieces may not hold their value when traded in, consumers have been reluctant to purchase the metal. In addition, a continued lack of effective marketing means that awareness of palladium remains fairly limited overall.

Despite new sales being constrained by a low exchange value, this has not prevented consumers returning old palladium jewellery, thus increasing palladium jewellery recycling as a share of gross demand. For more information, please see the Recycling chapter on page 18.

Other Regions

Hallmarking of UK-made palladium jewellery items increased by 13% in the first three quarters of 2012 – largely as a result of the increasing popularity of the metal in the men’s wedding band market, where it is competitively priced against white gold and has been introduced across a number of jewellery lines. Growth of palladium in the UK jewellery sector was augmented by an increase in use of the palladium-500 alloy, which saw a near-three-fold rise in British-made pieces stamped, to over 13,000 items in the first nine months. In the European market as a whole, we anticipate a modest increase in purchasing of palladium by the jewellery trade, by 10,000 oz to 70,000 oz.

In North America, demand for palladium jewellery is set to remain quiet. Palladium’s current positioning against base metals makes it relatively expensive in the eyes of many consumers, although a trade and consumer marketing campaign continues to raise palladium’s profile. Some mass market chain stores have begun to order palladium pieces to broaden their range of lower cost precious metals in the bridal segment.

The Japanese market, where palladium is mainly used as a whitening agent in white gold alloys as well as in platinum jewellery alloys, is expected to be flat this year at 70,000 oz. There is limited appetite for plain palladium jewellery, with only a small number of companies currently offering pieces in the metal.
INDUSTRIAL

Despite higher purchasing in the chemical sector and in the control of non-road emissions, softer sales to electrical applications are forecast to dampen industrial demand for palladium by 70,000 oz (3%) to 2.41 million ounces in 2012.

Demand for palladium in the chemical sector is expected to show a 19% year-on-year increase to 530,000 oz, a record high, on the back of strong growth in China. The opening of new chemical plants in that country, as well as the expansion of several others, is driving purchasing of palladium for catalysts used in the production of purified terephthalic acid (PTA) and vinyl acetate monomer (VAM). Production of these bulk chemicals is expanding rapidly to satisfy booming demand for consumer products including textiles (made from PTA) and coatings and adhesives (made using VAM) in China and elsewhere in Asia. Purchasing of palladium for use in nitric acid catchment gauze is forecast to remain steady in 2012. The production of hydrogen peroxide, used mainly in the paper and pulp industry but with growing demand in water treatment and disinfection, also continued to support palladium demand.

In electrical applications, we forecast that palladium demand will decline this year by 12% to 1.21 million ounces. The use of palladium in multi-layered ceramic capacitors (MLCCs) destined for mass-market electronics has been declining for several years due to competition from cheaper base metal alternatives. This has broadly offset growth in the complexity of devices, which has meant that typically more MLCCs are required per consumer product. Palladium-based MLCCs continue to be used in high-end and niche applications where component reliability is key, however even in those markets palladium faces threats from technically improved nickel-based MLCCs, use of lower palladium content alloys on the basis of cost and the emergence of copper as a potential replacement material.

Demand for palladium in dental applications is expected to see another decline in 2012, weakening by 2% to 540,000 oz. Ceramic treatments continue to grow in popularity in dental restorations in developed markets for aesthetic reasons, leading to a decline in palladium use.

We forecast increased demand for palladium in non-road emissions control as a result of legislation-driven adoption of pgm aftertreatment for a range of construction and agricultural machinery in Europe, Japan and North America. Palladium is used alongside platinum in oxidation catalysts and filters designed for various non-road diesel engines.

INVESTMENT

We forecast a 950,000 oz swing in identifiable net physical investment demand for palladium as the market returns to net positive investment this year following heavy liquidation in 2011.

The palladium ETF market saw steady net investment in the first six months of the year as investors returned to the market following a steep sell-off in the fourth quarter of 2011. Total palladium ETF holdings continued to rise between late February and mid-May this year even as the price was on a downwards trend, in contrast to platinum holdings which fell generally along with the price during this time. The divergence of investor sentiment towards the two metals may be explained by the fundamental picture for palladium still looking strong, together with lower prices than in 2011 representing a buying opportunity. Cumulative investment volumes reached the highest since September 2011 in early June before experiencing light selling as the price fell towards a nine-month low in late July.

As pgm prices tracked upwards in response to supply disruptions in South Africa in the second half of August and into September, there was initially net investment. This soon gave way to a sell-off that took cumulative holdings back to their level of six months prior, of just over two million ounces, considerably down on the record level in early 2011 of more than 2.4 million ounces. The behaviour of investors in the palladium ETF market contrasted with that in platinum ETFs, which reached record holdings in September, perhaps reflecting investors seeking exposure to the upside brought about by disruption in South Africa.

On an individual fund basis, the two funds that were responsible for most of the net disinvestment in 2011, ETFS’ London and US funds, both saw net inflows in the first nine months of 2012. The US fund saw over 200,000 oz of net investment, in contrast with almost half a million ounces of liquidation last year.

<table>
<thead>
<tr>
<th>Palladium Demand: Investment</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>(5)</td>
<td>(35)</td>
<td>105</td>
</tr>
<tr>
<td>Japan</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>North America</td>
<td>1,090</td>
<td>(535)</td>
<td>280</td>
</tr>
<tr>
<td>China</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1,095</td>
<td>(565)</td>
<td>385</td>
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