

www.valcambi.com
www.tanaka.co.jp

© 2017 Thomson Reuters. All rights reserved. Reproduction or redistribution of Thomson Reuters content, including by framing or similar means, is prohibited without the prior written consent of Thomson Reuters. Thomson Reuters and the Kinesis logo are trademarks of Thomson Reuters.

THOMSON REUTERS

GFMS PLATINUM GROUP METALS SURVEY 2017



cover sponsors



THE GFMS TEAM AT THOMSON REUTERS GRATEFULLY ACKNOWLEDGES
THE GENEROUS SUPPORT FROM THE FOLLOWING COMPANIES FOR
THIS YEAR'S GFMS PLATINUM GROUP METALS SURVEY



TANAKA PRECIOUS METALS

A leading company in the field of precious metals,
With superior creativity and technical excellence,
We build customer trust through rapid responses that exceed expectation,
Contribute to the creation of a prosperous society,
As well as to the future of the planet through sustainable use of precious metals.

valcambi
suisse

Valcambi is a leader in precious metals refining and operates one of the world's largest and most efficient integrated precious metals plants situated on a 33 hectare site, at Balerna, Switzerland.

We are one of the world's largest manufacturers of minted ingots. Reacting to the demands of investors in different markets around the globe we are continuously carefully developing within the size range from 0.5 g to 1,000 g, gold, silver, platinum and palladium minted bars in different forms and new designs. For our clients, according to their wishes we customise individually obverse and reverse of the bars, certificates and tailored packaging solutions.

All products produced in our foundry and minting facilities are certified by our laboratory, carefully inspected by our operators, individually packed and controlled before shipment. The Hallmark is not only a guarantee for quality of Swiss workmanship, it guarantees also the fineness of the most sought after bars in the world, desired by precious metals connoisseurs and investors alike.

A Valcambi manufactured bar is not only sold at an outstanding price but is synonymous with unique craftsmanship, guaranteed fineness, transparency and reliability.



THOMSON REUTERS™

GFMS PLATINUM GROUP METALS SURVEY 2017

BY:

Rhona O'Connell, Head of Metals Research & Forecasts

Cameron Alexander, Manager

Ross Strachan, Manager

Bruce Alway, Manager

Sudheesh Nambiath, Lead Analyst

Johann Wiebe, Lead Analyst

Ling Wong, Senior Analyst

Erica Rannestad, Senior Analyst

Samson Li, Senior Analyst

Dante Aranda, Senior Analyst

Natalie Scott-Gray, Analyst

OTHER CONTRIBUTORS:

IFR Production, Thomson Reuters

Karen Norton, Senior Analyst

Wenyu Yao, Senior Analyst

Linda Zhang, Analyst

PUBLISHED MAY 2017 BY THOMSON REUTERS

The Thomson Reuters Building, 30 South Colonnade
London, E14 5EP, UK

E-mail: gfms@thomsonreuters.com

Web: financial.tr.com/eikon-metals

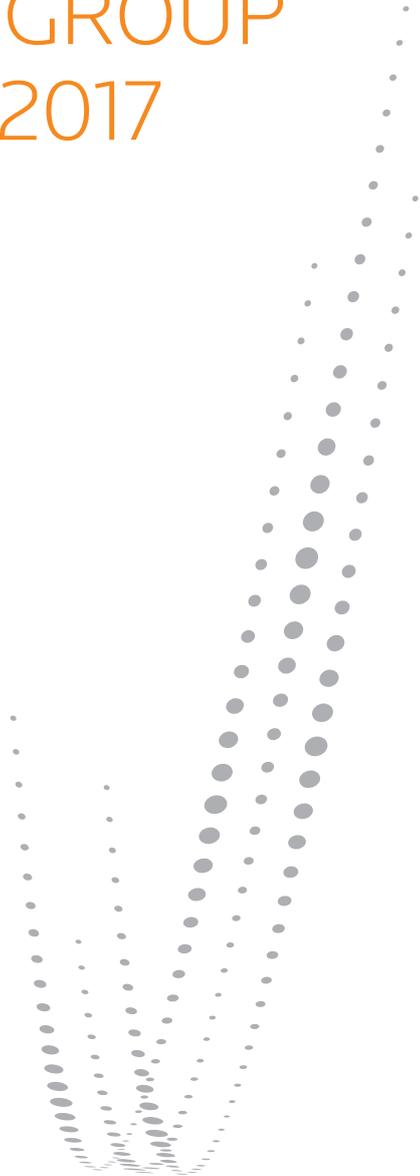


TABLE OF CONTENTS

1. Summary and Price Outlook	5
• Introduction 5 • Platinum in 2016 6 • Palladium in 2016 7 • Rhodium in 2016 8 • Outlook 9	
2. PGM Prices	10
• Platinum & Palladium 10 • Rhodium 11	
3. Investment	13
• Overview 13 • Commodity Exchanges 13 • Retail Investment 14	
4. Supply	17
• Mine Production 17 • Production Costs 21 • Autocatalyst Recycling 22	
• Jewellery Scrap Supply 24 • Above-Ground Bullion Stocks 24	
5. Demand	27
• Autocatalyst Demand 28 • Jewellery 35 • Dental 40 • Electronics 40	
• Glass 42 • Chemical 43 • Petroleum 44	
6. Appendices	46
• Appendix 1 - Platinum Supply and Demand (ounces)	
• Appendix 2 - Palladium Supply and Demand (ounces)	
• Appendix 3 - Platinum Supply and Demand (tonnes)	
• Appendix 4 - Palladium Supply and Demand (tonnes)	
• Appendix 5 - Rhodium Supply and Demand (ounces)	
• Appendix 6 - Rhodium Supply and Demand (tonnes)	
FOCUS BOXES	
• Ruthenium and Iridium Prices	11
• Platinum and Palladium Price Correlations	12
• Platinum, Palladium and Rhodium Exchange Traded Funds	15
• Uncovering Earnings Surprises in the PGM Sector using SMART Estimates	19
• Fuelling the Future	45

© THOMSON REUTERS 2017.

All content provided in this publication is owned by Thomson Reuters and/or its affiliates (the “Thomson Reuters Content”) and protected by United States and international copyright laws. Thomson Reuters retains all proprietary rights to the Thomson Reuters Content. The Thomson Reuters Content may not be reproduced, copied, manipulated, transmitted, distributed or otherwise exploited for any commercial purpose without the express written consent of Thomson Reuters. All rights are expressly reserved.

TRADEMARKS

“Thomson Reuters” and the Thomson Reuters logo are trademarks of Thomson Reuters and its affiliated companies. The third party trademarks, service marks, trade names and logos featured in this publication are owned by the relevant third parties or their affiliates. No use of such mark, names or logos is permitted without the express written consent of the owner.

DISCLAIMER OF WARRANTIES AND NO RELIANCE

This publication is provided by Thomson Reuters on an “as is” and “as available” basis. Thomson Reuters makes no representations or warranties of any kind, express or implied, as to the accuracy or completeness of the Thomson Reuters Content. Thomson Reuters is an aggregator and provider of information for general information purposes only and does not provide financial or other professional advice. Thomson Reuters is not responsible for any loss or damage resulting from any decisions made in reliance on the Thomson Reuters Content, including decisions relating to the sale and purchase of instruments, or risk management decisions.

ISSN: 2397-5784 (Print)

ISSN: 2397-5792 (Online)

THOMSON REUTERS SURVEYS

GFMS GOLD SURVEY 2017	31st March 2017
GFMS COPPER SURVEY 2017	5th April 2017
GFMS BASE METALS REVIEW AND OUTLOOK	10th May 2017
GFMS PLATINUM GROUP METALS SURVEY 2017	9th May 2017
WORLD SILVER SURVEY 2017	11th May 2017
GFMS GOLD SURVEY 2017: Q2 UPDATE AND OUTLOOK	July 2017
GFMS BASE METALS REVIEW AND OUTLOOK	30th October 2017
GFMS GOLD SURVEY 2017: Q3 UPDATE AND OUTLOOK	October 2017
GFMS GOLD SURVEY 2017: Q4 UPDATE AND OUTLOOK	January 2018

ACKNOWLEDGEMENTS

The estimates shown in *GFMS Platinum Group Metals Survey* for the main components of mine production, scrap, fabrication, investment and stock movements are calculated on the basis of a detailed supply/demand analysis for each of the markets listed in the main tables. In the vast majority of cases, the information used in these analyses has been derived from visits to the countries concerned and discussions with local traders, producers, refiners, fabricators and central bankers. Although we also make use of public domain data where this is relevant, it is the information provided by our contacts that ultimately make *GFMS Surveys* unique. We are grateful to all of them.

NOTES

UNITS USED:

troy ounce (oz) =	31.1035 grammes
tonne =	1 metric tonne, 32,151 troy ounces

- Unless otherwise stated, all statistics on supply and demand are expressed in terms of fine metal content.
- All references in this publication to “ounces” refer to troy ounces.
- Unless otherwise stated, US dollar prices and their equivalents are for the p.m. fixes of the London Platinum and Palladium Fixing Company Limited for prices prior to 1st December 2014 and the p.m. LBMA Platinum Price and LBMA Palladium Price from 1st December onwards and the Johnson Matthey London a.m. Rhodium Price.
- Throughout the tables, totals may not add due to independent rounding.

TERMINOLOGY:

“-”	Not available or not applicable.
“0.0”	Zero or less than 0.05.
“dollar”, “\$”	U.S. dollar unless otherwise stated.
“3PGM”	Platinum, palladium & rhodium
“4E”	Four elements: platinum, palladium, rhodium and gold (3PGM+Au).
“6E”	Six elements: 4E plus iridium and ruthenium (5PGM+Au).

Estimates of **supply** include mine production and the recycling both of scrapped autocatalysts and old jewellery, but exclude contributions from above-ground stocks, such as supplies from stocks controlled by state institutions in Russia. **Demand** estimates are net of recycling with the exception of autocatalyst and jewellery, where gross demand is shown - i.e. the total amount of metal absorbed to these two sectors. Estimates of recycling from scrapped autocatalysts and jewellery are shown separately as part of supply given their scale and potential for change. Estimates of demand exclude the movements of any above-ground stocks held within the specified industries, for example any changes in stocks held by the automotive industry.

By simple arithmetic, this leaves either a **“Physical Surplus or Deficit”** (in previous publications “Gross Surplus or Deficit”) before any movements in above-ground stocks are considered. This is a critical measure of the underlying fundamentals of platinum and palladium and indicates the extent to which fabrication demand may have depended on the release of above-ground stocks, or otherwise. At the same time, this also indicates the change in global above-ground stocks.

Unless otherwise stated, all references to **“above-ground stocks”** of platinum and palladium refer to stocks of refined metal, of a form and quality accepted as good delivery in the London and Zurich market and the world’s principal commodity exchanges. Our supply/demand tables also show **“Estimated Movements in Stocks”**. These specific movements relate only to above-ground stock holdings for which reasonable estimates of movement can be made and attributed. A listing and breakdown of these appears in the more detailed tables in the Appendices section of this Survey.

Having allowed for the Estimated Movements in Stocks as defined above, the **“Net Balance”** (previously “Residual Surplus or Deficit”) is arrived at by deduction. A negative Net Balance implies the extent to which other **above-ground stocks**, including those held by financial institutions and/or investors, were released to meet fabrication demand. Conversely, positive Net Balance implies the extent to which these other **above-ground stock** holdings were augmented. However, this should not be construed as indicating the change in global above-ground stocks. For this, please refer to the reported Physical Surplus or Deficit.

1. SUMMARY AND OUTLOOK

INTRODUCTION

Last year was another tough one for many producers and investors in platinum, palladium and rhodium, as dollar denominated prices slid for the second successive year on an annual average basis. Indeed, on this basis, platinum stumbled below \$1,000/oz for the first time since 2005 as prices fell for the sixth year in a row which, when coupled with a thirteen year low for rhodium, meant dollar basket prices for PGMs were exceptionally low.

This poor price performance arguably flies in the face of deficits for these metals. However, the platinum market is arguably more accurately described as broadly balanced and the platinum price performance in key producer currency terms was far better than in dollars; for example in rand terms it rose 9% on an annual average basis and in roubles by 3%. Despite this, mine production of all PGMs, but particularly platinum dropped back, in no small part a function of limited capital expenditure in earlier years. Meanwhile, for palladium the decline

in the annual average masked a substantial intra-year improvement in prices, of 22%, a pattern which has continued so far in 2017.

Indeed, having averaged just over \$1,000/oz between 2007-2012 the gap between platinum and palladium has continued its relentless drop to less than \$200 at the time of writing. This superior performance for palladium is unsurprising given that 2016 marked another year of substantial deficit, this time of 1.2 Moz (37 t). This is underpinned by palladium autocatalyst demand growing robustly as sales in countries with a preference for palladium-based aftertreatment rose strongly, especially in China ahead of the tax increase on 1st January. In fact, the continued run of deficits led to indications that this was, at times, causing market tightness for palladium, to an extent that had not occurred in that market since early in this century. Contrastingly, platinum demand is struggling as diesel is under growing pressure from politicians and dropped below 50% of light vehicle sales last year in the crucial European market.

WORLD PLATINUM SUPPLY AND DEMAND

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	% Change
Supply											
Mine Production											
South Africa	5,075	4,676	4,603	4,750	4,740	4,182	4,368	3,220	4,522	4,305	-5%
Russia	917	830	793	785	818	803	741	687	721	711	1%
North America	324	342	294	238	389	338	337	397	365	396	9%
Others	267	309	358	411	457	472	565	552	550	634	15%
Total Mine Production	6,584	6,156	6,048	6,183	6,404	5,796	6,011	4,856	6,158	6,046	-2%
Autocatalyst Scrap	910	1,007	786	904	996	927	1,050	1,093	992	1,041	5%
Old Jewellery Scrap	560	966	496	522	606	512	491	516	546	574	5%
Total Supply	8,054	8,130	7,331	7,609	8,006	7,234	7,551	6,466	7,696	7,661	0%
Demand											
Autocatalysts	4,109	3,575	2,541	3,018	3,090	2,974	2,957	3,112	3,211	3,286	2%
Jewellery	2,061	1,847	2,678	2,201	2,388	2,585	2,656	2,558	2,466	2,176	-12%
Chemical	370	341	283	482	487	399	432	595	476	553	16%
Electronics	397	292	254	252	225	195	169	162	151	148	-2%
Glass	431	507	91	505	338	361	22	(74)	183	291	59%
Petroleum	150	191	163	168	144	126	107	122	96	117	22%
Other Industrial	472	456	431	494	559	621	649	700	681	741	9%
Retail Investment	23	452	313	95	312	282	136	141	582	540	-7%
Total Demand	8,013	7,662	6,755	7,215	7,542	7,543	7,128	7,317	7,846	7,853	0%
Physical Surplus/(Deficit)	41	468	576	394	464	(309)	423	(851)	(150)	(192)	
Stock Movements	(394)	(402)	281	(574)	(245)	(539)	(1,892)	1,082	210	55	
of which ETF Release/(Build)	(194)	(102)	(384)	(574)	(145)	(239)	(892)	(218)	260	5	
Net Balance	(353)	65	857	(181)	220	(848)	(1,469)	231	60	(137)	
LBMA PM Price (US\$/oz)	\$1,302.81	\$1,577.53	\$1,203.50	\$1,608.98	\$1,721.87	\$1,551.48	\$1,486.72	\$1,387.57	\$1,052.91	\$988.76	-6%

Source: GFMS, Thomson Reuters; LBMA

PLATINUM IN 2016

One quirk for 2016 is that total supply and total demand for platinum were barely changed, leaving the market broadly balanced. However this masks major changes as mine supply declines were offset by rising flows of both jewellery and autocatalyst scrap. Meanwhile, demand rose for industrial applications, which was offset by a slump in offtake from the jewellery sector.

Platinum **mine production** fell moderately in 2016, by 2%, to stand at 6.05 Moz (188 t) driven by lower production from South Africa's five largest operations. Few mines escaped disruptions to production. Stoppages, mine suspensions, and stringent capital allocation in light of no recovery in metal prices, were behind much of the drop. As detailed on page 21, the closure of high cost shafts and rand weakness pushed costs down by 9% on a Total Production Cost basis, while increasing the peer group's EBIT by 104% to \$1,009 M, year-on-year. The drop in costs placed 30% of production under water, down from 33% in 2015.

Global platinum jewellery **scrap** edged 5% higher in 2016 to an estimated 0.57 Moz (17.9 t) despite a 6% decline

in the dollar denominated platinum price. The modest increase, the third in succession, was entirely the result of a 15% jump in Chinese collections, to an all time high, as slow moving stock was returned for remelt. Elsewhere, lower platinum prices accounted for the drop in scrap supply with sizeable falls in Japan and North America.

Autocatalyst scrap also rose, by 5% in 2016, reversing half of the prior year's losses to reach 1.04 Moz (32.4 t). The increase was fuelled by higher returns from Europe, aided by a recovery in the total recyclable value of vehicles, and emerging markets.

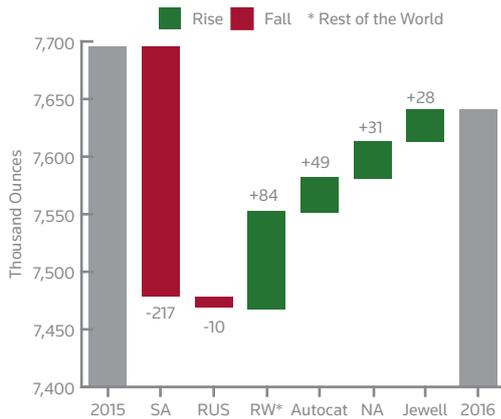
Turning to demand, platinum consumption in **autocatalyst applications** rose by 2% to 3.3 Moz (102.2 t) last year, less than half the pace of palladium demand growth. This increase was due to higher offtake in Europe and emerging markets, which was partially offset by lower demand in North America and Japan. Rising offtake in Europe might seem surprising given that this was the first full year following the VW scandal and diesel is losing market share. However, overall sales grew strongly and diesel production was higher in 2016, as were loadings to meet the Euro 6b legislation which applies to all vehicles from September last year.

WORLD PALLADIUM SUPPLY AND DEMAND

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	% Change
Supply											
Mine Production											
South Africa	2,677	2,365	2,481	2,646	2,686	2,391	2,432	2,008	2,653	2,470	-7%
Russia	3,049	2,701	2,677	2,722	2,704	2,624	2,527	2,582	2,575	2,526	-2%
North America	995	908	688	726	959	953	934	978	925	932	1%
Others	329	407	475	518	512	528	575	568	561	635	13%
Total Mine Production	7,050	6,381	6,321	6,612	6,861	6,497	6,468	6,136	6,713	6,563	-2%
Autocatalyst Scrap	957	1,200	1,077	1,307	1,514	1,472	1,587	1,813	1,604	1,719	7%
Old Jewellery Scrap	185	192	116	179	248	223	230	248	266	275	3%
Total Supply	8,192	7,772	7,515	8,098	8,623	8,191	8,286	8,197	8,584	8,557	0%
Demand											
Autocatalysts	4,797	4,489	4,032	5,303	5,594	6,188	6,376	6,647	6,991	7,360	5%
Jewellery	1,281	1,295	1,110	797	674	595	525	478	345	299	-13%
Dental	615	620	602	590	567	546	511	475	449	426	-5%
Chemical	388	372	304	367	382	378	410	396	395	435	10%
Electronics	1,275	1,347	1,240	1,451	1,487	1,500	1,378	1,358	1,200	1,080	-10%
Other Industrial	91	91	84	101	103	110	110	117	116	113	-3%
Retail Investment	45	94	170	80	61	37	38	45	45	45	0%
Total Demand	8,491	8,309	7,543	8,689	8,868	9,354	9,349	9,515	9,540	9,757	2%
Physical Surplus/(Deficit)	(300)	(537)	(28)	(591)	(245)	(1,162)	(1,063)	(1,318)	(956)	(1,200)	
Stock Movements	620	899	593	(289)	1,282	(148)	(300)	(299)	577	527	
of which ETF Release/(Build)	(280)	(381)	(507)	(1,089)	532	(448)	(0)	(899)	727	637	
Net Balance	320	362	566	(880)	1,037	(1,311)	(1,363)	(1,616)	(379)	(673)	
LBMA PM Price (US\$/oz)	\$354.78	\$352.25	\$263.22	\$525.24	\$733.63	\$643.19	\$725.06	\$803.23	\$691.63	\$613.72	-11%

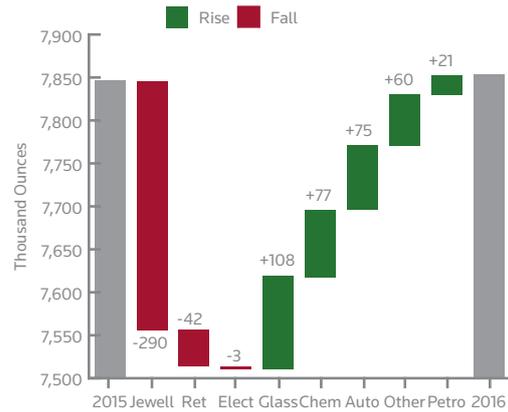
Source: GFMS, Thomson Reuters; LBMA

WORLD PLATINUM SUPPLY



Source: GFMS, Thomson Reuters

WORLD PLATINUM DEMAND



Source: GFMS, Thomson Reuters

Platinum **jewellery** demand declined by 12% in 2016 to reach 2.18 Moz (67.7 t). China accounted for the bulk of this loss, hindered by a softer economy and a market share loss to yellow 18-carat jewellery. Elsewhere, fabrication demand in North America was also dragged lower by a lack of promotion and the high cost of jewellery when platinum was trading at a steep discount to gold. Japanese demand held up well, declining only at the margin, while European offtake was also impacted by a lack of promotional activity.

Turning to **industrial demand**, growth was recorded in most industry segments in 2016 with a combined increase of 17% year-on-year. The most pronounced gains were recorded from the **glass** and **petroleum** sectors which rebounded 59% and 22% respectively, the former boosted by new manufacturing capacity built in China. Moreover, **chemical** and the **other industrial** sectors also enjoyed a healthy rise, with the former benefiting from a recovery in capacity expansions in paraxlyene (PX). The only outlier last year was electronics demand which eased 2% in part due to a drop in global PC demand.

Lower prices and a lack of expectation last year impacted **retail investment** which contracted by 7% on the 2015 record level to an estimated 0.54 Moz (16.8 t). While remaining at historically high levels a hefty fall from Japan accounted for the bulk of the decline. Elsewhere, the release of a platinum coin in Austria boosted the European number while North America was also stronger, jumping to a four-year high.

PALLADIUM IN 2016

Palladium's **Physical Deficit** grew by a quarter in 2016 to 1.20 Moz (37.3 t). Adjusting for stock movements (from ETF redemptions), the **Net Balance** rose to a deficit of 0.67 Moz (20.9 t).

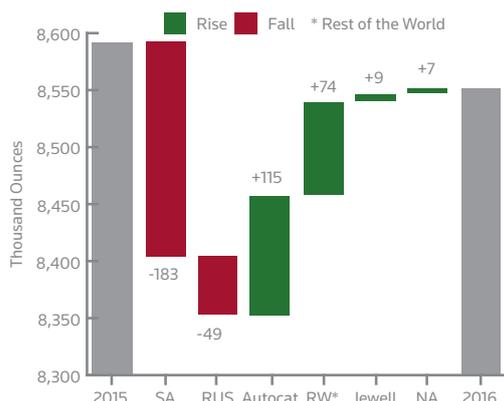
Mine production of palladium contracted by 2% to total 6.57 Moz (204 t) last year as output fell in South Africa, Russia, and Canada, but was supported by the ramp-up of operations in Zimbabwe and the United States. The closure of high cost shafts in South Africa, processing constraints in Russia, and lower grades in Canada echoed some of the challenges faced by these countries in 2012. At the asset level, the largest decrease was registered at Norilsk's Russian operation, while the largest increase was posted at Ngezi in Zimbabwe, lifting the country's supply by 20% year-on-year.

Almost exactly offsetting the decline in mine production was an increase in scrap flows, from both autocatalysts and jewellery. **Autocatalyst scrap** supply rose by 7% in 2016 to 1.72 Moz (53.5 t) to the second highest level recorded. The increased receipts occurred in all regions with the developed world flows that had been postponed in 2015 finally starting to recover in line with stronger steel and palladium prices.

The recycling of old palladium **jewellery scrap** edged 3% higher in 2016 to 0.27 Moz (8.6 t), an historic high. The ongoing remelt of old jewellery inventory in China accounted for the bulk of the rise. European recycling was also marginally higher due in part to higher prices in sterling terms, which boosted recovery in the UK.

Palladium demand in **autocatalyst applications** reached 7.36 Moz (228.9 t) last year, the fifth successive all-time high, and an annual increase of 5%. The key factor underpinning this strong growth was the robust pace of both global gasoline production and sales. This was driven by tax breaks in China and increased market share for gasoline in Europe, and to a lesser extent an improving economy there. The 18% increase in Chinese offtake in this sector saw it overtake Europe to top spot for the first time.

WORLD PALLADIUM SUPPLY



Source: GFMS, Thomson Reuters

WORLD PALLADIUM DEMAND



Source: GFMS, Thomson Reuters

Demand for palladium in **industrial applications** was broadly weaker, with total combined offtake falling 7% to a 10-year low of 2.05 Moz (63.9 t). A double-digit percentage fall in **electronics** offtake due to economic pressures, combined with a 3% drop in the **other industrial** sector helped offset healthy gains in **chemical** and **petroleum** applications. Lower palladium prices failed to arrest the slide in dental offtake which declined by 6% in 2016 due to continued substitution losses.

Palladium **jewellery fabrication** declined in 2016 despite the 11% fall in the dollar price, retreating 13% to an estimated 0.30 Moz (9.3 t). Losses were again concentrated in China as the market there struggles for survival with a sole fabricator remaining, while elsewhere demand was subdued, retreating in all other key markets.

RHODIUM IN 2016

The rhodium market realised a surplus of almost 200,000 ounces last year, the largest annual surplus in our records and the fourth consecutive year of annual oversupply. At the same time, the average price hit its lowest level since 2003. Despite averaging 27% lower than in 2015, at \$693.50/oz, rhodium prices stabilised in 2016. Rhodium traded above \$800/oz in the fourth quarter of the year and prices have continued to strengthen in 2017, rising above \$1,000/oz in March for the first time since July 2015.

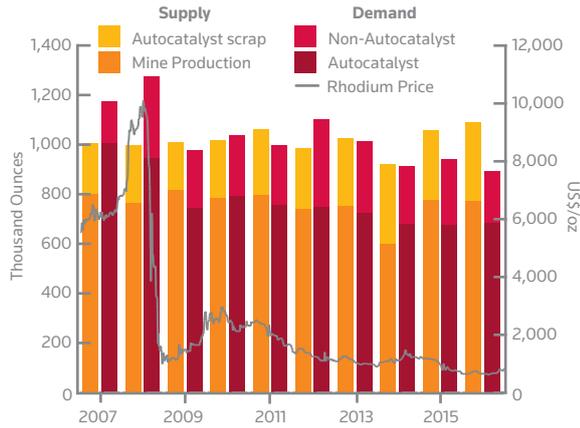
After years of aggressive thrift following the metal's rise to \$10,000/oz in 2008, industrial users appear to have sidelined these efforts. This scale back from thrift

WORLD RHODIUM SUPPLY AND DEMAND

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	% Change
Supply											
Mine Production											
South Africa	658	631	683	653	647	587	599	449	624	615	-1%
Others	143	131	132	131	149	153	154	149	151	155	3%
Total Mine Production	801	762	815	784	796	741	752	598	775	771	-1%
Autocatalyst Scrap	203	234	193	232	265	245	272	322	284	318	12%
Total Supply	1,004	995	1,009	1,016	1,061	985	1,024	920	1,058	1,089	3%
Demand											
Autocatalysts	1,004	943	743	791	755	748	722	679	675	683	1%
Chemical	73	73	69	71	78	81	84	88	90	94	5%
Glass	76	89	143	140	129	201	118	51	53	81	54%
Other	23	171	24	38	35	72	92	95	124	37	-70%
Total Demand	1,176	1,276	979	1,040	998	1,102	1,015	912	941	895	-5%
Physical Surplus/(Deficit)	(172)	(281)	29	(23)	64	(117)	9	8	117	194	
ETF Release/(Build)					(17)	(36)	(49)	(4)	5	(4)	
Net Balance	(172)	(281)	29	(23)	47	(152)	(40)	4	122	190	
JM London Price (US\$/oz)	6,191	6,564	1,595	2,453	2,021	1,275	1,064	1,173	952	693	-27%

Source: GFMS, Thomson Reuters; Johnson Matthey

WORLD RHODIUM SUPPLY & DEMAND



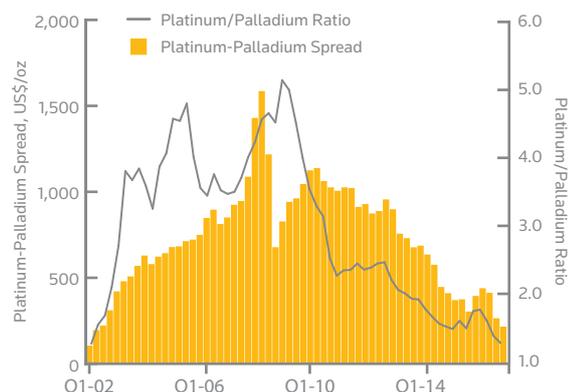
Source: GFMS, Thomson Reuters; Johnson Matthey

coupled with a newly launched rhodium ETF helped rhodium find its floor in the medium term, positioning its price for recovery into 2017.

Standard Bank launched a physical ETF in South Africa backed by rhodium in late 2015. Since its launch, the ETF has amassed almost 50,000 ounces as of April 2017, equivalent to about one month's worth of market demand. The 'AfricaRhodium' ETF accounted for 46% of global rhodium ETF holdings by the end of 2016 and while this ETF increased by 47,900 ounces last year, the European ETFs shed 43,000 ounces in the period. On a net basis, global rhodium ETF holdings increased by a little over 4,000 ounces, after declining by around 5,350 ounces in 2015.

Rhodium supply increased by 3% to 1.1 Moz. Mine supply fell to 770,677 ounces in 2015, 0.5% lower than production in 2015. The bulk of the decline is owed to strategically reduced output from high-cost shafts in South Africa amid an unfavourable price environment. The 12% increase in autocatalyst scrap supply more than offset the drop in mine output.

PLATINUM PREMIUM



Source: GFMS, Thomson Reuters

Total demand fell to 894,682 ounces, which was 5% lower than the previous year. Autocatalyst demand, which accounted for 76% of the total, increased by 1% last year. This was the first annual increase since 2010 and was driven by increased usage of lean NOx traps in small vehicles, which are loaded with rhodium. Chemical and glass demand also increased in 2016, by 5% and 54%, respectively. These two components made up just shy of 20% of total demand. Demand in our 'Other' category, which includes physical investment, jewellery, thermocouples, and various other applications, contracted by 70% last year, offsetting gains in the three main segments.

Physical investment demand, which is mostly in bar form for the retail market and sponge form at the institutional level, declined by 84% last year to about 16,600 ounces, as strong initial interest in retail bars, a relatively new product offering, in the North American and European markets dissipated and Chinese investors liquidated due to financial stress from persistent unrealised losses in the market. Jewellery demand also weakened on the back of lower gold and silver jewellery fabrication. The bulk of rhodium is used to plate jewellery.

OUTLOOK FOR 2017

Platinum has been the worst performing precious metal in the year to date, continuing a pretty underwhelming performance in 2016. We do not expect it to continue to lag its peers substantially as the market has priced in much of the bad news, notably with respect to diesel usage, and that it is starting a recovery, albeit a cautious and difficult one. We are looking for a small fundamental deficit this year as mine production continues to be hindered by the lack of investment in earlier years.

Palladium is in a persistent large deficit and the market is tightening, a development we think will be increasingly felt in the coming years, with more bouts of higher lease rates. This has also been translating into a strong price recovery, and while the market is susceptible to a short term correction we would expect prices to recover from that to be back in excess of \$800 well before year-end.

More detailed outlooks are produced by the GFMS team at Thomson Reuters, which presents its supply and demand forecast data, regular commentary and price forecasts to customers via Thomson Reuters Eikon subscriptions. For more information please visit: financial.tr.com/eikon-metals.

2. PGM PRICES

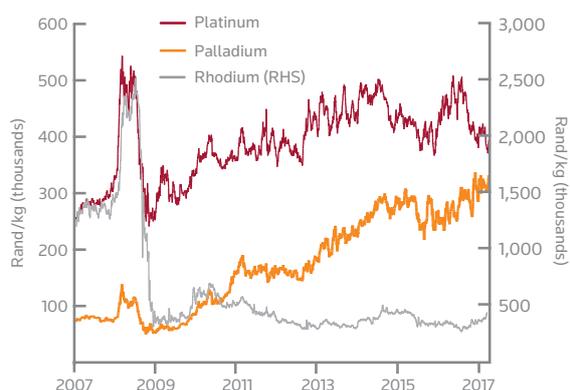
PLATINUM & PALLADIUM

After declining 28.0% in 2015, the **platinum** price rebounded by 3.6% in 2016. However, the annual average price still dropped 6.1%, from \$1,053/oz to \$989/oz in 2016. The average 20-day rolling price volatility increased to 24% last year, from 19% the year prior. The increase in price volatility was heightened in January, when the meltdown in global equities markets dragged down the platinum price, causing the average price volatility for the month to spike to 32%, a relatively high level. During the period, neither the increase in the gold price, the robust demand during this period from the vehicle sector, nor the active purchasing by Japanese private investors, did not offer much support to the platinum price. Total ETF holdings were relatively stable throughout the year, only losing 5,096 ounces (0.16 t), or 0.2%.

On the other hand, after falling 31.6% in 2015, **palladium** prices rebounded strongly, increasing by 20.7% in 2016. The annual average price was still 11.3% lower however, averaging \$614/oz last year. The strong performance in the palladium price last year was mainly attributed to the robust growth in the vehicle production sector, particularly from China. The Chinese automobile market was stimulated by the tax cut policy imposed on small light duty vehicles in October 2015, which brought life back to the domestic auto industry. Total vehicle production in China increased 14.4% over 2015 output. The increase in the palladium price last year was in spite of the continual outflows of ETFs, which lost 637,140 ounces (19.8 t), or 27.2% during the year.

Both platinum and palladium prices were dragged down during the first month of the year, as turmoil in the global equity markets forced market capital into safe haven

PGM PRICES: SOUTH AFRICAN RAND



Source: Thomson Reuters

assets. While platinum showed strength towards the end of January, and broke over the \$900/oz barrier in February, palladium remained weak and hovered around the \$500/oz area in the first two months. According to the CFTC reports, managed money net positions in platinum were 14 tonnes at the end of 2015. After a small step back in January 2016, net long positions in platinum began a more meaningful uptick as of the start of February, indicating a stronger investment interest. Meanwhile, managed net positions in palladium were 27 tonnes by the end of 2015, and declined in early 2016, dropping to 13 net tonnes by the end of February.

Momentum in both platinum and palladium prices accelerated in March. Platinum finally broke over the \$1,000/oz barrier and stayed above that level in late April, with palladium following suit by breaking over \$600/oz. The increase in metal prices was stimulated by a weaker dollar, as a slowdown in the U.S. manufacturing sector and reduced consumer spending lowered expectations for an interest rate rise, which consequently pushed the dollar index down to the 92 level, the lowest level since January 2015. However, palladium soon dropped back under the \$600/oz barrier in early May, while platinum sank below \$1,000/oz in late May. The dollar index bounced back from April's low boosted by a series of encouraging U.S. economic data. The result of the Brexit in late June did affect the PGMs, and instead set up for further price appreciation in July. The platinum and palladium prices increased by 15.1% and 6.1% respectively for the first half of 2016.

Platinum started July with a bang, breaking above the \$1,000/oz again, and palladium regained above the \$600/oz barrier the following trading day. Both metals were benefited by positive auto sales figures from Europe and China. Managed net long positions in platinum increased in July, and peaked at the equivalent of 67 tonnes on the 9th August. The 67 tonnes net position was the second highest recorded, just one tonne shy of the historical high recorded on the 8th July 2014. Net long positions in platinum then slowly retreated as short positions began to build, and ended the quarter at 33 net tonnes. Platinum prices, however, reacted more slowly. The price managed to break above the \$1,100 level by late July, and did not peak until the 10th August, when it hit \$1,182/oz. Meanwhile, palladium largely traded in the range of \$660-720/oz during the third quarter, with managed net money position equivalent to 42 tonnes by the end of September.

PRECIOUS METALS PRICE PERFORMANCE

	Au	Ag	Pt	Pd	Rh
2015	1,160	15.68	1,053	692	952
2016	1,251	17.14	989	614	693
Change (yoy)	7.8%	9.3%	-6.1%	-11.3%	-27.2%

Source: GFMS, Thomson Reuters; LBMA; Johnson Matthey

With the market directing its attention to the possibility of further interest rate rises in the United States, platinum fell below \$1,000/oz again in early October, and palladium fell below \$700/oz. Platinum and palladium began to diverge in November, as the election of Donald Trump to the presidency of the United States helped industrial metals including palladium, but platinum was dragged down by gold and silver. The palladium price peaked at \$770 by the end of November, and closed the year at \$670/oz.

Meanwhile platinum continued to sink and closed the year at \$898/oz. Net managed long positions in platinum dropped heavily in the final quarter, falling to 13 net tonnes by the end of the year, while palladium amounted to 40 net tonnes. The platinum/palladium ratio averaged 1.63 last year, but the ratio contracted as palladium started to catch up in the second half. The strong momentum in palladium continued into the first quarter in 2017 as the average ratio fell to 1.26.

RHODIUM

Rhodium prices averaged \$693/oz last year, a 27.2% decrease from the year before due to the continual increase in supply combined with falling demand. Total supply increased 2.9% year-on-year to 1.1 Moz (33.9 t), mostly due to an increase in auto catalyst scrap, which jumped from 26.8% of total supply in 2015 to 29.2% in 2016. On the other hand, total demand fell 4.9% to 0.9 Moz (27.8 t), mostly dragged down by physical investment, jewellery, thermocouples and other applications.

Automotive catalytic converters accounted for over 76% of total rhodium demand last year, and increased modestly by 1.2% to 0.7 Moz (21.2 t). Glass demand also surged 53.7% to 81,253 ounces (2.5 t) of rhodium last year, mainly from increased demand from China. Total ETFs also increased 4.1%, to 0.1 Moz (3.2 t) during 2016.

Net balance last year increased 55% to 0.2 Moz (5.9 t) surplus. We expect the surplus to continue to increase in the future, as an increase in autocatalyst scrap will continue to be an important component of supply for the market. Rhodium ended the year at \$770/oz, an increase of 16.7%. With higher demand and limited supplies, rhodium spiked over 33% in early 2017 and closed at \$1,025/oz by the end of the first quarter of 2017.

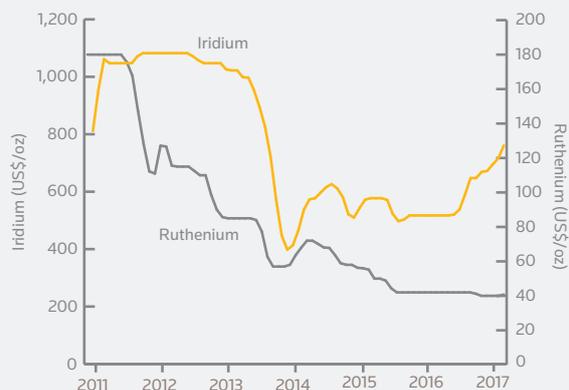
RUTHENIUM & IRIIDIUM PRICES

Ruthenium prices suffered their eighth consecutive annual price decline in 2016, with the price averaging \$41.6/oz last year, a 12.4% year-on-year decrease. The price was relatively stable last year, as the highest price throughout the year was \$42/oz and the lowest at \$40/oz. The continual fall in ruthenium prices was mainly attributed to the decline in shipment and demand for hard disk drives (HDDs). Global HDDs shipments fell by an estimated 9.6% in 2016, with a shift of consumer preferences away from traditional PCs to mobile devices. In contrast to 2016, the price has risen dramatically so far in 2017, by over 60% until the time of writing, as industrial buying has increased in Asia, with limited supplies available.

On the other hand, the annual average price of Iridium increased 6.0% last year, to \$576/oz. Iridium is mainly used in electronics, as well as spark plugs, electrodes and chemical catalysts. Prices were stable in the first few months of the year. However, with such a small market, especially with tight supply, any meaningful demand could boost iridium prices. Signs of life began to show in iridium price in May, with the

price slowly started to trend upwards. In the second half of the year, the situation became more problematic as availability was limited. As a result, the iridium price increased further and sellers were waiting for higher levels. The situation caused the iridium market to become even less liquid and this continued into 2017. However due to the small size of the market, there is little opportunity for investors to become actively involved.

RUTHENIUM & IRIIDIUM PRICES



Source: GFMS, Thomson Reuters

PLATINUM AND PALLADIUM PRICE CORRELATIONS

Platinum and palladium belong to the same group in the periodic table and therefore share similar physical and chemical properties, and tend to occur together in mineral deposits. Both are used in automotive catalytic converters, electronics, jewellery and act as catalyst during chemical process. The automotive sector dominates platinum and palladium usage in autocatalysts, representing 42% and 75% of gross usage respectively in 2016. From the supply side, both metals are also fairly concentrated, with mine production from South Africa accounting for over 56% of total platinum supply last year. Supply for palladium is more diversified, with mine production from South Africa and Russia constituting 29% and 30% of total supply respectively last year.

The platinum and palladium correlation was very high during the first half of the year, as both metals were being dragged down by the global equities market meltdown starting the year. A soft dollar in April enhanced strength in commodities, only to retreat in May as the dollar rebounded. Gold did relatively well in June, as market capital to safe haven assets prior to the Brexit vote.

In the third quarter, the correlation between platinum and most other commodities began to diverge, but it retained a fairly high correlation with gold. With wage negotiations in South Africa going peacefully and a lack of price direction, the market started to pay attention to the price differences between platinum and gold. After an average gold/platinum ratio of 1.27 in the first half of last year, the ratio fell to 1.23 in the third quarter. Strong sales of vehicles in China provided support for palladium prices during the period.

Platinum remained highly correlated with gold in the final quarter of the year, but posted strong negative correlations with other commodities. The U.S. equity market and the dollar both advanced, celebrating Donald Trump's victory in the presidential election in November, as the market became optimistic and capital flowed from risk haven assets into riskier assets. Prices of base metals also surged, as Donald Trump promised the market he would reform the country's infrastructure. While platinum is also an industrial metal, it was being dragged down with gold and silver, and the gold/platinum ratio increased to 1.29 in the final quarter. On the other hand, palladium did well in the final quarter, supported by strong auto sales in China, and its price saw the peak of the year in late November.

QUARTERLY CORRELATION COEFFICIENTS

(daily log returns)

	2015	2016	2016	2016	2016	2017
	Q4	Q1	Q2	Q3	Q4	Q1
Platinum-Palladium	0.91	0.76	0.81	0.26	-0.41	0.19
Platinum						
Gold	0.94	0.94	0.36	0.66	0.85	0.38
US\$/Euro Rate	0.72	0.70	0.34	-0.17	0.82	-0.07
CRB Index	0.81	0.87	0.58	-0.04	-0.58	-0.21
Oil (WTI)	0.77	0.61	0.15	-0.45	-0.54	0.71
Palladium						
Gold	0.95	0.64	0.27	-0.11	-0.57	0.79
US\$/Euro Rate	0.81	0.60	0.36	0.43	-0.50	0.32
CRB Index	0.86	0.86	0.48	0.76	0.69	0.52
Oil (WTI)	0.84	0.84	-0.10	-0.26	-0.02	-0.25

Source: GFMS, Thomson Reuters

The gold/platinum ratio increased to a daily average of 1.27 in 2016, compared to 1.11 in 2015. In 2016, the market focused on potential impacts brought by political incidents (i.e. Brexit, the presidential election of the United States) and the interest rate time table of the Federal Reserve. All these events had huge influences on the demand for flight to safety, and the strength of the dollar, and in turn, gold became a spotlight focus.

This momentum has carried forwarded into 2017. Despite the Federal Reserve raising interest rates in March, the dollar actually showed weakness after the event. Prices of base metals also retreated in the first quarter, as the market became more rational after assessing Donald Trump's actions. The increasing geopolitical tensions, and the upcoming voting in several European countries, also boosted safe haven demand. The gold/platinum ratio averaged at 1.25 during the first quarter of 2017.

PLATINUM, PALLADIUM AND OTHER COMMODITIES



Source: Thomson Reuters

3. INVESTMENT

- **Total Identifiable Investment in platinum, which includes retail investment and ETF inventory build, gained 66% in 2016 to 535,000 ounces (6.7 t). In indicative value terms, investment demand amounted to \$529 million.**
- **The gains in our platinum Identifiable Investment figure was solely attributable to the losses in ETF holdings. Last year they posted a much smaller outflow (5,000 ounces or 0.16 t) than in 2015 (0.26 Moz or 8.1 t).**
- **Palladium suffered net disinvestment for the second consecutive year in 2016, to total 593,000 ounces (-18.4 t). Again, investors' net outflows in ETFs were responsible for the decline.**
- **Meanwhile, rhodium ETF positions gained 4% in 2016, to total 104,421 ounces (3.2 t).**

COMMODITY EXCHANGES

Net investor positions on TOCOM futures are used to analyse investment activity on the exchange. Starting with platinum, net long positions declined last year, falling from 263,000 ounces (8.2 t) at the beginning of the year to 66,000 ounces (2.0 t) by year end. Investor activity was tepid even during the first eight months when platinum prices in dollar terms gained by 36% (as on 10th August). As of end-May net longs were 186,000 ounces (5.8 t), but speculators started taking profits as prices rallied through June and July to the extent that they were net short during these two months; in July 353,000 ounces (11.0 t) were on the short side. This trend is in contrast to western markets and is primarily attributed to a stronger Japanese yen which in the first seven months appreciated by 17%, thereby partly negating the gains in the dollar price. The impact was to an extent that while the dollar platinum price gained by 36% from the beginning of the year to 2016 peak of \$1,182 during the same period the yen price gained only 10%. While this is a reasonably strong gain, it was likely tempered by

concerns over interest rate decisions in the United States and their potential knock-on effect on the domestic currency. In hindsight it may be viewed that after a record rise in net longs in July 2015, investors were cautious following US interest rate decisions and in measuring its influence on domestic currency.

Turning to palladium, from a net long position by speculators at 7,000 ounces at beginning of the year it reversed to a net short of 1,431 ounces (44 kilogrammes) by the end of 2016. The reversal from net long to shorts first occurred in July, though it was followed by panic buying as the price went higher. However, the short position built up by September as signs of a potential price reversal were being supported by news related to a weakness in precious metals prices and lower demand.

CFTC reports on managed money positions on NYMEX, which include both futures and options, provide a good proxy for investor activity on the exchange. Looking to platinum in 2016, the sharp 49% year-on-year decline of net managed long positions in 2015 was reversed in 2016 to gain 9% in 2016 to 0.41 Moz (13 t). Bargain hunting at lower price levels and reallocating of funds to platinum were visible from December 2015 as the price declined to the lowest since 2009 and the build up in long positions gathered steam by the second week of February last year. Net long positions were volatile during 2016 overall, as the price increased from \$868 at the beginning of the year to \$1,182 on 10th August, the highest level since 6th March 2015, however by the end of the year the price was only \$30 higher than at the start of the year. During the same time frame the net long more than doubled from 0.45 Moz (14 t) to peak at 2.2 Moz (67 t) before dropping back by the end of year to 0.41 (13 t). The investor activity was intense enough to lift the net long positions to a record high level; this was in contrast to 2015 when short positions had touched a record high. Meanwhile, palladium posted a 47% year-on-year increase in managed net long positions, rising to 1.2 Moz (40 t). That

IDENTIFIABLE INVESTMENT*

(000 ounces)	Platinum					Palladium				
	2013	2014	2015	2016	Change	2013	2014	2015	2016	Change
Retail Investment	136	141	582	540	-7%	38	45	45	45	-
Exchange Traded Funds	892	218	(260)	(5)	n/a	0.1	898	(727)	(637)	n/a
Total Identifiable Investment	1,028	359	322	535	66%	38	944	(683)	(593)	n/a
Indicative Value \$M**	1,528	498	339	529	56%	28	758	(472)	(364)	n/a

*Excludes investment activity in the futures and OTC markets.

**Indicative value calculated using annual average volume and prices.

Source: GFMS, Thomson Reuters

NET INVESTOR POSITIONS ON THE TOCOM AND NYMEX

(end-period; positive represents net longs)

	Platinum				Palladium			
	Q1.16	Q2.16	Q3.16	Q4.16	Q1.16	Q2.16	Q3.16	Q4.16
TOCOM Futures Contracts	11,575	(6,646)	14,616	4,100	383	251	(769)	(89)
- equivalent in ounces (000)	186	(107)	235	66	6	4	(12)	(1)
NYMEX Futures Contracts	15,159	13,484	21,058	8,223	7,577	5,115	13,450	12,742
- equivalent in ounces (000)	24	21	33	13	24	16	42	40

Source: TOCOM, CFTC

said, investor activity was mixed, after rising by 112% from the beginning of the year at 868,000 ounces (27 t) to early August at 1.8 Moz (57 t); thereafter it declined by 68% to 595,000 ounces (19 t), only to rebound by 114% by end of the year.

Total platinum volumes traded on the Shanghai Gold Exchange (SGE) in 2016 were higher by 79% year-on-year, rising to 1.67 Moz (26.4 t). The gains were fuelled by the increase in fabrication demand from autocatalyst, chemicals and glass industry as the majority of the trading is driven by fabricators from industrial and jewellery fabrication.

RETAIL INVESTMENT

Investment demand for platinum last year declined by 7% to 540,443 ounces (16.8 t), primarily due to a fall in demand from Japan, which has historically taken the largest share of total investment demand. **Japan's** share of total retail investment averaged 54% in the previous five years; however last year's share was 77%. Thus, its 17% year-on-year decline in 2016 to 415,000 ounces (12.9 t) weighed heavily on global retail demand. That said, it is important to note that 2015 volumes were at a record 498,000 ounces (15.5 t). The key trigger for volumes of this magnitude in the last two years, which is equivalent to 7.5% of mined platinum production, were price weakness and expectations for a recovery. It wasn't a surprise to see investors lining up at stores when the price was hovering in range of \$800 to \$900 during November and December following a fall from \$1,182 attained on 10th August. Interestingly some of these were investors who had taken profits in Q3 as the local price had rallied by 10% since the beginning of the year.

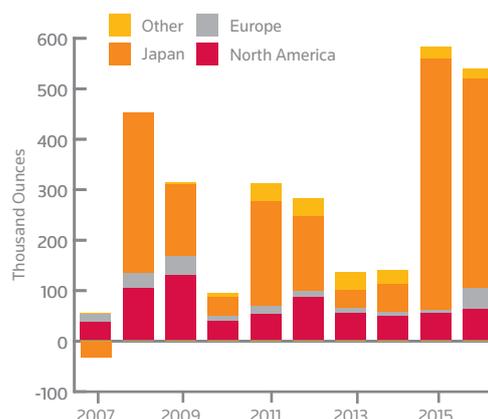
In **North America**, platinum retail investment increased by 15% year-on-year to an estimated 63,262 ounces (2 t), in sharp contrast to the decline in Japan. Firstly the size of the investment market is very small and American investors were relatively slow, with growth of just 10% in 2015, while investment in Japan had grown by approximately 800%. On a relative basis American investors were responsible for 74% of retail investment

demand for palladium investment. However, while North American retail investment increased by 3% year-on-year, global investment stay flat at 45,000 ounces (1.4 t).

Physical platinum investment in **Europe** gained 564% year-on-year in 2016 to 43,181 ounces (1.3 t), reversing four years of consecutive declines. Crucial to this was the introduction of a new Philharmonic platinum coin in February 2016 by the Austrian Mint. With respect to other emerging markets in the platinum investor segment, there have been increased enquiries from the high income segment in India for investing in platinum, but the lack of transparent price discovery, which is also related to low liquidity, hasn't helped its growth.

In the coin sector, platinum demand soared by 102% year-on-year in 2016 to 115,199 ounces (3.6 t), the highest since we started keeping records. North America, which contributes 54% of the demand, noticed an increase of 66% year-on-year in 2016 to 62,192 ounces (1.9 t). That said, American Eagles reported sales of 20,000 ounces (0.62 t). With no platinum coin release in 2015, volumes in January 2017 were the equivalent to the whole of 2016. Demand elsewhere also grew strongly, particularly aided by the aforementioned new platinum coin from the Austrian Mint.

PLATINUM RETAIL INVESTMENT



Source: GFMS, Thomson Reuters

PLATINUM, PALLADIUM AND RHODIUM EXCHANGE TRADED FUNDS

Platinum ETF holdings ended 2016 marginally lower at 2.48 Moz (77.2 t), making it the lowest year-end total in four years. Price was a critical factor; after initially rallying by 36% its decline eroded investor confidence and it eventually ended just 3.5% higher year-on-year. In value terms the ETF holdings increased by 3.2% year-on-year to \$2.3 Bn; this at its peak for the year touched \$2.83 bn on 10th August. The biggest addition in a single day last year was on 28th April, where ETF holdings gained by 57,643 ounces (1.8 t), in reaction to the price crossing \$1,000 that week for the second time in four months. Looking at it on a quarterly basis the fourth quarter noted a net inflow of 116,969 ounces (3.6t) as against a net outflow of 117,451 ounces (-5.5 t) in Q3.

In the case of palladium the ETF holdings declined by 27% year-on-year to 1.7 Moz (53.1 t), to the lowest level in seven years and in value terms to \$1.1 bn. The biggest addition in 2016 to palladium ETFs was 59,970 ounces (1.9 t) on 6th June, largely driven by bargain hunting.

The ETF investment activity was primarily driven by factors that were driving gold prices, U.S. interest rates, Trump elections and wage negotiations between AMCU and the three largest platinum producers in South Africa, Amplats, Implats and Lonmin. Unfavourable movements in the rand, concerns over the health of European diesel demand in addition to continued concerns over the Chinese economy encouraged disinvestment from the metals in H2 2016.

Taking a look at each of the major ETFs, starting with platinum, holdings at ETF Securities were the highest at 908,732 ounces (28.3 t), rising by 15%

NET MOVEMENTS IN PLATINUM, PALLADIUM & RHODIUM ETFS

(000 ounces)	2015	2016	YoY%	Jan-Mar* 2017
Platinum	(260)	(5)	n/a	72
Palladium	(727)	(637)	n/a	(161)
Rhodium	(5.4)	4.1	n/a	(1.9)

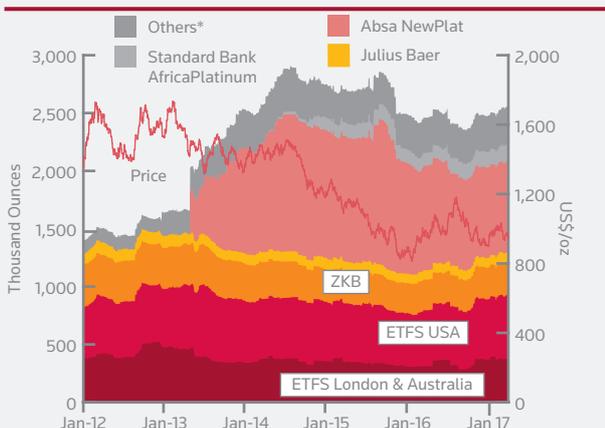
Source: Respective ETF issuers

year-on-year, with large gains coming from Glitter ETF. On the other hand the second largest NewPlat ETF declined 18% year-on-year and the third highest ZKB noticed 5% gains in holdings. These three together are approximately 80% of the ETF holdings, and they together had a net outflow of 40,712 ounces (1.3 t).

Moving to palladium ETFs, we saw more intense liquidation; declines were across all the major ETFs. ETF Securities, which has the largest holdings declined 13% with a net outflow of 96,459 ounces (3.0 t). The sell off was even larger at Source ETF with a net outflow of 132,435 ounces (4.1 t). Net outflow from the top three ETFs, which together constitute 73% of the ETF holdings, was at 399,839 ounces (12.4 t). The first quarter of 2017 saw significant further liquidations, with palladium holdings dropping a further 161,073 ounces (5.0 t). The drop occurred almost entirely in under a week in mid-January in the ETF Securities London fund.

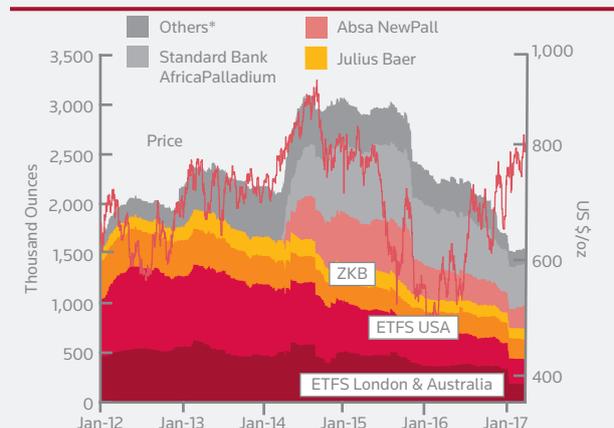
Total holdings in rhodium ETFs gained 4% year-on-year in 2016 to total 104,421 ounces (3.2 t). The notable development last year was an increase in holdings at Africa Rhodium ETF; from less than a percentage share in the Rhodium ETF market a year ago, its share had spiralled to 46% by end of 2016 by adding 47,938 ounces (2.0 t) over the year following its introduction in late 2015. A large part of the rise appears to have been a shift from the DB Physical Rhodium ETC fund which happened in March 2016.

PLATINUM ETF HOLDINGS



Source: GFMS, Thomson Reuters; collated from respective ETF issuers' data

PALLADIUM ETF HOLDINGS



Source: GFMS, Thomson Reuters; collated from respective ETF issuers' data

sBEad*coin



extraterrestrial



4. SUPPLY

- *Global refined platinum mine production contracted by 2% to total 6.05 Moz (188.0 t) in 2016, led by lower supply from South Africa.*
- *Palladium production fell at an equal rate accentuated by sharper losses in South Africa and Russia, partially offset by higher production from Zimbabwe.*
- *Global Total Production Costs (expressed in U.S. dollars) fell by 9% in 2016 to \$974/PtEqoz, primarily led by lower costs at Marikana and Amandelbult.*
- *Producers (excluding Norilsk Nickel) cut capital expenditure by 22% to \$1 Bn.*

WORLD PLATINUM MINE PRODUCTION

(000 ounces)	2014	2015	2016	Change
South Africa	3,220	4,522	4,305	-5%
Russia	687	721	711	-1%
Zimbabwe	398	398	484	22%
Canada	278	242	268	10%
United States	119	122	129	5%
Others	154	152	150	-1%
World Total	4,856	6,158	6,046	-2%

Source: GFMS, Thomson Reuters

WORLD PALLADIUM MINE PRODUCTION

(000 ounces)	2014	2015	2016	Change
Russia	2,582	2,575	2,526	-2%
South Africa	2,008	2,653	2,470	-7%
Canada	578	519	512	-1%
United States	401	406	420	3%
Zimbabwe	325	323	388	20%
Others	243	238	246	4%
World Total	6,136	6,713	6,563	-2%

Source: GFMS, Thomson Reuters

WORLD RHODIUM MINE PRODUCTION

(000 ounces)	2014	2015	2016	Change
South Africa	449	624	615	-1%
Russia	87	88	87	-1%
Zimbabwe	36	35	41	17%
Canada	22	24	23	-4%
United States	3	3	3	-1%
Others	-	-	-	-
World Total	598	775	771	-1%

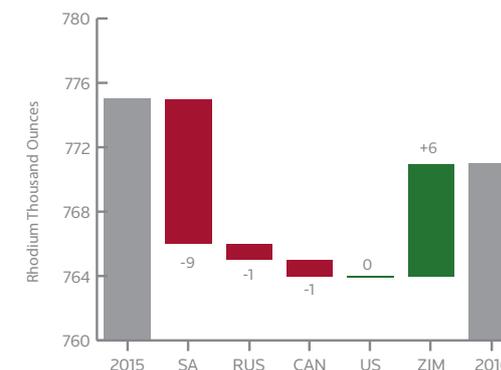
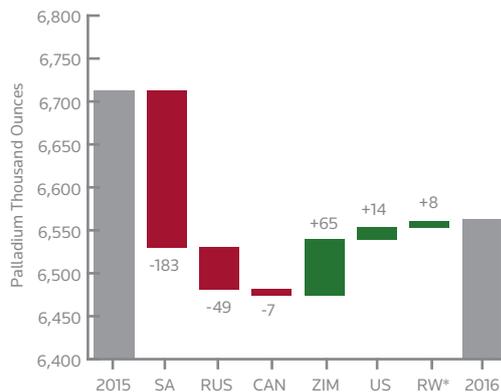
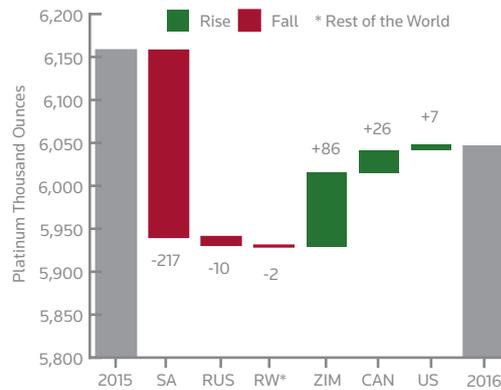
Source: GFMS, Thomson Reuters

MINE PRODUCTION

SOUTH AFRICA

South African platinum production fell by 5% last year, with palladium registering a sharper 7% drop. South Africa was unable to retain the top spot as the world's largest producer of palladium due to lower production from its five largest operations managed by Lonmin, Amplats/Sibanye, and Implats. The closure of high cost shafts at Marikana resulted in a 0.15 Moz (4.7 t) drop in 3PGE sales. Of the three metals, platinum production contracted the most, registering a

PGM PRODUCTION VARIANCE



Source: GFMS, Thomson Reuters

92 koz (2.9 t) drop year-on-year. After accounting for the change in ownership, platinum output at Rustenburg Platinum Mines fell by an estimated 54 koz (1.7 t) due to lower throughput as a result of accidents, and lower operational flexibility at the Thembelani and Khuseleka mines. A drop in tonnes milled was also seen at Impala Lease Area, where tonnes processed fell by 15% impacted by the closure of two mechanised sections in December 2015, an underground fire at 14 Shaft in January, and a fall of ground incident at 1 Shaft in May. The combined effect of these three events is estimated to have dampened production by at least 62 koz platinum ounces, partially offset by ramp-up efforts at 16 Shaft and 20 Shaft.

Further losses were accounted at Bokoni mine as a result of lower volumes from the Klipfontein Merensky open-pit operation, and the closure of the UM2 and Vertical Merensky shaft operations.

RUSSIA

Russian production of mined platinum and palladium stood at 0.71 Moz (22.1 t) and 2.53 Moz (78.6 t), respectively. GFMS estimates that rhodium production closed the year at 87 koz (2.7 t). Palladium output from Russian mines fell by 2% to 2013 levels due to downstream processing constraints originating from the retirement of Norilsk’s Nickel Plant and lower metal contained in mined ore. The production shortfall was partially countered by a drawdown of the company’s metal inventory. The company expects to produce 2.68 Moz (83.5 t) from Russian feedstock in 2017, pointing to an increase of 0.16 Moz (4.98 t) year-on-year. Though downside risks prevail following weak Q1 2017 results, we estimate FY17 production to remain near these levels supported by further inventory draw downs.

Rhodium production is estimated to have dropped by 1%

SOUTH AFRICAN MINE PRODUCTION



Source: GFMS, Thomson Reuters

last year as the company’s Nickel Plant was closed and accumulated stocks of PGM-rich pyrrhotite concentrate were rerouted to be processed at the Nadezhda Metallurgical Plant.

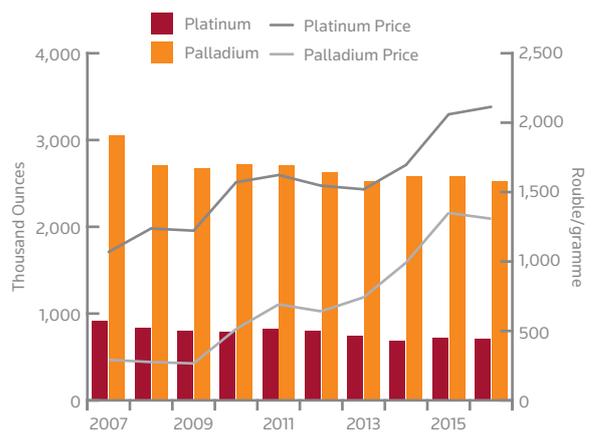
Platinum production from Russia decreased by 1% last year. Production at Norilsk’s Russian operations were flat at 0.61 Moz (19.0 t) after accounting for the Russian feed processed at the company’s Harjavalta Oy Plant in Finland. The drop stemmed from the largest player, Russian Platinum, where production dropped slightly from budgeted levels at 0.11 Moz (3.5 t). This was a function of weaker production from the country’s largest alluvial operation, Kondyor in Khabarovsk Krai, which recovered significantly in 2015 following equipment availability issues in 2014. We estimate that the relatively modest Koryakgeoldobycha alluvial operations in Kamchatka also recorded a slight drop last year.

ZIMBABWE

In **Zimbabwe** 3E PGM production surged by 21% to a record level of 0.91 Moz (28 t) aided by higher output at Ngezi across all three metals. Production at the mine was supported by higher throughput stemming from increased tonnage at the Mupfuti and Bimha mines, and the processing of the remaining stockpile material from the outage of Zimplats’ smelter in May 2015. Though redevelopment efforts at Bimha mine continued, these didn’t hinder production to the same level as in 2015. Capital expenditure rose by 12% to \$66 M, and is expected to nearly double in 2017 as development work begins at the Mupani mine.

Elsewhere, platinum in concentrate output at Mimosa rose modestly on the back of higher throughput, though partially offset by an accident in January, while at Unki, a 7% jump in head grades was behind the increase.

RUSSIAN MINE PRODUCTION



Source: GFMS, Thomson Reuters

UNCOVERING EARNINGS SURPRISES IN THE PGM SECTOR USING SMARTESTIMATES

StarMine SmartEstimates is a proprietary blend of analyst estimates on Eikon that more accurately forecasts upcoming financial results than consensus estimates and functions as a leading indicator of future revisions. Over time, SmartEstimates are proven to predict the direction of the actual earnings surprise with a success rate of about 70% when our estimates diverge from the consensus by 2% or more. Given the consistency across sectors, these estimates can help us shed light on this year's new PGM producer, Sibanye Gold.

The most recent wave of M&A activity in the PGM sector brought a new PGM player following the acquisition of Aquarius Platinum in March 2016, Amplat's Rustenburg operations in November 2016, and Stillwater Mining expected to close in May 2017. In the span of 19 months since the first announcement, Sibanye has become the world's third largest platinum producer. However, such status has come at a cost with the company's net debt to EBITDA ratio rising from 1.0x to 2.2x after the latest acquisition.

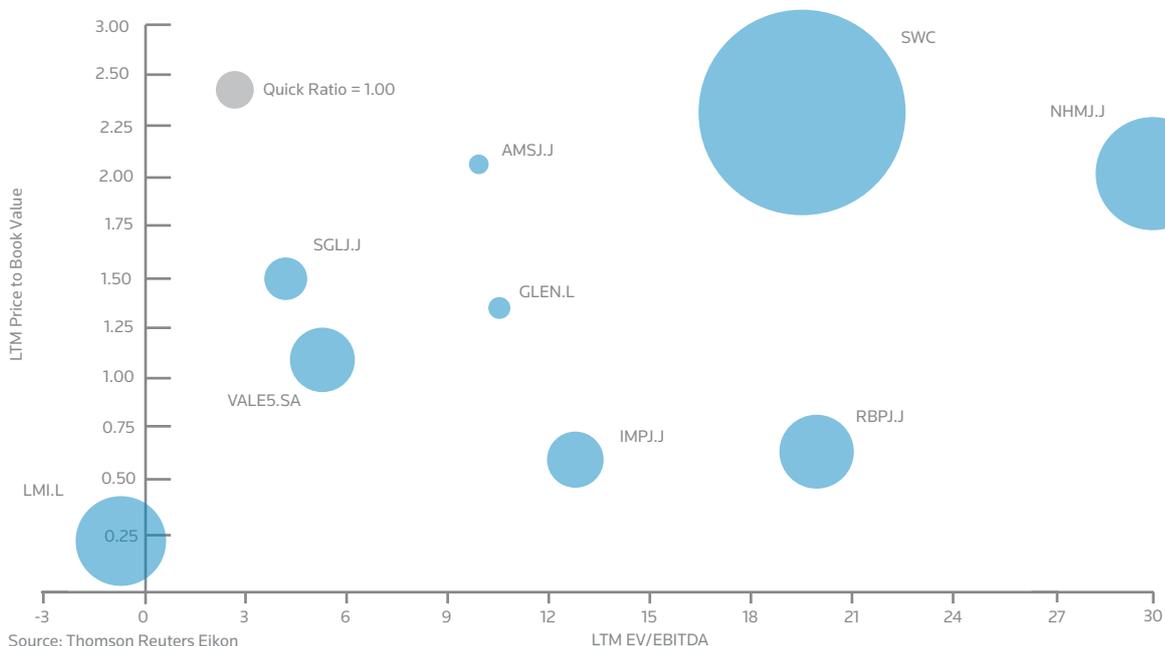
The differences of opinion on this new diversified mining company were last seen in the latest earning results for FY2016. The consensus EPS estimate was R3.53, while the SmartEstimate EPS pointed to a lower R3.15, resulting in a predicted surprise of -10.7%. Lower than expected revenue from gold and platinum divisions, and a higher than expected increase in the group's gearing led to a headline EPS of R2.70. Over the following seven days, Sibanye's shares slid by 9%, underperforming the mining sector which saw mixed results on the back of a sell off in the precious metals complex.

Turning to 2017, Sibanye's platinum division is forecast to produce between 1.05 Moz and 1.10 Moz. Recent changes to the company's capital allocation plans on the Burstone and Rustenburg UG2 projects may well postpone the delivery of new production. This factor, coupled with the deployment of new maintenance plans, and the fruition of nominal cost savings stemming from operational synergies, will underpin the sustainability of the the company's production profile as it strives to return to profitability on an all-in cost basis. For more information and more up to date estimates, visit our StarMine Quantitative Analyticcs pages available in Thomson Reuters Eikon.

SMART ESTIMATES

Company	Mean EPS	Smart Estimate EPS	Pred. Surprise	Mean Rev	Smart Estimate Rev	Period
Anglo American Platinum Ltd.	+10.16	+10.38	+2.21%	64.58 Bn	65.03 Bn	FY DEC17
Impala Platinum Holdings Ltd.	+0.15	+0.13	-11.37%	37.2 Bn	37.2 Bn	FY JUN17
Lonmin plc.	-0.20	-0.14	+30.95%	1.1 Bn	1.1 Bn	FY SEP17
OJSC MMC Norilsk Nickel	+12.16	+12.76	+4.88%	8.6 Bn	8.6 Bn	FY DEC17
Northam Platinum Ltd.	-0.83	-0.81	+3.46%	7.2 Bn	7.4 Bn	FY JUN17
Sibanye Gold Ltd.	+2.00	+1.97	-1.19%	41.2 Bn	41.4 Bn	FY DEC17
ARM Platinum	+20.11	+20.24	+0.63%	9.2 Bn	9.2 Bn	FY JUN17
Vale S.A.	+1.36	+1.44	+5.72%	32.2 Bn	36.1 Bn	FY DEC17
Glencore plc.	+0.34	+0.35	+5.65%	187.8 Bn	193.8 Bn	FY DEC17

RELATIVE VALUATION:



TOP 10 PLATINUM PRODUCING COMPANIES

Rank	Output (000 ounces)		Company	Output (000 ounces)	
	2015	2016		2015	2016
1	1	Anglo American Platinum Ltd. ¹	1,837	1,688	
2	2	Impala Platinum Holdings Ltd ²	1039	1,082	
3	3	Lonmin plc. ³	755	720	
4	4	OJSC MMC Norilsk Nickel	656	644	
5	5	Northam Platinum Ltd. ¹	242	271	
N/A	6	Sibanye Gold Ltd.	-	239	
8	7	ARM Platinum	158	175	
9	8	Vale S.A. ⁴	154	166	
7	9	Glencore plc.	158	148	
11	10	Royal Bafokeng Platinum Ltd. ⁵	115	127	

¹ Refined production from mining operations

³ Calendar year refined sales; ⁴ Including custom feeds

Source: GFMS, Thomson Reuters

TOP 10 PALLADIUM PRODUCING COMPANIES

Rank	Output (000 ounces)		Company	Output (000 ounces)	
	2015	2016		2015	2016
1	1	OJSC MMC Norilsk Nickel	2,689	2,618	
2	2	Anglo American Platinum Ltd. ¹	1,238	1,091	
3	3	Impala Platinum Holdings Ltd ²	621	660	
4	4	Stillwater Mining Co.	403	420	
5	5	Lonmin plc. ³	342	332	
6	6	Vale S.A. ⁴	341	322	
7	7	Glencore plc.	202	209	
9	8	ARM Platinum	158	170	
8	9	North American Palladium Ltd.	167	150	
13	10	Sibanye Gold Ltd.	-	136	

² Attributable mine production including Zimplats

⁵ Estimated metal in concentrate

CANADA

Canadian output of PGMs showed a divergent trend last year, with platinum output rising by 25 koz (0.8 t) while palladium dropped marginally. Glencore’s Canadian nickel assets registered the largest production increase year-on-year as platinum and palladium output jumped by 14 koz (0.4 t) and 16 koz (0.5 t), respectively. Further support came from KGHM International’s Sudbury Basin mines, where higher quality ore resulted in a 20% increase in precious metal production. Vale reported group sales, inclusive of custom feeds, as 1% lower year-on-year. However, excluding toll refining, we calculate that attributable mined production of platinum grew by 11,000 ounces (0.3 t), while palladium production fell by a similar amount.

Canada’s sole primary palladium mine, Lac des Iles, reported a sharp 10% decrease in payable palladium production due to a change in the mill operating schedule and run down of stockpiles and tailings feed. As a result, throughput dropped by 7% coupled with a 14% decrease in head grades.

UNITED STATES

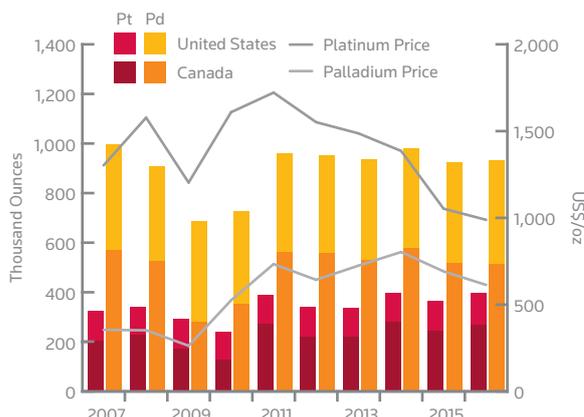
Mine production from the United States extended gains for a second year in a row with platinum and palladium posting respective increases of 5% and 3%. Production from the country’s largest PGM producer, Stillwater Mining, spearheaded the year-on-year result on the back of a 12% increase in throughput at East Boulder. Output at this mine rose by 9% to 0.22 Moz (6.8 t) of platinum and palladium ounces as production ramped-up at the Graham Creek project. In addition, Stillwater’s namesake operation provided further support, registering a 2.3% increase to 0.33 Moz (10.2 t). Combined capital expenditure dropped by 19% in 2016 to \$56 M as development efforts focused around the Blitz project area (adjacent to the Stillwater mine), and Stillwater’s revised mine plan, drafted in 2015, took further effect. Meanwhile, Lundin Mining’s Eagle Ni-Cu mine in Upper Michigan saw production drop as the operation delivered below-budget base metal output on the back of lower grades, and we believe, accompanied by lower PGM production.

ZIMBABWEAN MINE PRODUCTION



Source: GFMS, Thomson Reuters

NORTH AMERICAN MINE PRODUCTION



Source: GFMS, Thomson Reuters

PRODUCTION COSTS

- **Global average Total Production Costs (TPC) expressed in dollars dropped by 9% to \$974 platinum equivalent ounce (PtEqoz).**
- **Producers (excluding Norilsk Nickel) cut capital expenditure by 22% to \$1 Bn.**
- **Producers also gained from macroeconomic tailwinds in the form of currency depreciation and lower oil prices.**

Producers' concerted efforts to contain costs resulted in a 9% drop in TPC to \$974/PtEqoz for 2016, placing 30% of production under water, 3% below last year. The peer group's EBIT, excluding Norilsk Nickel, rose by 104% to \$1,009 M, slightly surpassing 2014 levels. The result was driven by a number of operations in South Africa, where costs dropped by a similar rate following efforts at Marikana and Amandelbult mines. At Marikana, TPC fell by 16% to \$980/PtEqoz aided by a 34% drop in depreciation to \$102 M following the impairment of assets in 2015. The closure of high cost shafts together with the flow of ounces from the smelter clean-up project and a weaker rand, led to significant cost savings, though partially offset by lower platinum ounces and higher labour costs. Turning to Amandelbult, TPC fell by 11% to \$937/PtEqoz thanks to an increase in PGM and chrome sales, and a 9.5% drop in cash operating costs.

Although U.S. operations did not have the advantage of currency devaluation, Stillwater Mining succeeded in cutting costs at East Boulder and Stillwater mine by a combined 3% to \$905/PtEqoz largely thanks to a ramp-up at the Graham Creek Project. In addition, at Stillwater mine, labour costs, which account for 52% of operating

TOTAL PRODUCTION COSTS PER EQUIVALENT OUNCE (US\$)

	2015	2016	Change
North America	1,040	977	-6%
South Africa	1,072	975	-9%
Zimbabwe	1,106	955	-13%
Russia	448	477	7%
World*	1,069	974	-9%

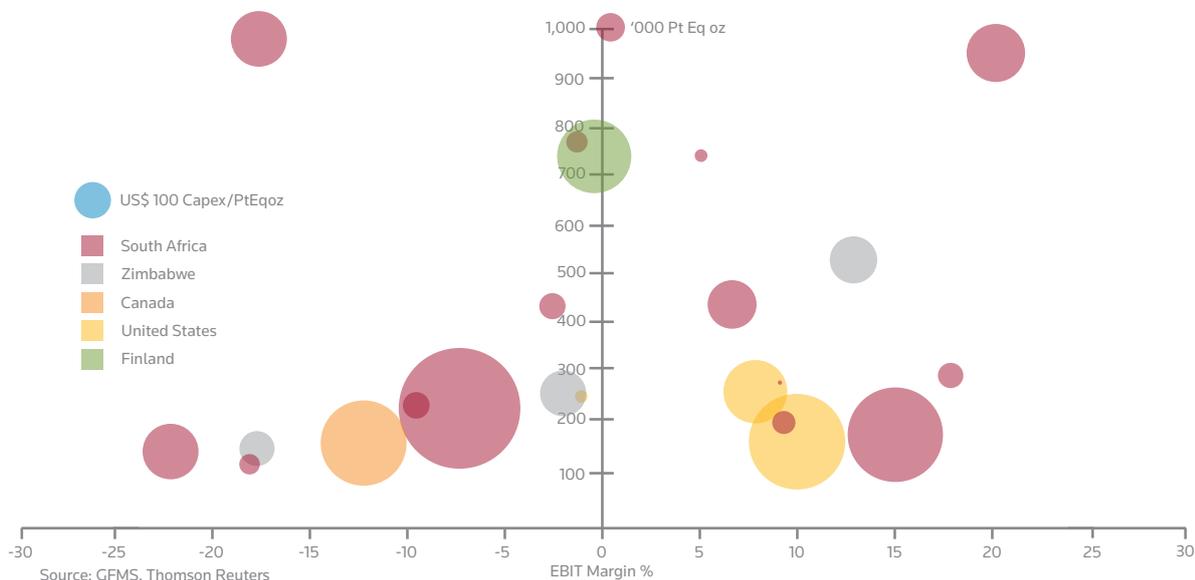
*Excluding Russia
Source: GFMS, Thomson Reuters

costs, fell by an estimated \$11 M following reorganisation initiatives in Q3 2015. As available reserves were depleted at a faster rate in 2016, depreciation rose by 14% to \$73 M. The low-cost profile of both operations is depicted in the chart below showing the East Boulder mine with an EBIT margin of 10%, followed closely by Stillwater mine at 7%.

Year-on-year, capital expenditure saw a sharp drop, falling by 22% to \$1 Bn as a result of severe cuts in expansionary capex. At the company level, Impala saw a 32% cut in capital spending to \$222 M, led by an \$86 M cut at Impala Lease Area to \$150 M following the commissioning of 16 Shaft and 20 Shaft.

This analysis excludes Norilsk Nickel, which produces large quantities of platinum and palladium as co-products of its nickel-copper mining activities in Russia. This exclusion is deliberate in order to avoid distortion to the cost statistics. Inclusion of Norilsk's Russian assets would have the effect of dragging the 2016 TPC down to \$765/PtEqoz. Relative to 2015, capital expenditure rose moderately by 2% to \$1.7 Bn.

PLATINUM EQUIVALENCY AND EBIT MARGIN BY OPERATION



AUTOCATALYST RECYCLING

— *Recycling from spent autocatalyst scrap last year recovered from the significant decline recorded in the prior year, rising by a combined 7% for platinum, palladium and rhodium to 3.08 Moz (87 t).*

Automobiles are the most recycled consumer product in the world today and consist of many more materials that are subject to recycling other than just PGM's. In fact, around 80% of materials found in a car today are reusable. In the most advanced car recycling country, the United States, approximately 12 M cars are recycled every year. In Europe the figure is slightly lower but still a respectable 8 M units, which is around 35% of new vehicle sales in 2016. In total, around 27 M cars on average are recycled globally every year.

Although values tend to differ, depending on the underlying commodity prices in a given year, PGM's on average, in the form of autocatalysts, make up between one third and half of the recycled vehicles' worth.

Global scrap from spent autocatalyst applications for platinum, palladium and rhodium rose 7% to 3.08 Moz (87 t). At a 56% share, palladium recorded the largest rise in volume of 0.12 Moz (3 t) reaching 1.72 Moz (49 t) last year, closely followed by rhodium (up 10%) and platinum (up 5%).

Autocatalyst scrap recycling revived last year following a considerable decline in 2015. Indeed, the prior year, platinum, palladium and rhodium recycling fell 9%, 12% and 12% respectively. The drop in material reaching refiners was a result of lower steel prices. At various stages in the supply chain, material was shelved in the hope of better prices.

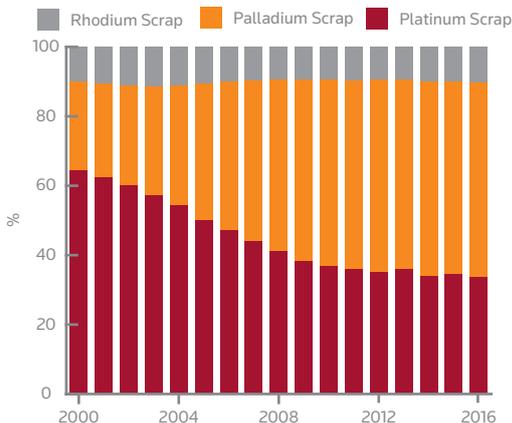
Autocatalyst recycling is still quite strongly concentrated in the mature markets, such as North America, Europe and Japan. It's in these regions where the majority of the recycling capabilities are located. Material collected from other parts of the world is mostly shipped out of the relevant countries and directed to the modern refining facilities in either of these regions.

Despite the rise in autocatalyst scrap recycling last year, the market has become a very competitive space. This has motivated some players to look at other services that they can add in order to keep expanding and diversify. Electronic scrap has been one of those areas, although also there margins are not what they used to be despite rising volumes. Others have looked at forward integration in order not only to look at the pre-processing area, but also integrate refining capabilities. To be successful at all those stages has proven to remain challenging.

Supply of platinum, palladium and rhodium from spent autocatalyst in **North America** rose 3% to 1.45 Moz (41 t) last year. For the majority of the year, recycling rates were muted driven by mainly lower PGM prices; -6%, -11% and -27% for platinum, palladium and rhodium respectively. The steel price, on the other hand, one of the major drivers of lower recycling rates in 2015, recorded a substantial increase last year of 15%, according to the SHFE futures figures. Particularly towards the end of last year, autocatalyst scrap recyclers received a flood of material from the market, with catalysts that had previously been shelved waiting for better prices. Although PGM prices were lower on an annual basis, the higher steel price was enough to release the accumulated stock to the market.

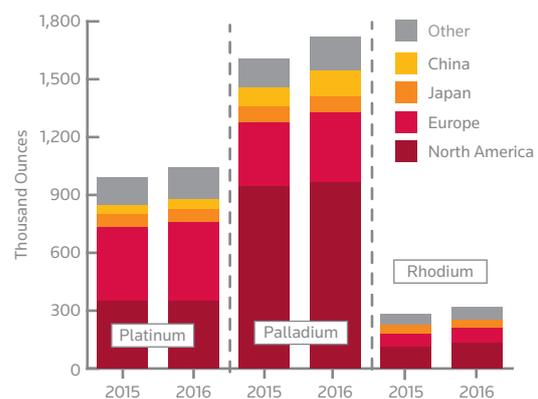
In addition, used car sales in the United States rose to a new record last year of 42 M units, with more sales expected this year due to lease periods coming to an end.

TOTAL OPEN LOOP SCRAP SHARE OF TOTAL SUPPLY



Source: GFMS, Thomson Reuters; LMC

GLOBAL AUTOCATALYST RECYCLING



Source: GFMS, Thomson Reuters

The majority of bought cars were done on credit with the average vehicle loan rising to \$19,227 in the third quarter last year. This obviously questions the sustainability of this trend in a rising interest rate environment. Annual default rates on car loans rose as well in 2016. As a result, securitised bonds based on car loans saw an upward pressure on yields which has made financing more expensive.

On the one hand, car purchases based on financing stimulate demand and increase consumers' access to vehicles, boosting the economy in the process. But it can also have an adverse effect, for example, when longer-term loans to finance the purchase of new and used-cars stretch to as many as 84 months and can hurt the lender recoveries by putting borrowers underwater, leaving lenders with an asset worth far less after repossession. Nevertheless, more used vehicle sales last year also meant that more cars were scrapped, which increased the material flow from the market.

The flood of material from the market was not so much an isolated North American development but more a transatlantic phenomenon. European recyclers experienced a similar trend. As a result, platinum, palladium and rhodium recovered from spent autocatalyst in **Europe** all rose by 8% in total to 0.84 Moz (24 t). Unsurprisingly, platinum recycling volume accounts for the majority of metal recovered from spent autocatalyst, 48%, closely followed by palladium, 43%, and rhodium 9%.

Spent autocatalyst recycling in **China** is estimated to have continued to rise by an impressive 33%, reaching 0.19 Moz (5 t) which is similar to the combined volumes of platinum, palladium and rhodium recorded in **Japan** last year. The growth pattern in China, however, is of course considerably different from that of Japan, which

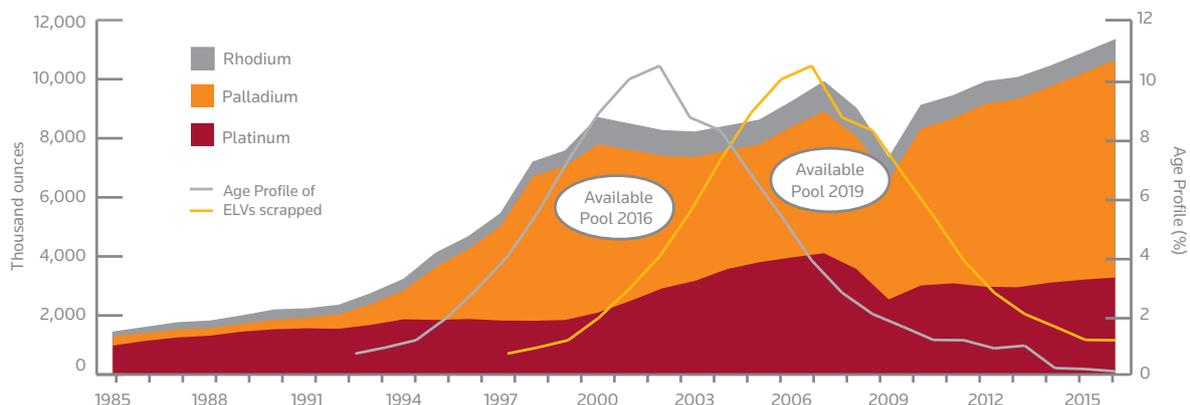
has been dealing with a stagnating market for quite a while. China on the other hand is booming, but recycling volumes are coming from a very low base. At last year's level, PGM spent catalyst recycling still only accounted for 13% of that recorded in North America and 23% of that of Europe.

In spite of the huge growth potential, not many international players have established a subsidiary in the country or are actively participating in this playing field. The scrap business, which is reputed to be known for being a cash-driven business that can attract illegal activity at times, in China has issues with corruption and policy regarding resource nationalism. Shipping material out of the country is difficult as the Chinese are eager to keep the valuable materials themselves. The 5% tax break last year, however, contributed towards new vehicle sales and motivated consumers to scrap their old cars.

There is, obviously, a lag between vehicle disposal and the return of recycled metal in refined form. In addition, scrapping volumes are still expanding, particularly inwards, as opposed to the stagnating mature markets in Europe and North America. As a result, China is estimated to scrap between 5-7 M units a year which was approximately 22% of new car production last year.

Our **Other Region** category is also estimated to have continued on a solid footing, increasing supply from spent autocatalyst by 14% to 0.40 Moz (11 t). This category traditionally features giant growth markets, such as India, Brazil and Thailand, but due to the lower emission standards in these countries, material recycled from vehicles is typically of less valuable content. In addition, none of these countries really have the technical capability to ultimately refine this material which means their supply chains are more concentrated on the collecting and pre-processing activities.

AUTOCATALYST DEMAND AND AGE PROFILE



Source: GFMS, Thomson Reuters (Johnson Matthey demand data for pre-1999)

JEWELLERY SCRAP SUPPLY

- **Global platinum jewellery scrap rose 5% last year to reach its highest level since 2011 of 0.57 Moz (18 t), driven by a 15% surge in supply from China.**
- **Palladium jewellery scrap rose for the fourth consecutive year in 2016, by 3% to 0.28 Moz (8 t), the highest recorded scrap level in our records.**

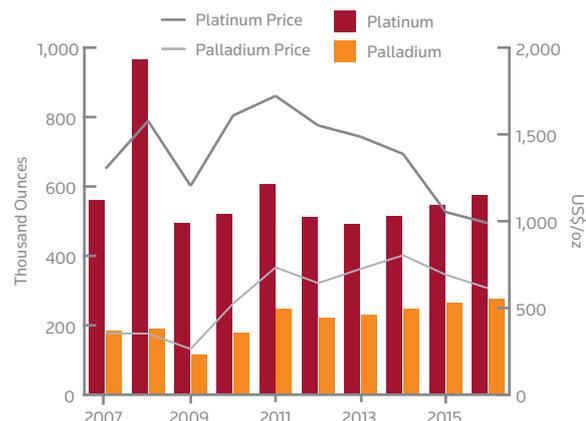
Global platinum jewellery scrap increased by 5% last year to reach 0.57 Moz (18 t), while the supply of palladium jewellery scrap increased by 3% to 0.28 Moz (8 t). Price was just one of the reasons but most instrumental was the changing market dynamics in Chinese jewellery fabrication as a result of costs related to platinum jewellery, which was making it less attractive for end use consumers. As a result, China's share of total jewellery scrap was 63%, up from 57% the year earlier. It was followed by Japan with its contribution at 34%, although Japan's share has seen a marked decline over this decade, falling from 57% in 2011. Moving to palladium jewellery, China remained the largest contributor to scrap volumes with a market share of 85% last year, the highest on record. Year-on-year China's jewellery scrap sales increased by 6%.

Platinum jewellery scrap from **China** continued to increase in 2016, by adding another 15% to 0.4 Moz (11.2 t), and covered 63% of the global market share. The increase in Chinese scrap was platinum's high domestic price, which includes 17% Value Added Tax (VAT), thus encouraging fabricators looking for materials that are less costly. While on an industry wide basis, 23% of the platinum jewellery fabricated in China came from old scrap last year, the share was as high as 50% for several fabricators. As a strong rebound in Chinese demand for platinum jewellery may not happen anytime soon, fabricators are eager to cut their costs and we expect the proportion of that jewellery fabricated from old scrap to continue to increase in 2017.

Meanwhile, looking to **Japan**, platinum scrap continued to decrease last year, down by 9% to 0.2 Moz (6.2 t). The decline in scrap supply was due to the weakening price in domestic terms, which fell 8% year-on-year. The scrap volume recorded last year was also at the lowest level since 2005.

Palladium jewellery scrap increased by 6% in **China** last year, to 0.2 Moz (6.2 t). The loss of market interest in palladium jewellery has changed the landscape of the domestic palladium jewellery sector, with the annual volume of scrap larger than jewellery demand since

PLATINUM & PALLADIUM JEWELLERY SCRAP



Source: GFMS, Thomson Reuters

2014. The ratio between jewellery scrap and demand has increased from over one in 2014, to close to 20 in 2016.

Scrap supply from **North America** has seen a sustained decline since 2008, with its contribution to total scrap falling from 7% in 2009 to just one percent in each of the last two years. Last year the volume of platinum scrap generated from jewellery dropped to the lowest since 2003 to 5,900 ounces (0.18 t), indicating the impact of the improving economic situation, as scrapping hardly increased despite the price soaring 39% in first seven months of the year. Similarly looking to **Europe**, scrap supply continued to edge lower for the seventh consecutive year, albeit it was at just a single percentage point last year as against the previous nine-year average of 9% decline.

ABOVE-GROUND BULLION STOCKS

- **For the second successive year platinum was a broadly balanced physical market in 2016 leaving above-ground bullion stocks of platinum at 6.3 Moz (195 t) at end-year.**
- **The fall in above-ground bullion stocks of palladium continued at a significant pace in 2016, leaving the market susceptible to bouts of tightness.**

Our supply/demand balances for platinum and palladium are designed to separate any distorting effect of flows from pre-existing above-ground stocks. Where we are able to identify such flows, these are shown separately as "below the line" items. Consequently, the arithmetical difference between our estimates of new supply (from mining and recycling) and fabrication demand, i.e. the physical surplus or deficit, represents our view of the underlying fundamentals of these metals. When a physical surplus is reported, this shows an excess of new supply over fabrication demand, implying an

increase in above-ground stocks. Conversely, a physical deficit, which developed in contrasting degrees for platinum and palladium in 2016, indicates a shortfall of new supply relative to fabrication demand. This implies a similar decline in above-ground stocks as this metal is required to redress that shortfall and satisfy fabrication needs. Meanwhile, we also quantify the scale of above-ground platinum and palladium bullion stocks. This includes inventories in the terminal markets, allocations to physically-backed ETFs and declared stock holdings on futures exchanges. In addition, we include an estimate for Russian government stocks of palladium and stocks of refined metal that may be held by industrial consumers and producers over and above normal levels.

PLATINUM

In 2016 the platinum market remained in broad balance at the physical level for the second year in a row. Indeed, neither total supply or total demand changed materially last year as a sharp reduction in jewellery offtake was almost exactly offset by an increase in usage across industrial and automotive applications. What's more, the drop in mine output was counterbalanced by a similar scale increase of supply from scrap. Our estimate of above-ground stocks at end-2016 is in the region of 6.3 Moz or 195 tonnes, of which approximately more than 2.5 Moz (77 t) are ETF holdings, and is equivalent to eleven months' fabrication demand.

In contrast to recent years we believe that there were limited net above-ground stock movement of platinum last year. Highlighting this change is the fact that whereas in 2015 ETF holdings had fallen by the largest annual amount ever, the total at the end of last year was almost identical to a year earlier. As expected, last year

saw a small decrease, of an estimated 50,000 ounces, in industry stocks due to Norilsk Nickel's release of inventory that it had set aside in the previous year to smooth sales in anticipation of lower output.

PALLADIUM

The palladium market recorded a physical deficit for the tenth year in a row in 2016, reaching 1.2 Moz (37 t). This was roughly a quarter bigger than a year earlier. This was chiefly due to sharply higher autocatalyst demand, although South African mine output was also appreciably lower. As a result, the relentless decline in above-ground palladium stocks continued and they are estimated to have dropped to 7.4 Moz (231 t) by end-2016, equal to roughly nine months' fabrication demand. For the second successive year the massive reduction in palladium ETF holdings means that the amount of above-ground stocks held outside ETFs dropped by a far more modest amount. In a similar vein to platinum, we believe Norilsk Nickel utilised industry stocks that it had built up in the previous year to smooth production. However, unlike platinum, we believe they also made purchases of around 160,000 ounces (5 t) of palladium in 2016 for its new Global Palladium fund. The 2016 purchases were reportedly made from both the central bank of Russia and other suppliers. It is also expected to purchase at least five tonnes in 2017.

The remorseless downward trend in palladium inventories due to the string of physical deficits this century finally showed signs of affecting market liquidity at times last year. To be clear, we would not suggest that inventories have become truly tight but we note that the market is becoming more susceptible to bouts of tightness as these substantial deficits persist.

ESTIMATED MOVEMENTS IN STOCKS

PLATINUM (000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Physical Surplus/(Deficit)	41	468	576	394	464	(309)	423	(851)	(150)	(192)
Industry Stocks	(200)	(300)	665	0	(100)	(300)	(1,000)	1,300	(50)	50
Exchange Traded Funds	(194)	(102)	(384)	(574)	(145)	(239)	(892)	(218)	260	5
Sub total - stock movements	(394)	(402)	281	(574)	(245)	(539)	(1,892)	1,082	210	55
Net Balance	(353)	65	857	(181)	220	(848)	(1,469)	231	60	(137)

PALLADIUM (000 ounces)

Physical Surplus/(Deficit)	(300)	(537)	(28)	(591)	(245)	(1,162)	(1,063)	(1,318)	(956)	(1,200)
Russia	900	1,280	1,100	800	800	400	200	0	0	(100)
Stillwater	63	0	0	0	0	0	0	0	0	0
Industry Stocks	0	0	0	0	(50)	(100)	(500)	600	(150)	(10)
Exchange Traded Funds	(280)	(381)	(507)	(1,089)	532	(448)	(0)	(899)	727	637
Sub total - stock movements	620	899	593	(289)	1,282	(148)	(300)	(299)	577	527
Net Balance	320	362	566	(880)	1,037	(1,311)	(1,363)	(1,616)	(379)	(673)

Source: GFMS, Thomson Reuters



Side by side with the technologies that usher in new eras

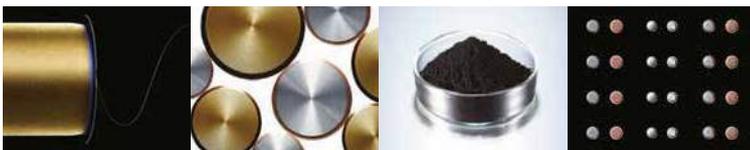
Since our founding in 1885, TANAKA PRECIOUS METALS has been pursuing new values and possibilities as precious metals professionals.

Automobiles, semiconductors, home electronics, alternative energy, medical, environment and infrastructure.

Our mission is to support all fields that require precious metals and to advance the businesses of all our customers.

By doing so, we contribute to a better society and a better future.

You will always find us side by side with the technologies that usher in new eras.



High-quality products proudly "Made in Japan"

TANAKA PRECIOUS METALS
—Thinking precious metals, serving the world.



<http://pro.tanaka.co.jp/en>

5. DEMAND

FABRICATION BY REGION, 2007-2016

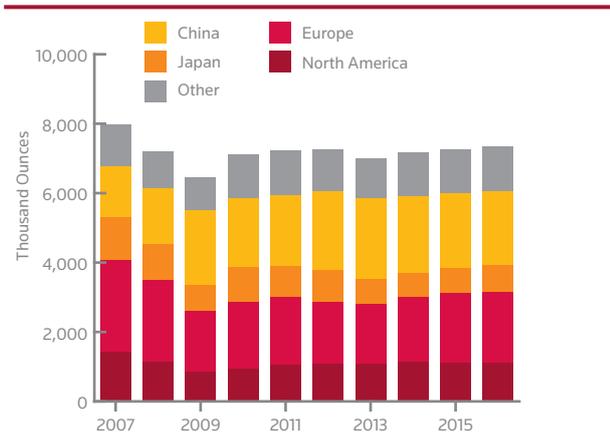
PLATINUM (000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
North America	1,421	1,121	851	920	1,036	1,065	1,079	1,135	1,117	1,104
Europe	2,659	2,356	1,745	1,952	1,982	1,795	1,738	1,876	1,997	2,037
Japan	1,208	1,062	754	995	884	929	700	689	734	757
China	1,472	1,586	2,169	1,977	2,018	2,256	2,348	2,209	2,145	2,146
Other Regions	1,230	1,083	923	1,275	1,310	1,216	1,128	1,266	1,271	1,269
Total	7,990	7,210	6,441	7,120	7,230	7,261	6,992	7,176	7,264	7,312

PALLADIUM (000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
North America	2,311	2,040	1,591	1,979	2,028	2,319	2,310	2,303	2,345	2,227
Europe	1,884	1,819	1,637	2,026	2,240	2,194	2,146	2,235	2,386	2,468
Japan	1,668	1,690	1,393	1,585	1,501	1,672	1,599	1,595	1,481	1,423
China	1,495	1,532	1,646	1,706	1,730	1,830	1,987	2,060	2,006	2,284
Other regions	1,088	1,134	1,105	1,313	1,308	1,302	1,269	1,277	1,277	1,310
Total	8,446	8,215	7,373	8,609	8,807	9,317	9,311	9,470	9,495	9,713

RHODIUM (000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
North America	339	253	161	182	206	228	233	219	239	212
Europe	323	314	265	274	303	259	248	234	250	242
Japan	245	274	197	198	158	195	155	118	120	106
China	26	181	95	110	104	158	165	196	185	199
ROW	242	254	260	275	226	262	214	145	146	136
Total	1,176	1,276	979	1,040	998	1,102	1,015	912	941	895

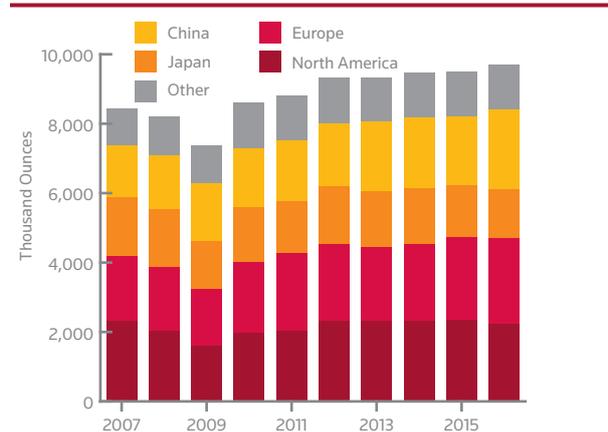
- *Platinum demand was broadly unchanged in 2016, as gains in autocatalyst, chemical and glass were offset by falls in jewellery and the electronics sector.*
- *Platinum jewellery offtake fell by 12% in 2016, dragging fabrication down to levels last seen in 2008, with falls in North America and China central to the decline.*
- *Demand for platinum in autocatalyst applications rose 2% to an eight-year high, with gains in China and Europe offsetting weaker Japanese and North American demand.*
- *A rise in palladium autocatalyst demand, coupled with an uptick in chemical and petroleum fabrication helped lift demand for palladium 2% higher in 2016.*
- *The glass, chemical and petroleum sectors recovered strongly but this was tempered by a modest decline in electronics demand.*
- *The 5.3% rise in palladium autocatalyst fabrication to a new record high 7.36 Moz (228.9 t) was largely a function of stronger demand from Europe and another impressive gain from China.*

PLATINUM DEMAND BY REGION



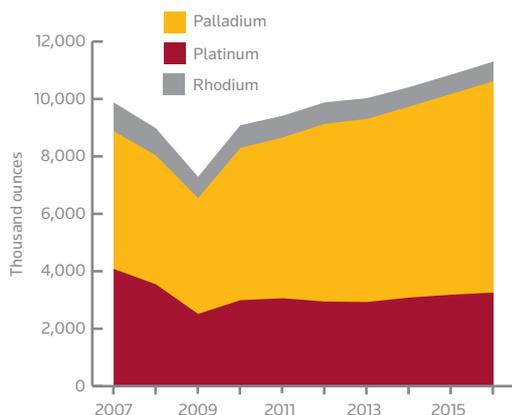
Source: GFMS, Thomson Reuters

PALLADIUM DEMAND BY REGION



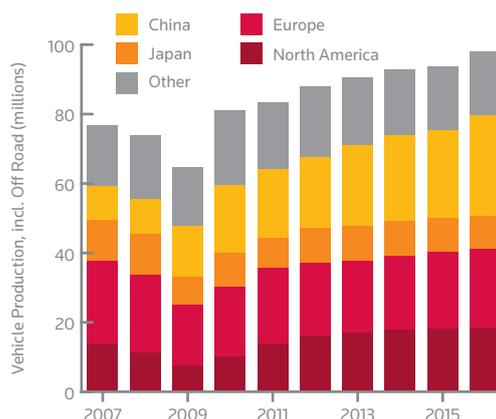
Source: GFMS, Thomson Reuters

PGM AUTOCATALYST DEMAND



Source: GFMS, Thomson Reuters; Johnson Matthey

GLOBAL VEHICLE PRODUCTION



Source: GFMS, Thomson Reuters; LMC Automotive

AUTOCATALYST DEMAND

PLATINUM OVERVIEW

Automotive exhaust mainly contains three harmful pollutants that are generated through inefficient fuel combustion process. Carbon Monoxide (CO), Hydrocarbons (HC) and Nitrogen Oxides (NOx) are the main pollutants generated from a gasoline powered vehicle, whereas NOx and particulate matter (PM) are generally a diesel related phenomenon. Autocatalytic solutions have been developed over the years to reduce these harmful pollutants by approximately 90% and precious metals, such as platinum, palladium and rhodium, form an integral part of this process.

PLATINUM OVERVIEW

Platinum is traditionally used in diesel vehicle aftertreatment solutions and is a good oxidation catalyst with resistance to poisons such as sulphur, phosphorus, or lead, which may be present in the exhaust. Two downsides to platinum use are its low activity for the conversion of NOx and its high price, particularly historically, compared to palladium. In addition, platinum is sensitive to the high temperatures which may occur in the catalytic converter during high engine loads. Platinum is used in both light duty diesel (LDD) and heavy duty diesel (HDD) vehicles. LDD consist of passenger cars and small commercial vehicles whereas HDD are heavy commercial transport and buses (for on-road applications) and Non-road mobile machinery (for off-road applications).

Platinum demand in autocatalyst applications rose 2% last year reaching 3.29 Moz (102 t) with a market share of 42% of total demand. Europe was the driving force behind the increase, lifting platinum consumption in

autocatalyst applications 5% to 1.49 Moz (46 t). Although from a low base, China, recorded the strongest relative increase globally, raising platinum consumption 15% to 0.30 Moz (9 t) last year. North America, in contrast, recorded a 9% decline to 0.44 Moz (14 t), and Japan reduced platinum consumption 3% to 0.33 Moz (10 t). Platinum demand in our Other Region category rose 3% to 0.73 Moz (21 t).

DEMAND BY REGION

Europe is the largest platinum consuming region, accounting for 45% of demand in autocatalyst applications last year, although its dominance has been waning over the last decade compared to, for example, its peak years in 2007-09 when platinum in Europe accounted for 51% of global demand in this segment. Last year, at 1.49 Moz (46 t), Europe recorded a 5% increase of platinum consumption in automotive applications. Unsurprisingly,

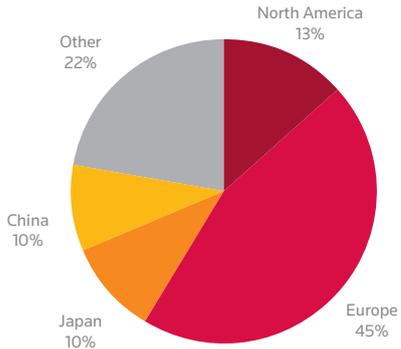
AUTOCATALYST DEMAND

PLATINUM			
(000 ounces)	2015	2016	Change
North America	485	443	-8.7%
Europe	1,420	1,488	4.8%
Japan	340	331	-2.6%
China	257	296	15.0%
Other regions	708	728	2.7%
Total	3,211	3,286	2.3%

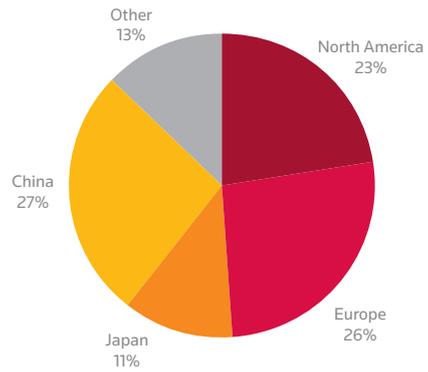
PALLADIUM			
(000 ounces)	2015	2016	Change
North America	1,757	1,672	-4.8%
Europe	1,828	1,938	6.0%
Japan	868	858	-1.2%
China	1,651	1,953	18.3%
Other regions	888	940	5.8%
Total	6,991	7,360	5.3%

Source: GFMS, Thomson Reuters

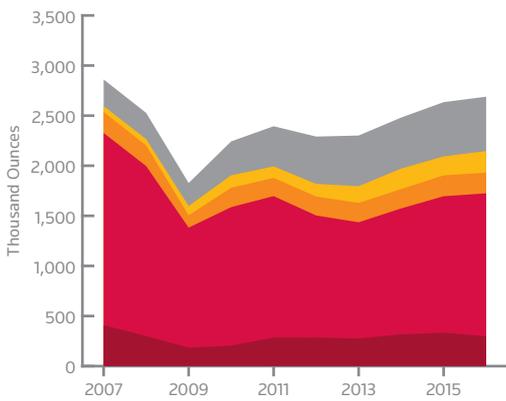
PLATINUM DEMAND IN AUTOCATALYSTS, 2016



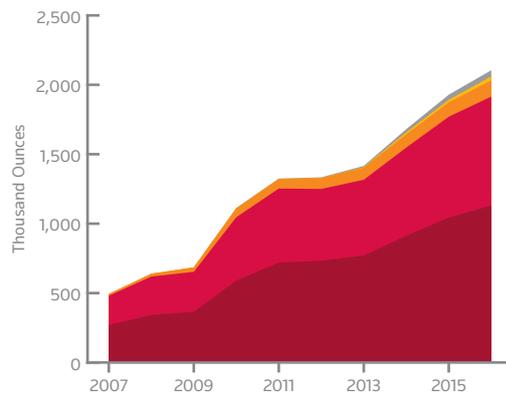
PALLADIUM DEMAND IN AUTOCATALYSTS, 2016



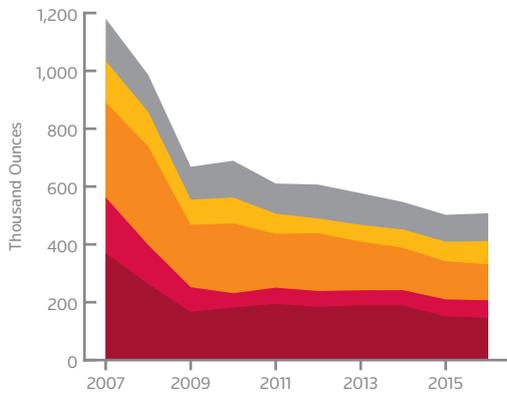
DIESEL PLATINUM DEMAND



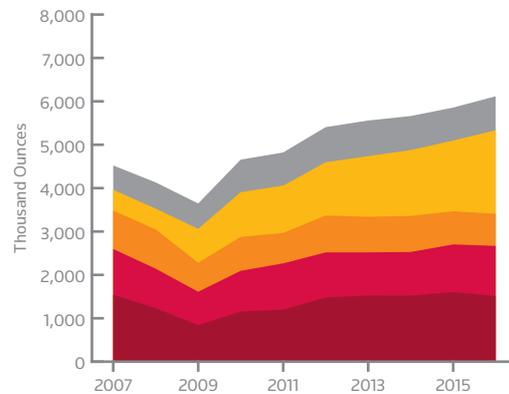
DIESEL PALLADIUM DEMAND



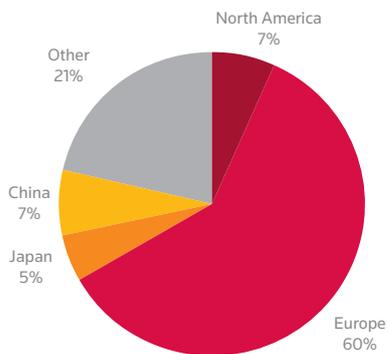
GASOLINE PLATINUM DEMAND



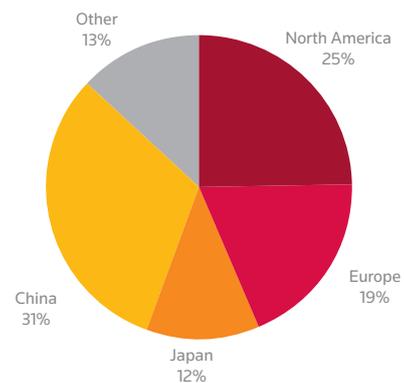
GASOLINE PALLADIUM DEMAND



PLATINUM IN DIESEL, 2016; REGIONAL DEMAND



PALLADIUM IN GASOLINE, 2016; REGIONAL DEMAND



All Charts Source: GFMS, Thomson Reuters

Legend: North America (Dark Red), Europe (Red), Japan (Orange), China (Yellow), Other (Grey)

DEMAND

between the various segments, LDD, which accounted for 81% of platinum demand, was the main contributor to the rise. What was surprising, however, was the continued rise in European diesel vehicle production, which climbed 3% to 10 M units; its third consecutive year of increase.

Since the VW emission scandal broke in September 2015, in which VW was found guilty of rigging emission results outside the laboratory test environment, Europe has been debating the future use of diesel vehicles in the region. Politicians in Paris and London have been particularly vocal expressing their discontent about the high levels of NOx and PM generated by diesels. In order to comply with the tighter fuel economy standards and reduction in CO2 to 95 grammes of CO2/km from 130 grammes at present, OEMs have geared their strategy towards an increased portion of diesels in their vehicle fleet. Diesels traditionally offer approximately 20% more energy than gasoline cars and around 15% lower CO2. In order to comply with the standards set by the European Commission, petrol consumption will have to fall to 4.1 L/100 km and diesel to 3.6 L/100 km.

The introduction of Euro 6b, which applies to all vehicles produced since September 2016, had a positive effect on PGM loadings. Henceforth, vehicles must meet Euro 6 emission limits when tested over the New European Drive Cycle (NEDC). Compared to Euro 5, NOx limits for diesels will have to be reduced by a further 56%. But the new testing procedure will in some instances also result in renewed engine calibration and aftertreatment optimisation in order to comply with the more challenging real life testing environment. This will positively affect the use of PGMs in autocatalysts.

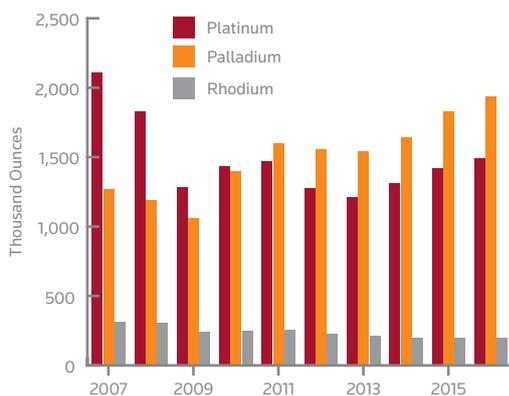
Platinum demand in **North America** fell 9% to 0.44 Moz (14 t) last year, reflecting heavy reliance on gasoline powered vehicles and the aftermath of the VW emission

scandal. Platinum consumption in the LDD segment reported a 2% increase, in line with LDD vehicle growth to 1.1 M units. Not so long ago, diesel penetration in the North American market was considered a huge opportunity given that it only had 5% market share. Following the VW scandal, those prospects have faded. Platinum loadings in gasoline and diesel applications are estimated to have reduced, but will likely increase this year due to tighter Low Emission Vehicle (LEV) III emission legislation. Platinum uptake was particularly hampered in the HDD segment, where sluggish manufacturing activity continuously affected commercial vehicle and non-road mobile machinery purchases.

Japan followed a similar trend to North America. Platinum use in gasoline and diesel applications fell 5% and 6% respectively. Although a collaboration of some Japanese OEMs have had plans for years to further develop diesel technology, few have actually increased their diesel driven models in their vehicle offering. Platinum consumption thus continues to suffer in this country, which generally is strongly geared towards gasoline, hybrid-gasoline and even electric vehicles. Diesel vehicle production fell 7% to 0.8 M units last year while platinum demand fell by 3% to 0.33 Moz (10 t).

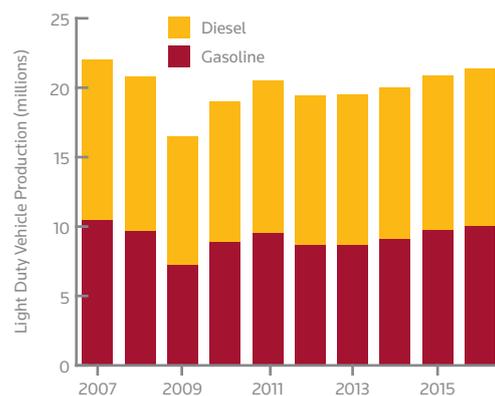
Last year, **China** once again recorded healthy vehicle production growth, rising 14% to approximately 29 M units. It has established itself as the largest vehicle production and sales market in recent years, with around 30% of total production in 2016. China is predominantly a gasoline market and diesel applications continue to play a much smaller role. That said, platinum demand for both the light duty gasoline (LDG) and LDD segments reported considerable increases last year but remain small compared to palladium's usage in LDG vehicles. For example, platinum use in China in LDV and HDV applications only accounted for 13% of total platinum and

AUTOCATALYST DEMAND: EUROPE



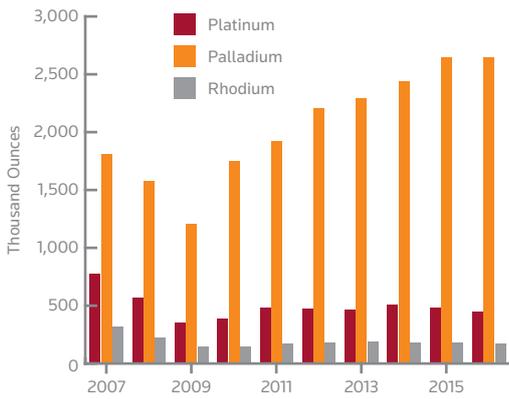
Source: GFMS, Thomson Reuters

EUROPEAN LIGHT DUTY VEHICLE PRODUCTION



Source: GFMS, Thomson Reuters; LMC

AUTOCATALYST DEMAND: NORTH AMERICA



Source: GFMS, Thomson Reuters

palladium demand. Nevertheless, albeit from a low base, platinum demand rose 15% to 0.30 Moz (9 t) last year.

China has made great strides in trying to reduce pollution generated by vehicles in recent years through implementing stricter legislation. In fact, China 6, the equivalent of Euro 6, set for introduction in 2021 will be the strictest emission standard in the world. Enforcing legislation remains a challenge in the country, however, as well as reducing fuel impurities. Diesel vehicles in China are largely utilised in the small commercial vehicle sector ranging from vans to small trucks. In terms of size it's a rather fragmented market with the 2.8 L and 3.7 L engines dominating the space, with 16% and 26% of the total market each. On the personal vehicle front, the 2 L engine is the dominant vehicle size, which accounts for 45% of total diesel personal vehicle production last year.

In line with Europe, our **Other Regions** category is the only other region with a considerable share of platinum consumption in its vehicle fleet. Platinum consumption rose 3% to 0.73 Moz (23 t) here, mainly as a function of increased usage in gasoline applications. We estimate

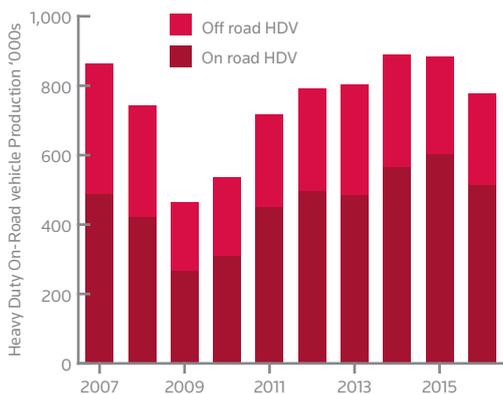
that, in line with the 1% overall rise in LDG vehicle production last year (12 M units), platinum gained some market share on top of continued rising PGM loadings. Indeed, just like China, various countries in this region are catching up with their emissions legislation and the platinum-palladium spread has narrowed considerably stimulating increased platinum use in diesel applications.

The most prominent country in this category is India, which plans to leapfrog Bharat stage V and go straight to the Euro 6 equivalent Bharat stage VI from 2020 onwards. This is a very welcome development particularly since India hosts four of the top ten most polluted cities globally based on PM2.5 pollution. PM2.5 stands for particulate matter and is one-thirtieth the size of a human hair. These are big health hazards as they enter human lungs and blood tissues and cause serious health problems. But it is also ambitious and many remain sceptical about the viability of the plan.

PALLADIUM OVERVIEW

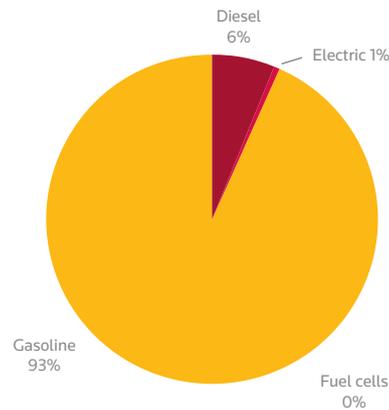
Trading at an average of \$614/oz last year, palladium remained the cheapest of platinum, palladium and rhodium. In addition, palladium has excellent activity for the oxidation of hydrocarbons, very good thermal durability and excellent properties for the removal of NOx. The most common drawbacks to palladium include its sensitivity to poisons. Largely for these reasons, most catalytic converters today consist of some combination of palladium and rhodium. At current precious metals prices, with rhodium trading at an average of \$693/oz last year, a palladium-rhodium formulation gives a good trade-off between cost and performance. While there are still incentives to find cheaper alternatives to the precious metals, the tightening aftermarket and OEM emission standards provide a strong case for continued use of precious metals in key components of catalysts.

NORTH AMERICA MEDIUM & HEAVY DUTY VEHICLE PRODUCTION



Source: LMC; GFMS, Thomson Reuters

US DOMESTIC PASSENGER CAR SALES



Source: LMC Automotive; GFMS, Thomson Reuters

Palladium is widely utilised in gasoline applications. For example, platinum globally accounts for an estimated 18% or 0.60 Moz (19 t) in gasoline applications compared to palladium’s 85%, or 6.23 Moz (194 t). Total global palladium demand in autocatalysts (including LDD, HDD on-road & off road and motorcycles applications) rose 5% to 7.36 Moz (229 t) last year. The big driver behind the strong annual increase was robust gasoline vehicle production, gaining 6% to 73 M units. Despite the rise, excess capacity persists, with utilisation rates falling slightly to just below 70%.

DEMAND BY REGION

For the first time in our records, **China** surpassed Europe last year as the largest palladium consuming market in autocatalyst applications. An 18% gain pushed China’s market share to 27%, at 1.95 Moz (61 t), 1% higher than Europe volumes. As in 2015, gains were recorded across the various segments with the LDG segment leading the way. A looming re-introduction of a normal 10% tax rate on small engine vehicles, up from 5% in 2016, pulled a large amount of vehicle sales forward. This year the Ministry of Finance raised the tax to 7.5% to reduce some sales but not choke off demand completely. This measure is largely positive as the underlying market is weak without this temporary prop. In addition, the net effect on reducing pollution might actually be slightly positive, given that old polluting cars are exchanged for newer less polluting ones, as long as the total Chinese domestic vehicle fleet doesn’t increase. Tighter nationwide emission legislation, China 5, is to be introduced during 2018, although stricter standards are already in force in the major cities which has aided palladium demand.

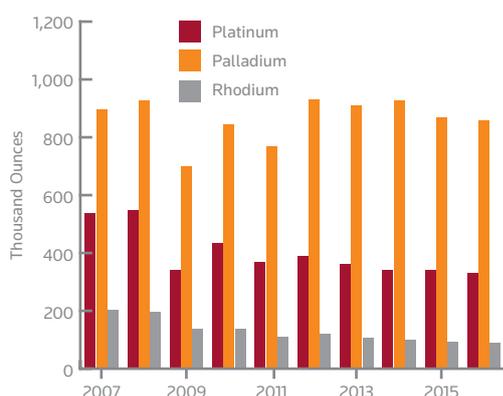
Stricter emission standards have also been introduced in **North America** in the Low Emission Vehicle Program (LEV III) from California’s Air Resource Board (CARB).

These are equivalent to the federal Tier 3 standards, but currently the less stringent Tier 2 standards are in force nationwide. We estimate that loadings in North America fell slightly due to ongoing thrifting but are likely to rise with the wider phase-in of tighter standards. Consequently, demand for palladium in autocatalyst applications fell 5% to 1.67 Moz (52 t) last year.

In addition, particulate in number (PN) will be the next in line to be reduced, which will require gasoline vehicles to adopt a gasoline particulate filter (GPF). These come in various forms, integrated as a 4-way catalyst or as a separate brick downstream and do not always have a PGM loading. However, higher fuel economy standards in our view will force OEMs to fully adopt direct injection engines and even move towards more lean burn options. These solutions have an issue with reducing NOx which might actually result in the introduction of a NOx trap in gasoline vehicles. That will be PGM positive.

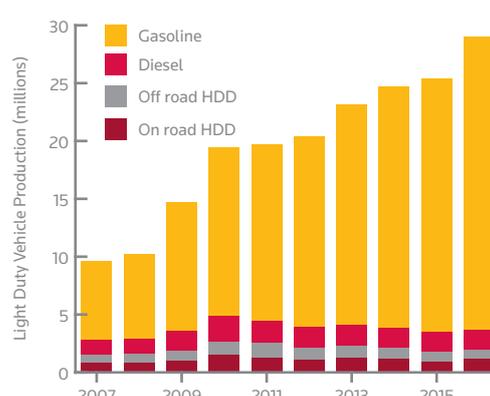
If and when that tighter legislation gets implemented is still, despite the clear timeline outlaid by the government, a shot in the dark considering President Trump’s predilection to listen to the auto lobby and postpone further emission tightening. In addition, if 45% of U.S. LDV are imported and new policies impose a tariff and border adjustment taxes, there could well be a shift to “Made in America” which could boost local demand. But trade barriers would impose price increases which could in turn reduce demand and the “America first” effect could also have consequences for domestic brands to sell their cars abroad. Rising domestic capacity has increased excess capacity and reduced utilisation rates, although at approximately 90% this is still high when compared with elsewhere. How this is all going to play out on PGM consumption remains uncertain. We believe, however, that further emission tightening could at best be delayed which pushes higher PGM demand further

AUTOCATALYST DEMAND: JAPAN



Source: GFMS, Thomson Reuters

CHINESE LIGHT DUTY VEHICLE PRODUCTION



Source: GFMS, Thomson Reuters; LMC

down the line. Lower domestic demand and ability to export, in case tariffs were to emerge, will downwardly affect demand for vehicles and PGM consumption too.

With China ramping up production as well as its own automotive brands, more established car makers are struggling to remain competitive. **Japan**, which traditionally is heavily geared towards exports, posted another drop in vehicle production last year. Including HDD, vehicle production fell 2.5% to 9 M units. Due to the localisation effect, where international brands establish production plants in their local markets to circumvent import duties and to be in closer proximity to their customers, not all local production is a reflection of how the Japanese car manufacturers are performing. But the fact of the matter is that production in the country itself is stagnating. Japan represented 12% of total palladium demand last year and saw palladium consumption fall 1.2% to 0.86 Moz (27 t).

On a brighter note, palladium demand in **Europe** continued its steady growth, lifting gasoline vehicle production volumes 2% to 11 M units. Due to expected more stringent emission legislation on the back of real driving conditions, loadings rose slightly last year which, in combination with higher sales, boosted palladium demand 6% to 1.94 Moz (60 t). Growth in palladium demand was also recorded in our **Other Regions** category, rising 6% to 0.94 Moz (29 t). Palladium use in the LDG segment dominates the space at 83% market share and therefore was the main driver behind the rise.

HEAVY DUTY VEHICLES

Heavy duty vehicles are almost exclusively diesel fuelled and therefore strongly focused on platinum usage. Production of both road-going and off-road applications, which both account for half of total production, rose 2.1% to approximately 7 M units. For road-going HDD (including heavy buses), a lot of the aftertreatment options used are based on similar rough combinations of filters, such as a diesel oxidation catalyst (DOC), a selective catalytic reduction catalyst (SCR) and a diesel particulate filter (DPF). In combination with high, medium, low or no exhaust gas circulation this covers the bulk of the market. The on-road HDD sector has made great progress over the years reducing major pollutions by over 90%. The current legislation therefore is geared less towards further reducing NOx and PM in favour of increasing fuel consumption and reducing CO₂.

We estimate that platinum used in HDD on-road applications marginally contracted last year, mainly due

to a strong fall in North American vehicle production and continued thrifing in that region. Vehicle production and thus platinum demand in Japan and Europe followed an opposite trend, while PGM consumption in on-road and off-road applications in both China and our Other Region remains low, as many countries have no or very little aftertreatment options installed (see a more detailed analysis of that on Eikon). That, however, is rapidly changing, also on the non-road mobile machinery side where China and India move towards Tier 4 Interim. The stage V/Tier 5 introduction in the EU will drive DPF demand dramatically and reduce SCR solutions, which is a PGM positive development. We estimate that platinum demand dominates the non-road mobile machinery space with a market share of 80%, but we expect this to decline due to continued substitution towards palladium.

RHODIUM

Rhodium is currently the most expensive precious metal of the three and has by far the highest activity for the removal of NOx from the exhaust. In addition, it has significant activity for the oxidation of HC and CO and very good resistance to the poisons present in the exhaust stream. The primary drawback is its relatively high cost, particularly historically when the price ballooned to peak at \$10,100/oz on 19th June 2008. Rhodium is mainly used in gasoline applications but is also used in smaller diesel engines in the form of a lean NOx trap (LNT). Last year rhodium recorded a 1% increase reaching 0.68 Moz (19 t). Small vehicle sales in China rose considerably last year driven by the 5% tax cut which boosted demand for rhodium in this region as well. Japan, North America and our Other Region category on the other hand all recorded declines in rhodium consumption in autocatalyst applications. European offtake only marginally increased.

AUTOCATALYST DEMAND: REST OF WORLD



Source: GFMS, Thomson Reuters

HIGHLIGHTS OF EMISSION STANDARD TIMETABLES

DEMAND

Light Duty Vehicles Legislation Overview

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Europe	Euro 6b		Euro 6c / RDE Phase 1			RDE Phase 2 / 95 g/km CO2			Possible Euro 7		
North America EPA	Tier 2		Tier 3 Introduction								
North America CARB	LEV III Phase in						LEV III Tightening				
Japan	Japan 09			Possible Japan 18							
South Korea (diesel)	Euro 6b				Euro 6c						
China (Nationwide)	China 4			China 5			China 6				
India	Bharat Stage 4					Bharat Stage 6					
Indonesia	Euro 2			Euro 4							
Thailand	Euro 4				Euro 5					Euro 6	

Heavy Duty Vehicles On-Road Legislation Overview

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Europe	Euro VI								Possible Euro VII		
North America	Greenhouse Gas Phase 1						Greenhouse Gas Phase 2				
Japan	Japan 09		Japan 16								
South Korea	Euro VI									Euro VII	
Brazil	Euro V							Euro VI			
Russia	Euro IV			Euro V					Euro VI		
India (major cities)	Euro IV		Euro V			Possible Euro VI					
India (nationwide)	Euro III		Euro IV			Euro VI					
China (major cities)	Euro IV		Euro VI								
China (nationwide)	Euro IV			Euro V			Euro VI				

Heavy Duty Vehicles Off-Road Legislation Overview

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Europe	Tier 4b				Stage V						
North America	Tier 4b							CARB/EPA			
Japan	Tier 4b										
South Korea	Tier 4b					Possible Stage V					
Brazil	Tier 3					Tier 4a				Tier 4b	
China (major cities)	Tier 3			Tier 4a				Tier 4b			
China (nationwide)	Tier 3					Tier 4a					Tier 4b

Source: Various Government Departments; GFMS, Thomson Reuters

JEWELLERY

- *Global platinum jewellery demand fell by 12% to an estimated 2.18 Moz (67.7 t) in 2016, dragged lower by another material decline from China.*
- *A precipitous fall in Chinese demand saw palladium jewellery demand decline by 13% last year to 0.30 Moz (9.3 t).*

In 2016, global **platinum** jewellery demand fell by 12% to reach 2.18 Moz (67.7 t). This took jewellery's share of total fabrication to 28%, down from 45% at the start of the millennium. The bulk of the losses were centred on two major markets, namely China and North America, which both saw fabrication fall by double-digit percentages. The former was hindered by a weaker economic environment and market share loss to yellow 18-carat jewellery, while for the latter, a lack of promotion, slow moving stock, and that jewellery sticker prices did not reflect that platinum was trading at deep discount to gold, accounted for the decline. Japanese demand held up well, declining only at the margin, while European offtake was also impacted by a lack of promotional activity.

Palladium jewellery fabrication also fell last year, slipping 13% to an estimated 0.30 Moz (9.3 t). Losses were concentrated in China as the market there struggles for survival, plummeting by 77% in 2016 to represent just 4% of global demand against over 75% of the market at the peak in 2005. North American demand declined 5% on a year-on-year basis to record the eighth consecutive annual contraction on the back of weaker promotional activity, while European offtake was only marginally weaker, supported by a resilient wedding ring market.

JEWELLERY DEMAND

PLATINUM			
(000 ounces)	2015	2016	Change
North America	248	223	-10%
Europe	215	207	-4%
Japan	324	317	-2%
China	1,561	1,299	-17%
Other regions	118	130	10%
Total	2,466	2,176	-12%
PALLADIUM			
(000 ounces)	2015	2016	Change
North America	55	52	-5%
Europe	148	147	-1%
Japan	47	44	-5%
China	52	12	-77%
Other regions	43	43	1%
Total	345	299	-13%

Source: GFMS, Thomson Reuters

CHINA

Chinese **platinum** jewellery fabrication declined for a third consecutive year, falling 17% year-on-year to an estimated 1.3 Moz (40 t) last year. In value terms, demand fell 13% to approximately US\$1.4 billion, as the average price of platinum in local terms increased by 13%.

China's annual GDP growth rate was 6.7% in 2016. The strength of the Chinese economy took a notable downturn since 2015 and this downwards momentum continued into 2016, although sentiment did start to improve in the second half of the year. The official manufacturing PMI, which tracks manufacturing activities of the larger sized enterprises in China, saw monthly ratings below 50.0 recorded in three months in 2016, compared to seven months during 2015. When the PMI is below 50.0 this indicates that the manufacturing sector is shrinking and a value above indicates an expansion. Meanwhile, if we look at the Caixin manufacturing PMI, which tracks orders of the more middle and smaller sized companies, things looked less rosy, with monthly readings below 50.0 for six months last year, all during the first half. While the Chinese economy improved in 2016 compared to the prior year, unfortunately it did not translate to higher demand for platinum jewellery within the country.

The Chinese have a long cultural affinity to gold, and thus the gold market in China is much more developed than the platinum market. Compared to platinum, gold has higher transparency in terms of price as well as liquidity, which consumers will consider before purchase.

There has been a significant shift in market strategies for Chinese jewellery retailers in recent years. As the economy slowed this had a real negative impact on consumer sentiment with consumers reducing their discretionary spending in a bid to maintain cash reserves. The whole jewellery sector has not been performing well since the peak in 2013, and retailers have shifted their selling strategies from the volume based model used in the past to now focusing efforts on selling higher margin items. The traditional 24-carat gold items, which have been the dominant segment in the jewellery sector in volume terms, usually command a gross margin of less than 20%. Thus retailers have been cutting down orders for these low margin products, instead shifting their focus to products that carry much higher margins like 18-carat gold items and gem sets. While in theory, platinum jewellery also commands a much higher margin compared to the 24-carat gold products, this sector failed to take advantage of the high margin strategy

that retailers adopted last year, as its position has been eroded by the emergence of the 18-carat gold segment which is rapidly picking up market share.

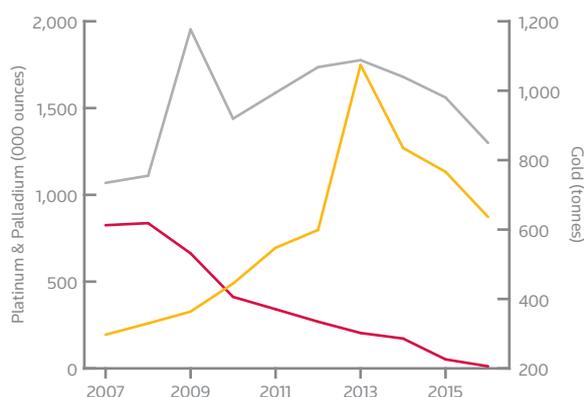
The Chinese have a long history with affinity to gold, and they predominately prefer jewellery of yellow colour. While the 18-carat gold segment continued to enjoy another year of robust growth in 2016, the most popular item within the 18-carat segment has been yellow gold, which covers approximately 60% market share within the 18-carat segment. The Chinese community has yet to fully embrace jewellery in other colours, or where they have it has been fleeting and driven by fashion trends, as demand for white gold has been falling dramatically in the last few years. Another tough blow for platinum has been the current preference of consumers choosing 18-carat yellow items (either plain or gem set) over platinum for wedding jewellery, with the estimated market share of the former in the gem sets segment close to 80% last year. In addition, due to the nature of the metal, fabricators are able to work on more sophisticated designs with 18-carat gold than platinum pieces, and given the general bullish nature of this industry segment, retailers were pushing 18-carat gold more aggressively than platinum.

Another influencing factor has been the cost of inventories for both the fabricators and retailers. As both need to display inventories in their show rooms and cabinets, it works to their advantage to focus more heavily on promoting 18-carat gold over platinum jewellery, as in general, the cost per 18-carat gold piece is lower than the same platinum piece and the turnover is faster. As a result they prefer filling the display cabinets with 18-carat pieces instead of platinum items - as it can create less stress to their cash flow and benefits their cost controls.

Another problem with the platinum market has been the lack of corresponding adjustments to sticker prices which failed to accurately reflect the price differential between the international platinum price and that of gold. The lack of clarity caused many consumers to think twice before purchasing given the widening gap at the retail level. Indeed, assuming all else being equal, a platinum piece is still more expensive at the retail level compared to a pure gold item, despite the international price of platinum trading lower than gold. While the price tags for some platinum jewellery have been adjusted downwards, many traders across the supply chain have been unwilling to reduce price points substantially as it would have limited their margins and some were also stuck with stock purchased at a higher price level. The industry participants argued that as the demand volume for platinum is so small compared to gold, they need higher margins to compensate the lack of volume.

In the last two years, China's platinum jewellery fabricators have also been shifting to produce platinum pieces with a lower purity content. China's platinum jewellery market is basically made up of purities in Pt999, Pt990 and Pt950, with the former two previously commanding the lion's share of the market. However, fabricators have been focusing more on producing Pt950 purity in the last two years, as this segment in particular was gaining market share over other purities. The Pt950 purity designs have become the dominant form within the segment, commanding over 60% market share. The popularity of the Pt950 purity product is two-fold: Firstly, working with a higher purity content requires a more sophisticated tooling process and increased costs of fabrication, thus lowering the purity pieces helps producers to contain and even reduce costs; secondly these production costs savings are now being passed on to the consumers, hoping that this may increase retail activity.

CHINESE JEWELLERY FABRICATION

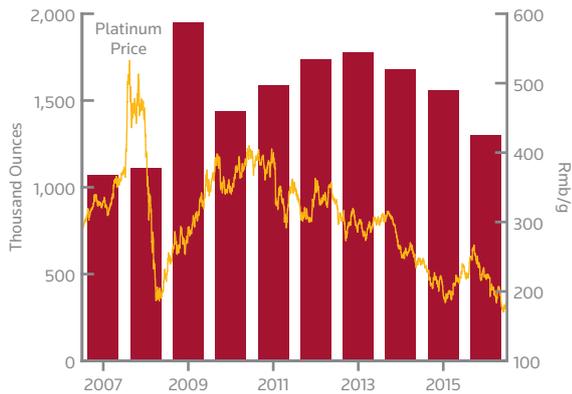


Source: GFMS, Thomson Reuters

Judging by the latest economic data the Chinese economy would appear to be maintaining the strong momentum seen since the final quarter of last year. However, we think consumer preference will play a vital role on the eventual demand from this market, and thus demand from the Chinese jewellery sector may continue to fall in 2017, although any contraction is likely to be smaller in percentage terms than in 2016.

Palladium jewellery fabrication in China plummeted 77% last year, to just 12,000 ounces (0.4 t), the eighth consecutive annual decline that has seen the industry ravaged. Indeed, demand from the domestic jewellery industry has slumped over 99% from its peak in 2005,

CHINESE PLATINUM JEWELLERY FABRICATION



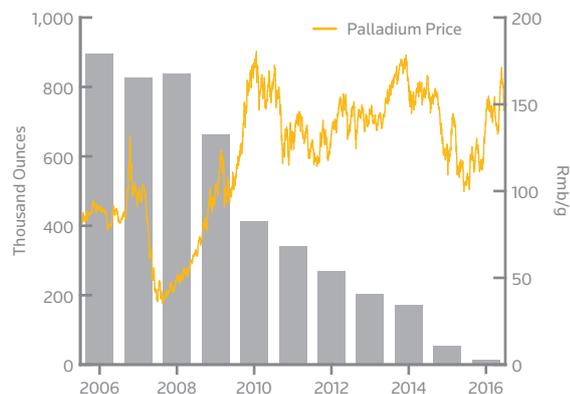
Source: GFMS, Thomson Reuters

when its annual demand was 1.0 Moz (32 t). The outlook for this industry remains bleak, with many industry insiders predicting that the palladium jewellery industry in China will soon cease to exist.

Like platinum, palladium also suffers from consumer preference which does not favour the white colour metal. A relative lack of market promotion or an adequate platform for consumers compared to the platinum jewellery industry makes this particular sector even more dire. Palladium jewellery also suffers from impediments such as an absence of a transparent pricing mechanism (palladium is not traded on the Shanghai Gold Exchange) and relatively low recognition of the metal among the general public.

As a result of poor market demand, there remains only one major palladium jewellery fabricator left in China, compared to three in 2014. While this particular fabricator has now become a monopoly, their fabrication volumes still fell substantially last year, and they expect

CHINESE PALLADIUM JEWELLERY FABRICATION



Source: GFMS, Thomson Reuters

that their orders could fall another 50% in 2017 without targeted promotion.

JAPAN

In 2016 Japanese **platinum** jewellery demand fell slightly to reach 317,000 ounces (10 t) on a gross basis. The 2% annual decline last year was primarily a function of weaker demand in the wedding sector though most categories of the jewellery industry remained moribund due to the health of the domestic economy which dragged down consumer spending. The decline in 2016, at just 2%, would have been greater if not for a solid recovery in the final quarter. This was led by the surprise victory by Donald Trump in the United States presidential elections that saw the domestic equities market rally, boosting consumer confidence and as a result retail spending. This lifted pre-Christmas sales and helped to partially offset declines earlier in the year.

The platinum price was not an influencing factor for the slowdown in fabrication demand in 2016 as the average domestic platinum price in yen terms fell to an eleven-year low of 3,451 yen per gramme, sliding 16% on a year-on-year basis. As outlined above, the major factor underpinning the bearish market has been the consistent weakness of the Japanese economy. Economic uncertainty has for many years dogged retail spending in Japan as the country has struggled to achieve a steady recovery after decades of deflation and stagnation. Economic output has oscillated between expansion and contraction, with a number of stimulus programmes failing to produce sustained growth. Japan's economy expanded just 1% last year, as a rise in exports in the second half helped offset a drop in private consumption. A fourth quarter resurgence, aided by a drop in the platinum price, helped offset earlier losses as both consumers and the supply chain took the opportunity to build stocks at the lower price level.

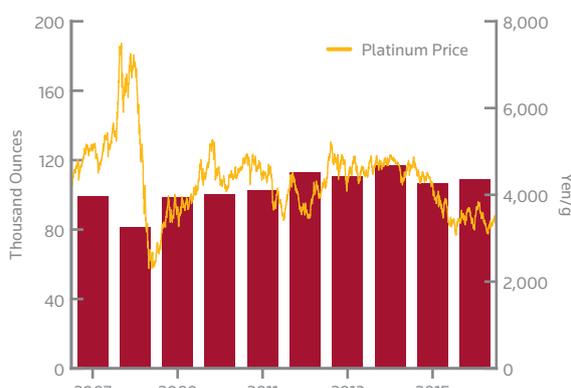
Offsetting some of the weakness in local consumption in recent years has been the prolific increase in tourist visitors to Japan, attracted by the weaker yen. While the yen recovered in 2016, most notably following the Brexit vote when its status as a safe haven currency came to the fore, foreign visitors continued to support the local market, albeit the growth rate declined significantly from the previous year. The number of visitors to Japan rose 21.8% to just over 24 million in 2016 and their spending grew 7.8% to ¥3.75 trillion (\$33 billion), both all-time highs, according to the Japanese National Tourism Organisation. Of the total visitors last year, the Chinese accounted for the largest portion at 26.5%, totalling

6.37 million visitors, up 27.6% from the previous year, followed by South Korea and Taiwan. Despite the rise in gross numbers the average spending per visitor actually fell 11.5% last year; a sentiment echoed by our research contacts who suggested that the purchasing power of tourists had indeed changed. Where in 2015 tourists were flocking to Ginza for luxury brands, last year spending was directed more to lower-end products.

The substantial decline in the local platinum price last year did allow retailers to drop sticker prices in a bid to attract customers and helped ease pressure on fabricators who have been forced to whittle down the weight of jewellery in order to meet key price points. With regards to the bridal sector, where platinum dominates, demand was again weaker than the previous year. Platinum jewellery outperformed its precious metals peers, eroding white gold's market share, but was still dragged lower by the lack of consumer spending. Department store sales were down sharply in 2016 with a very poor first half but there was a notable recovery in the latter stages of the year. On a brighter note, regional and smaller stores, offering a lower-end product, enjoyed more robust sales with regional offtake estimated at 35% of the country total. Online sales continue to grow, albeit from a low base.

Another positive sign for the future of Japanese platinum jewellery demand has been the success of the non-bridal sector. While growth has been stymied by the economic impact signs are emerging that suggests expansion in this segment in the coming years may offset declines in the bridal sector which is mature and on the wane due to a drop in the annual rate of marriages in Japan. Demand for fashion jewellery looks to be on the rise, with growth experienced last year, in particular for long chain and pendants with Pt999 purity. The non-bridal segment has traditionally been dominated by Pt850 purity market,

JAPANESE JEWELLERY FABRICATION



Source: GFMS, Thomson Reuters; Japan Chain Makers Association

aimed at the younger generations, but in the last few years there has been a notable uplift with Pt900 and Pt950 increasingly being used in this sector. Indeed, the greatest gains last year were seen in the Pt995 and Pt999 segments.

Turning to **palladium** jewellery offtake, demand in Japan retreated by 5% last year to 44,000 ounces (1.4 t). Palladium is often used as an alloying ingredient, in both platinum and white gold, and with both sectors under pressure last year, especially the latter which lost market share to platinum, offsetting the gains as a result of the shift to lower carat jewellery (10 and 14-carat), fabrication demand was softer. As a standalone product, demand benefited from the lower price but the weak economy and the overall negative tone of the jewellery sector drove consumption volumes lower.

NORTH AMERICA

Platinum jewellery fabrication in North America fell 10% to 0.22 Moz (7.0 t) in 2016. The drop last year followed six consecutive years of growth. Platinum jewellery is most widely used in the bridal segment, particularly in the form of engagement rings. A major consideration when choosing platinum as an engagement ring is the strength of the setting and the ability to secure the most valuable part of it, which is the diamond. Due to platinum's strength it lends itself very well as a secure fastening for the precious stone and reduces the possibility that the diamond will pop out. Some would argue it's a form of insurance against loss. Engagement rings made out of platinum usually also are of higher purity (90-95%) compared to gold, 14-18-carat (58.3-75%), which brings the benefit of less allergic reactions caused by alloys added in the gold pieces.

Despite that, however, retailers at present are still a bit reluctant to carry platinum jewellery inventory and only want to sell it to order. Moreover, due to its higher metal density, it's usually 40% heavier than a similar gold piece, platinum jewellery is generally more expensive compared to gold, despite platinum trading at an average record discount to gold of \$262/oz last year. The drop in platinum jewellery sales in the United States can also be attributed to the continued low conversion rate from desire to actual purchase.

Consumers in the United States, however, increased their spending on engagement rings by 5% last year from \$5,871 in 2015 to \$6,163 according to a survey conducted among 13,000 couples. The number of weddings last year reportedly increased by 1% to around 2.2 million last

year. We therefore envisage challenging but promising prospects to remain in the United States when it comes to platinum jewellery in the bridal sector.

Palladium jewellery fell 5% to 0.05 Moz (1.6 t) last year. This marked the seventh consecutive annual drop which is mainly due to a lack of marketing in the United States. Palladium in jewellery is most widely used as an alloy in gold wedding bands to whiten its colour and as a credible substitute to nickel, which can cause skin irritations.

EUROPE

In 2016 European **platinum** jewellery fabrication continued its downtrend with limited advertising still a factor which is arguably constraining demand. However, this overall drop masks a more mixed performance within the sector as a whole across the region. Central to the decline was the plunge in fabrication in Switzerland. Crucial to this was the drop in demand for watches, which is the dominant use for platinum and palladium in Switzerland. The ongoing demand weakness in China for these pieces was pivotal, although demand was soft globally. The watch industry in Switzerland struggled throughout 2016 and so far in 2017 against the combined headwinds of a continued crackdown on corruption in China and a doubling in import tax on luxury watches to 60% last year. As a result, platinum usage in Switzerland was down 45% in 2016 and we believe that the pace of decline has been sustained in the first quarter of 2017. However, with the industry having significantly destocked we would expect a recovery, albeit a muted one, to occur as 2017 progresses.

Elsewhere in Europe the picture has not been anywhere near so bleak. Indeed, softer platinum prices, especially when compared to gold, has encouraged sales and initiatives. This improvement was most clearly noted in the **United Kingdom** and **Germany**. In the United

Kingdom, hallmarking data had shown platinum usage to be up almost 10% year-on-year during the first half of last year. However, like the rest of the jewellery sector there, in the ensuing period since the referendum vote and concomitant jump in sterling metal prices offtake has dropped back. In Germany platinum usage has also performed strongly as the price advantage versus gold is cited as driving demand at the margin in the important wedding band sector.

In contrast, **palladium** jewellery fabrication is being hindered by the narrowing price gap between platinum and palladium. However, the crucial wedding ring market remains resilient and gold demand rose across much of the region in 2016 and this triggered an increase in palladium usage in white gold. Overall, usage of palladium in jewellery in Europe dropped by 1% last year.

INDIA

Indian platinum jewellery fabrication declined last year by 5% due primarily to the excise duty and liquidity crunch. The impact of the excise duty was widespread impacting all segments of the jewellery including those fabricators using platinum as most were under the ambit of excise duty limit, making it necessary for them to register for excise. By registering, this exposed their books to authorities with regards to manufacturing and sales of gold jewellery which dominated their portfolio. As a result retailers and fabricators had to limit transactions and move away from the conventional way of managing a two book system. Following a weak second and third quarter, fourth quarter demand related to weddings (chiefly bands) did pick up, but post demonetisation demand slowed. Moreover, diamond set platinum jewellery had its share of gains on the first two days of demonetisation as the public wanted to quickly convert their cash holdings in demonetised currency.

NORTH AMERICAN PLATINUM JEWELLERY FABRICATION



Source: GFMS, Thomson Reuters

EUROPEAN PLATINUM JEWELLERY FABRICATION



Source: GFMS, Thomson Reuters

DENTAL

- *The use of palladium in dental applications declined 5% last year to an estimated 0.43 Moz (13.3 t), with all key markets lower year-on-year.*

Dental demand for palladium in **Japan** is estimated to have declined by 4% last year, to reach 234,000 ounces (7.3 t), extending the long run of declines. Demand from this segment has retreated each year since 2008 and is currently 30% below the level recorded at the start of millennium. Demand for fresh metal in the first half of 2016 was surprisingly stronger year-on-year as the rebate offered to dentists by the Ministry of Health, Labour and Welfare for the use of 'Kinpala 12', a palladium-rich alloy that is used in almost 90% of dental treatments where an amalgam is required, was higher than the prevailing metal price which encouraged stock building. However, demand fell away sharply in the second half, and most notably in the fourth quarter, as the jump in the palladium price made it less economical to purchase large quantities of inventory despite an upwards adjustment to the rebate in October. Such was the abrupt decline that demand in the final quarter was easily down by a double-digit percentage.

North American demand in 2016 continued in a similar vein as the past eleven years with another modest decline as the dental market continues to move away from porcelain-fused-to-metal crowns to single layered monolithic restorations using mainly zirconia layering ceramic and pressable lithium disilicate owing to their biocompatibility and good mechanical properties as well as aesthetics, durability, and fracture toughness. Our research in this segment points to a 6% year-on-year decline in 2016 for North America to an estimated 127,000 ounces (3.9 t). The migration from analogue to digital, and from metal to metal-free will likely see further erosion in the use of palladium for dental applications in coming years.

DENTAL DEMAND

PALLADIUM

(000 ounces)	2015	2016	Change
North America	135	127	-6%
Europe	59	56	-6%
Japan	244	234	-4%
China	2	1	-13%
Other regions	9	8	-5%
Total	449	426	-5%

Source: GFMS, Thomson Reuters

Demand in **Europe** fell for the sixth consecutive year, easing 6% year-on-year to an estimated 56,000 ounces (1.7 t). This secular decline reflects the changing societal changes as consumers look to more aesthetic solutions such as ceramic and porcelain-fused-metal and away from metal based amalgams which have been popular since the 1970s.

ELECTRONICS

- *Platinum demand fell by 1.7% last year to 0.15 Moz (4.6 t) due to the continual fall in hard disk drive shipments.*
- *Palladium uptake from the electronics industry declined by 10% last year to 1.08 Moz (33.6 t) due to the decline in global demand for electronics, particularly in computers and TVs.*

The largest source of demand for platinum in the electronics sector comes from the hard disk drive (HDD) industry, where the metal is used as part of magnetic storage media to provide thermal stability and enhance data storage capabilities. Given the lacklustre global economy last year (particularly in the first half) and the already matured market, demand for traditional PCs continued to wane. The PC board market has been largely static as technology improvements have not been sufficient to drive real market growth, and with consumers having such a high dependency on smartphones, they either stretch PC life cycles longer, or have totally given up on PC. Along with the continual growth of other technologies such as solid-state drives (SSDs), global HDD shipments fell by an estimated 9.6% in 2016. The global shipments of HDD in the first half of the year were particularly soft, falling 15.7% year-on-

ELECTRONICS DEMAND

PLATINUM

(000 ounces)	2015	2016	Change
North America	2	2	5%
Europe	1	1	5%
Japan	15	15	0%
China	28	27	-3%
Other regions	105	103	-2%
Total	151	148	-2%

PALLADIUM

(000 ounces)	2015	2016	Change
North America	252	227	-11%
Europe	168	140	-17%
Japan	300	259	-14%
China	240	227	-5%
Other regions	240	227	-5%
Total	1,200	1,080	-10%

Source: GFMS, Thomson Reuters

year. However, the performance in the second half fared much better, with total shipments declining by just 3.5% year-on-year. The HDD market is relatively small, with the two largest HDD manufacturers accounting for over 75% of the market share as of the end of 2016, though their combined market share retreated from over 83% a year earlier. We estimate platinum use in HDDs amounted to 0.13 Moz (4.1 t) last year, a 3.7% decline from the previous year and the lowest level in our 18-year data series.

The largest market segment for HDDs is personal computers, and HDD shipments to the PC market fell by an estimated 29% last year. Meanwhile, enterprise HDD, specifically those used in servers and data centres, fell by an estimated 6%. While declines in HDDs shipments have decreased the demand for platinum, the increase in capacity per unit has boosted the usage of platinum per unit and offset some of the fall in total platinum used in HDDs.

The emergence of SSDs in recent years has been due to their higher performance, including better reliability and reduced power usage. However, HDDs should remain the most dominant storage technologies at least for this year, as the cost per terabyte for SSDs is higher. Indeed, the tight supply of NAND flash memory chips has led to higher priced SSDs, which may put a lid on the strong growth in demand in 2017. Having said that, the SSDs will continue to take market share away from HDDs, and as is often the case with new technologies, production costs and prices are likely to fall for SSDs in future, which will make HDDs even less attractive.

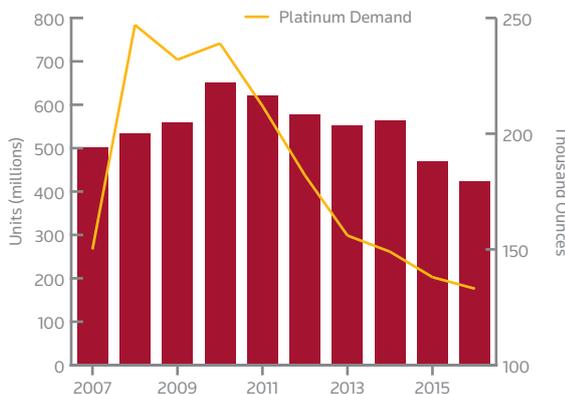
Global notebook and PC shipments have continued to decline in the first quarter of 2017. Despite falling demand, the PC industry has been experiencing a price increase, mostly due to a component shortage. DRAM

prices have doubled since the middle of 2016, and this will continue to discourage any meaningful rebound in consumer demand. While it is likely that SSDs will continue to take market share away from HDDs there is some positive news on the horizon with the emergence of new HDD technologies that should at least offset part of the lost demand. In addition, shipments of heat assisted recording (HAMR) have commenced in 2017, which should also enhance new orders for HDDs. However, if prices of SSDs start to decline in 2018, as some industry insiders are forecasting, then a more substantial decline in demand for HDDs is likely to follow.

Demand for **palladium** used in the electronics sector declined by 13% last year to a total of 1.08 Moz (33.6 t), its lowest level in the last decade. The main source of demand in the electronics sector comes from multi-layered ceramic capacitors (MLCCs), where palladium or silver-rich palladium alloys form a conductive electrode material sandwiched between ceramic wafers. These components are used in a wide range of electrical products, including computers, digital televisions, automotive vehicles, tablets and smartphones. However, the gradual thinning of palladium from multi-layered ceramic capacitors has hurt demand for palladium.

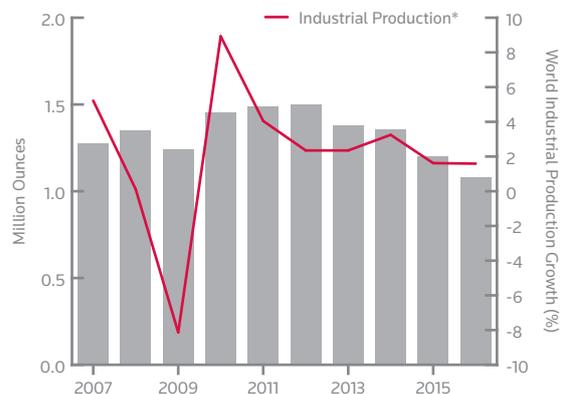
The softness in palladium uptake from the electronics sector last year was attributed to a particularly weak computer market, with global shipments declining by 12.3%. Among electronics, computers are the largest demand segment for palladium. Shipments of digital televisions also fell 1.2%, despite strong growth in the 4k TV segment. While global vehicle production and handsets increased 1.6% and 2% respectively, this increased demand for palladium was not enough to offset the loss seen in the computer industry.

GLOBAL HARD DISK DRIVE SHIPMENTS



Source: GFMS, Thomson Reuters

GLOBAL PALLADIUM ELECTRONICS DEMAND



Source: GFMS, Thomson Reuters; IMF * Industrialised economies

With hundreds of millions of electronic products produced and scrapped each year, e-waste has become an important secondary source for various metals, which has also decreased palladium uptake. We estimate palladium e-scrap increased 3% in 2016.

GLASS

- Demand rose to 0.29 Moz (9.0 t) in 2016, a 59% increase. Rhodium demand increased by 54% to total 0.08 Moz (2.5 t) last year. Most of the uptick came from new manufacturing capacity built in China.

PGMs are critical components of glass manufacturing equipment. Platinum is used in the production of display glass and glass fibre, mostly due to its high temperature tolerance and its inert nature while rhodium is used as a strengthening agent. PGM demand from the sector is mainly a function of new capacity added or new plants built. In addition, PGMs at existing facilities have to be recycled roughly once a year. Recycling the metals result in losses of around 2% for platinum and 6% for rhodium, which must be replaced.

Display glass demand increased modestly last year as a function of higher unit sales and an increase in the average size of TV panels, which account for about 80% of LCD demand; however overcapacity in the LCD substrate industry continued to weigh on prices. From 2006 to 2012, production capacity increased at a compound annual growth rate (CAGR) of 26%. Since that year, capacity growth slowed to a 2% CAGR. Overcapacity has put pressure on manufacturers to reduce production costs in order to maintain a competitive position in the market. This effort has pushed some players to relocate facilities from Japan to South Korea, Taiwan, and China. While Japanese capacity has contracted at a 7% CAGR since 2012, capacity in the latter three countries has expanded at a combined 8% CAGR. Consequently, PGMs contained in installed capacity have been flat since 2012. Meanwhile, glass fibre capacity was steady last year in all major markets except for China, where capacity increased by 20%.

Platinum demand rose to 0.29 Moz (9.0 t) last year, compared to 0.18 Moz (5.7 t) in 2015. This 59% growth was the strongest since 2010 and was largely driven by increased capacity in China. Rhodium demand totalled 0.08 Moz (2.5 t) in 2016, a 54% rise year-on-year, which was the largest increase since 2012.

GLASS DEMAND

PLATINUM

(000 ounces)	2015	2016	Change
North America	6	10	56%
Europe	34	21	-39%
Japan	-39	-31	n/a
China	65	249	285%
Other regions	118	43	-64%
Total	183	291	59%

RHODIUM

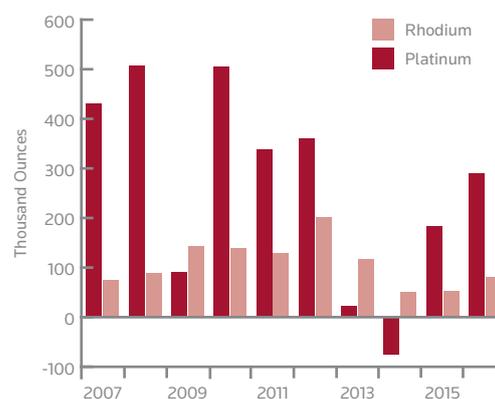
(000 ounces)	2015	2016	Change
North America	3	4	25%
Europe	11	8	-28%
Japan	1	2	95%
China	14	49	249%
Other regions	24	18	-23%
Total	53	81	54%

Source: GFMS, Thomson Reuters

The major display glass manufacturers expect price declines in 2017 to be more moderate relative to 2016. This trend of slowing price declines indicates that LCD glass demand is catching up with existing capacity. Over the next few years, capacity expansions could pick up once again. Major capacity is expected to be added in 2017 in China, particularly for thinner glass substrate. Similarly, glass fibre capacity is expected to expand, primarily from increased Chinese capacity.

As of 2016, glass production facilities housed 5.0 Moz (154.6 t) of platinum and 0.68 Moz (21.2 t) of rhodium. The metal tied up in glass facilities is equivalent to about eight months' worth of platinum demand and nine months' worth of rhodium demand.

GLOBAL PLATINUM & RHODIUM GLASS DEMAND



Source: GFMS, Thomson Reuters

CHEMICAL

- *Platinum demand from the chemical sector rebounded by 16% last year to 0.55 Moz (17.2 t), its highest level since 2014, driven by a recovery in capacity expansions in paraxylene (PX).*
- *Palladium use in the chemical sector also recovered last year, jumping by 10%.*
- *Demand for rhodium rose to a record high.*

Demand for platinum, palladium and rhodium from the chemical sector (in which we include demand from the petrochemical industry), arises from their use as catalysts. In the case of **platinum**, this is historically for the production of paraxylene (PX), nitric acid and Active Pharmaceutical Ingredients (APIs), while it is also used in the curing of silicones. More recent technologies have also recorded the use of platinum catalysts for use in production of on-purpose propylene and isobutylene derivatives via propane (and to a lesser extent butane) dehydrogenation reactions (PDH & BDH). We estimate that platinum use in the chemical sector rose by 16% year-on-year in 2016, rebounding from the previous year, to bring platinum use in the sector to a total of 0.55 Moz (17.2 t).

In terms of areas of usage, platinum as a catalyst in PX production was the largest driver in the recovery for platinum demand in 2016, rising by more than a third of the level recorded in 2015. Improving demand for PTA (of which PX is the largest feedstock), in addition to improving crude oil prices over the year and indeed higher product prices, saw delayed projects come back on line, despite persistent overcapacity in the industry. With platinum demand a direct function of capacity growth, the increase in capacity developments in China, (PX' largest market), helped contribute to the recovery, while growth was also witnessed in our 'rest of the world' category.

Meanwhile, platinum's catalytic use in the production of nitric acid strengthened in 2016, with growth chiefly coming from Western Europe. The production of silicones, platinum's largest demand sector in this area continued to have steady growth last year, with China's market share taking up almost 50% of total demand. Elsewhere, modest growth in API production lent further support to platinum demand, while delays in new PDH unit builds in China dampened expected demand.

Palladium's usage in the chemical sector primarily derives from demand for catalysts in the production of vinyl acetate monomer (VAM), purified terephthalic

CHEMICAL DEMAND

PLATINUM

(000 ounces)	2015	2016	Change
North America	65	74	14%
Europe	83	98	18%
Japan	36	39	8%
China	149	167	12%
Other regions	143	174	22%
Total	476	553	16%

PALLADIUM

(000 ounces)	2015	2016	Change
North America	58	65	12%
Europe	164	170	3%
Japan	20	22	7%
China	58	88	52%
Other regions	95	90	-5%
Total	395	435	10%

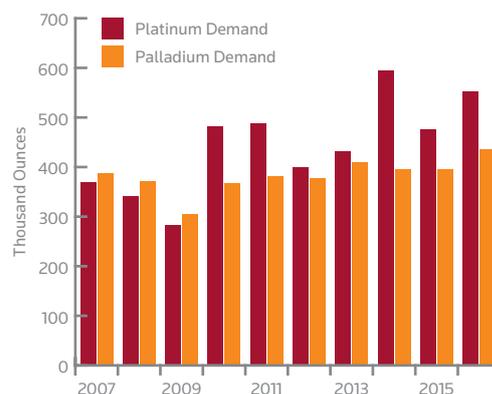
RHODIUM

(000 ounces)	2015	2016	Change
North America	18	18	3%
Europe	16	17	6%
Japan	7	7	2%
China	42	43	4%
Other regions	8	9	11%
Total	90	94	5%

Source: GFMS, Thomson Reuters

acid (PTA), hydrogen peroxide, catchment gauzes in nitric acid synthesis and for use in the removal of acetylene during ethylene production. In addition to being a catalyst for the production of methyl ethylene glycol (MEG) from coal, palladium salts are used for electroplating purposes. We estimate that palladium use in the chemical sector rose by 10% in 2016, to 0.4 Moz (13.5 t). The key drivers behind the recovery in demand for palladium stems from capacity expansions in PTA, particularly in China in addition to a rebound in nitric acid

PLATINUM & PALLADIUM CHEMICAL DEMAND



Source: GFMS, Thomson Reuters

demand (as mentioned above). Meanwhile, accelerated growth in niche applications of palladium were mixed, with a 7% increase in the use of palladium in the removal of acetylene, versus a more robust 40% increase in MEG production.

Demand for rhodium in the chemical sector is driven by its use as a catalyst in the production of oxo alcohols, acetic acid, nitric acid, while it is also being used as a catalyst in pre-reformers and hydrogenation reactions. In 2016, rhodium demand rose by 5%, recording its seventh consecutive year of growth to total 0.09 Moz (2.9 t). The key driver of growth this year came from nitric acid, while strong growth in acetic acid production, (in which rhodium is used in a methanol carbonylation step) lent support. Looking to the largest sector of demand, oxo alcohols production and demand continued to rise, increasing by 4% year-on-year. Currently, oxo alcohol production is responsible for over half of total chemical rhodium demand, in which rhodium is utilised in a hydroformylation reaction step, with oxo alcohol products used in end industries such as refrigeration, air conditioning, chemical processing and consumer goods.

PETROLEUM

— *Global demand for platinum in the petroleum sector recorded a recovery in 2016, rising by 22%, while palladium demand rose more modestly.*

Demand for platinum and palladium from the petroleum sector arises from their use as catalysts. In the case of platinum, developments in oil refining capacity, specifically new catalytic reforming and isomerisation capacity, remain the largest elements of platinum demand, while it is also utilised in alternative fuel producing technologies, such as GTL plants. Palladium usage in the petroleum sector primarily arises from its use as a bifunctional catalyst, in a two-stage hydrocracking (HC) unit, associated with a large proportion of downstream crude refiners globally.

We estimate that platinum's use in the petroleum sector in 2016 rebounded by 22% year-on-year, to 0.1 Moz (3.65 t), while demand for palladium remained broadly unchanged at 0.02 Moz (0.47 t). If we focus on platinum, the key region responsible for the rebound last year was Japan, in which the unexpected suspension in the merger deal between Showa Shell Sekiyu and Idemitsu Kosan Co. in October resulted in no refinery consolidations or rationalisations, with platinum once again returning to demand there, albeit at negligible levels.

PETROLEUM DEMAND

PLATINUM

(000 ounces)	2015	2016	Change
North America	37	48	32%
Europe	55	27	-51%
Japan	-21	4	n/a
China	3	6	91%
Other regions	23	32	42%
Total	96	117	22%

PALLADIUM

(000 ounces)	2015	2016	Change
Total	14	15	6%

Source: GFMS, Thomson Reuters

Looking to China, and the combination of a new state owned refinery coming online last year (marking the first major refining construction in the country for two years), in addition to the growing independence of tea-pot refiners (which were granted approval to both import crude oil and export refined products for the first time in 2016), saw demand for platinum rise sharply, by 91% to 6,000 ounces (0.2 t) year-on-year. North America continued to invest in refining, both on unit expansions and new capacity, despite high fuel inventory levels, (as a result of overproduction in the winter of 2015), resulting in several companies reducing their standard refining run rates.

Turning to Europe, and the positive trajectory of crude oil prices over the year, which jumped by more than 50%, resulted in margins falling across the region. With high inventory levels, falling demand and heightened competition from Eastern refineries, demand for platinum fell last year to 0.03 Moz (0.8 t), as refiners chose to focus only on their core assets. Meanwhile, on the flip side, improving crude oil prices allowed delayed projects to become realised in our 'Other regions' category.

GLOBAL PLATINUM & PALLADIUM PETROLEUM DEMAND



Source: GFMS, Thomson Reuters

FUELLING THE FUTURE

Fuel cells are devices that electrochemically combine hydrogen and oxygen to produce electricity, water, and heat. A fuel cell electric vehicle (FCEV) is a vehicle that uses a fuel cell to power its onboard electronic motor. Fuel cells do not burn fuel, making the process quiet and pollution-free. Unlike batteries, fuel cells continuously generate electricity as long as a source of fuel is supplied.

Fuel cells generated lots of headlines in 2015 when three automakers, Toyota, Honda and Hyundai, commercially launched their models for the first time. The strongest advocate of the technology has always been Toyota which expressed ambitious plans to make it one of its prime powertrain options in reducing the deployment of all its gasoline-only engines by 2050. It will load its future line-up with gasoline-electric hybrids, battery electric and fuel cell electric cars. As such, it targets to cut 90% of CO₂ emissions generated by its vehicles by 2050, compared to 2010. This ambitious plan, however, will need support from a lot of different angles. Aside from the infrastructure that needs to be built and the continued government subsidy, at present this is stretched across various countries in Asia, North America and Europe, its network of suppliers, dealers and most importantly customers will have to embrace this strategy as well.

Despite all the hype about the long awaited public introduction of the fuel cell powered electric vehicles, however, battery vehicles are getting all the attention. To the fuel cell experts that is not surprising considering the low energy conversion efficiency of hydrogen fuel cells. Large amounts of energy are required to isolate hydrogen from natural compounds (water, natural gas, biomass), package the light gas by compression or liquefaction, transfer the energy carrier to the user and convert hydrogen to useful electricity with fuel cells. This process leaves around 25% for practical use; a stark contrast with the less complex and far more efficient 70% energy conversion from battery electric cars.

FUEL CELL VEHICLE PRODUCTION

FCEV production was completely concentrated in Asia last year, rising by 224% to 2,504 units. The bulk of the market is dominated by Toyota, which has 85% market share. Hyundai follows at 11% and Honda stood at 4%. GM group in the United States and Daimler and the Renault Nissan group in Europe/ Japan are expected to launch FCEV themselves from 2017 onwards. Indeed, vehicle growth is expected to be more than 300% this year, reaching 10,093 units. The recent VW scandal and the introduction of real world driving emissions testing in Europe in 2017, mean that it is likely that various OEMs will add some hybrid, electric and FCEV models to their offering in

order to make their CO₂ vehicle fleet average compliant with the 95g/km target by 2021.

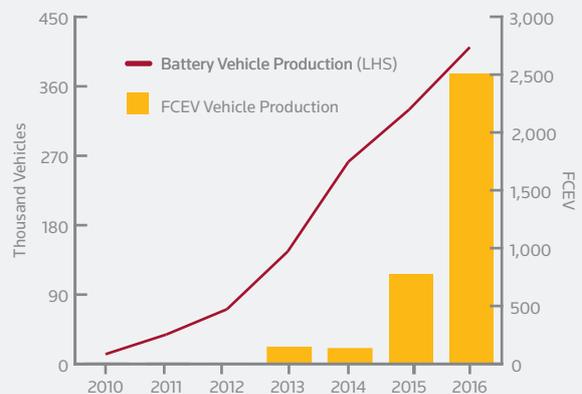
Toyota plans to sell 30,000 FCEV by 2020, although this is dependent on the development of a lot of different factors. Taking a more conservative approach based on forecast vehicle production from LMC Automotive, fuel cell driven vehicle production from all OEMs is likely to reach approximately 24,000 units by 2022. That represents a compound annual growth rate (CAGR) of 46%. However, compared to the total global vehicle sales of around 100 million units by that time this is still incredibly small. On the heavy duty side, Nikola Motors launched its Class 8 truck last year, which is powered by a 320 kWh pack and a stack of fuel cells and has a range of 1,200 zero emission miles. It plans to make more fuel cell models.

PGM CONSUMPTION IN FCEV

With regard to PGM consumption from this segment, despite its potential, the impact at present is still very small. Platinum demand used in FCEV installed on passenger cars amounted to around 24 Koz (0.7 t) last year. We expect demand for platinum in fuel cells from the automotive industry in 2020 to be at least five times what it is today, again a considerable increase and taking firmly the driving seat in overall platinum demand from this niche technology. However, putting it in perspective, the impact on the overall market remains small, representing merely 0.1% of total global platinum demand.

What lies beyond that remains susceptible to a lot of different variables. Challenges and hurdles to overcome with regard to infrastructure, government subsidies, supply chain adoption and consumer preference for example are just a few. OEMs will actively look for ways to thrift platinum. Eventually FCEV should not contain more platinum than is found on the catalytic converters fitted to the exhausts of diesel cars today.

ELECTRIC VEHICLE PRODUCTION



Source: GFMS, Thomson Reuters; LMC Automotive

APPENDIX 1 - PLATINUM SUPPLY AND DEMAND 2007-2016

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
South Africa	5,075	4,676	4,603	4,750	4,740	4,182	4,368	3,220	4,522	4,305
Russia	917	830	793	785	818	803	741	687	721	711
Canada	204	227	170	127	270	220	217	278	242	268
United States	120	115	123	111	119	118	120	119	122	129
Zimbabwe	169	180	229	286	341	335	409	398	398	484
Others	98	129	129	124	116	137	156	154	152	150
Total mine production	6,584	6,156	6,048	6,183	6,404	5,796	6,011	4,856	6,158	6,046
Autocatalyst scrap										
North America	528	557	393	449	475	413	463	424	350	351
Europe	247	295	259	299	347	313	375	434	381	407
Japan	64	69	56	62	55	58	60	66	69	66
China	6	7	10	13	17	23	30	36	43	54
Other regions	66	80	69	80	102	120	122	133	148	163
Total autocatalyst scrap	910	1,007	786	904	996	927	1,050	1,093	992	1,041
Old jewellery scrap										
North America	22	41	33	12	10	9	10	9	6	6
Europe	9	11	12	10	8	8	7	7	7	7
Japan	418	579	273	281	344	257	235	245	216	198
China	110	333	177	216	240	234	235	252	314	361
Other regions	1	2	1	2	3	3	3	3	3	3
Total old jewellery scrap	560	966	496	522	606	512	491	516	546	574
SUPPLY	8,054	8,130	7,331	7,609	8,006	7,234	7,551	6,466	7,696	7,661
Autocatalyst demand										
North America	778	564	350	386	479	469	464	505	485	443
Europe	2,111	1,831	1,283	1,431	1,468	1,273	1,212	1,310	1,420	1,488
Japan	537	546	339	435	368	389	362	339	340	331
China	204	183	180	214	185	178	225	268	257	296
Other regions	478	451	388	551	590	665	693	689	708	728
Total autocatalyst demand	4,109	3,575	2,541	3,018	3,090	2,974	2,957	3,112	3,211	3,286
Jewellery demand										
North America	217	205	181	212	218	224	235	243	248	223
Europe	251	239	222	219	214	212	221	217	215	207
Japan	482	249	270	262	283	320	327	318	324	317
China	1,069	1,110	1,953	1,439	1,588	1,736	1,776	1,680	1,561	1,299
Other regions	41	45	52	69	85	93	97	100	118	130
Total jewellery demand	2,061	1,847	2,678	2,201	2,388	2,585	2,656	2,558	2,466	2,176
Chemical demand										
North America	94	94	59	95	78	65	74	78	65	74
Europe	74	74	54	81	91	79	79	101	83	98
Japan	29	36	28	50	31	22	24	45	36	39
China	35	44	39	80	95	102	120	155	149	167
Other regions	138	92	101	176	191	131	135	216	143	174
Total chemical demand	370	341	283	482	487	399	432	595	476	553

APPENDIX 1 - PLATINUM SUPPLY AND DEMAND 2007-2016

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electronics demand										
North America	74	46	34	29	21	11	7	2	2	2
Europe	28	17	10	6	1	1	1	1	1	1
Japan	55	39	32	30	25	21	17	17	15	15
China	31	32	33	37	36	34	31	30	28	27
Other regions	209	159	145	150	141	128	113	113	105	103
Total electronics demand	397	292	254	252	225	195	169	162	151	148
Glass demand										
North America	(5)	3	7	(7)	12	18	(1)	1	6	10
Europe	(11)	(6)	(16)	15	9	13	11	3	34	21
Japan	40	114	31	142	108	98	(92)	(116)	(39)	(31)
China	112	177	(71)	157	56	143	121	1	65	249
Other regions	295	219	141	198	154	89	(16)	37	118	43
Total glass demand	431	507	91	505	338	361	22	(74)	183	291
Petroleum demand										
North America	58	27	56	30	28	41	52	33	37	48
Europe	44	38	40	35	16	15	4	23	55	27
Japan	12	26	9	21	8	8	(12)	7	(21)	4
China	5	22	4	7	7	11	15	7	3	6
Other regions	32	77	54	75	84	51	47	52	23	32
Total petroleum demand	150	191	163	168	144	126	107	122	96	117
Retail investment										
North America	39	105	131	40	53	87	55	50	55	63
Europe	15	30	38	10	17	13	10	8	7	43
Japan	(32)	317	142	37	206	148	37	55	498	415
Other regions	1	0	3	8	36	34	34	28	23	19
Total retail investment	23	452	313	95	312	282	136	141	582	540
Other industrial demand										
North America	203	182	162	175	200	237	248	272	274	303
Europe	163	163	152	165	183	202	208	222	190	196
Japan	53	53	44	56	60	71	73	79	79	82
China	16	18	30	43	50	52	60	68	82	101
Other regions	37	40	42	56	65	59	59	59	56	59
Total other industrial demand	472	456	431	494	559	621	649	700	681	741
DEMAND	8,013	7,662	6,755	7,215	7,542	7,543	7,128	7,317	7,846	7,853
Physical Surplus/(Deficit)	41	468	576	394	464	(309)	423	(851)	(150)	(192)
Identifiable stock movements										
Industry Stocks	(200)	(300)	665	0	(100)	(300)	(1,000)	1,300	(50)	50
ETF release/(build)	(194)	(102)	(384)	(574)	(145)	(239)	(892)	(218)	260	5
Sub Total - Stock Movements	(394)	(402)	281	(574)	(245)	(539)	(1,892)	1,082	210	55
Net Balance	(353)	65	857	(181)	220	(848)	(1,469)	231	60	(137)

APPENDIX 2 - PALLADIUM SUPPLY AND DEMAND 2007-2016

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
Russia	3,049	2,701	2,677	2,722	2,704	2,624	2,527	2,582	2,575	2,526
South Africa	2,677	2,365	2,481	2,646	2,686	2,391	2,432	2,008	2,653	2,470
Canada	570	524	281	352	560	557	530	578	519	512
United States	425	384	407	374	399	396	404	401	406	420
Zimbabwe	132	139	177	222	261	256	314	325	323	388
Others	197	267	299	296	251	272	261	243	238	246
Total mine production	7,050	6,381	6,321	6,612	6,861	6,497	6,468	6,136	6,713	6,563
Autocatalyst scrap										
North America	652	794	705	831	961	922	992	1,125	944	967
Europe	200	274	241	306	358	317	334	393	330	360
Japan	59	71	70	83	78	83	100	94	86	83
China	7	10	15	23	33	47	62	79	98	134
Other regions	39	50	46	64	84	104	99	122	146	175
Total autocatalyst scrap	957	1,200	1,077	1,307	1,514	1,472	1,587	1,813	1,604	1,719
Old jewellery scrap										
North America	2	4	3	1	2	3	4	4	3	3
Europe	7	9	9	10	12	12	11	9	9	10
Japan	64	84	25	32	39	29	28	30	27	23
China	108	87	71	129	190	172	181	197	220	233
Other regions	5	8	9	7	7	7	7	8	7	6
Total old jewellery scrap	185	192	116	179	248	223	230	248	266	275
SUPPLY	8,192	7,772	7,515	8,098	8,623	8,191	8,286	8,197	8,584	8,557
Autocatalyst demand										
North America	1,586	1,279	887	1,222	1,313	1,608	1,647	1,665	1,757	1,672
Europe	1,267	1,186	1,057	1,395	1,599	1,558	1,541	1,641	1,828	1,938
Japan	897	926	700	845	769	929	908	925	868	858
China	481	478	782	1,032	1,093	1,230	1,402	1,533	1,651	1,953
Other regions	565	621	607	808	820	862	878	883	888	940
Total autocatalyst demand	4,797	4,489	4,032	5,303	5,594	6,188	6,376	6,647	6,991	7,360
Jewellery demand										
North America	99	131	135	115	85	78	75	65	55	52
Europe	129	138	128	138	146	148	149	150	148	147
Japan	98	64	48	48	47	52	54	52	47	44
China	825	837	663	412	341	269	204	172	52	12
Other regions	130	125	135	85	55	48	42	40	43	43
Total jewellery demand	1,281	1,295	1,110	797	674	595	525	478	345	299
Dental demand										
North America	196	196	190	188	178	170	163	148	135	127
Europe	82	87	91	97	91	83	72	63	59	56
Japan	322	322	305	289	283	278	263	253	244	234
China	3	3	3	2	2	2	2	2	2	1
Other regions	12	12	13	14	13	13	11	10	9	8
Total dental demand	615	620	602	590	567	546	511	475	449	426

APPENDIX 2 - PALLADIUM SUPPLY AND DEMAND 2007-2016

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Chemical demand										
North America	60	53	43	53	54	54	55	55	58	65
Europe	199	189	159	160	162	160	160	160	164	170
Japan	22	22	19	21	21	21	22	21	20	22
China	38	46	31	44	66	78	100	77	58	88
Other Regions	69	64	53	90	80	64	73	83	95	90
Total chemical demand	388	372	304	367	382	378	410	396	395	435
Electronics demand										
North America	308	323	285	334	327	330	289	285	252	227
Europe	191	202	186	218	223	225	207	204	168	140
Japan	321	349	314	373	374	384	345	339	300	259
China	146	164	165	213	225	248	275	272	240	227
Other regions	309	309	290	313	337	313	262	258	240	227
Total electronic demand	1,275	1,347	1,240	1,451	1,487	1,500	1,378	1,358	1,200	1,080
Retail investment										
North America	35	68	140	68	47	27	30	35	34	33
Europe	10	26	30	12	14	10	8	6	5	6
Other regions	0	0	0	0	0	0	0	5	6	6
Total retail investment	45	94	170	80	61	37	38	45	45	45
Other industrial demand including petroleum										
North America	62	58	52	68	72	78	80	85	88	84
Europe	16	17	16	19	19	19	17	17	19	18
Japan	8	8	8	8	7	7	7	6	2	6
China	2	4	2	3	3	3	3	6	4	3
Other Regions	3	4	6	4	3	3	3	3	3	1
Total other industrial demand	91	91	84	101	103	110	110	117	116	113
DEMAND	8,491	8,309	7,543	8,689	8,868	9,354	9,349	9,515	9,540	9,757
Physical Surplus/(Deficit)	(300)	(537)	(28)	(591)	(245)	(1,162)	(1,063)	(1,318)	(956)	(1,200)
Identifiable stock movements										
Russia	900	1,280	1,100	800	800	400	200	0	0	(100)
Stillwater	0	0	0	0	0	0	0	0	0	0
Industry Stocks	0	0	0	0	(50)	(100)	(500)	600	(150)	(10)
ETF release/(build)	(280)	(381)	(507)	(1,089)	532	(448)	(0)	(899)	727	637
Sub Total - Stock Movements	620	899	593	(289)	1,282	(148)	(300)	(299)	577	527
Net Balance	320	362	566	(880)	1,037	(1,311)	(1,363)	(1,616)	(379)	(673)

APPENDIX 3 - PLATINUM SUPPLY AND DEMAND 2007-2016

(tonnes)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
South Africa	157.9	145.4	143.2	147.7	147.4	130.1	135.9	100.2	140.7	133.9
Russia	28.5	25.8	24.7	24.4	25.4	25.0	23.0	21.4	22.4	22.1
Canada	6.4	7.1	5.3	4.0	8.4	6.9	6.8	8.7	7.5	8.3
United States	3.7	3.6	3.8	3.5	3.7	3.7	3.7	3.7	3.8	4.0
Zimbabwe	5.3	5.6	7.1	8.9	10.6	10.4	12.7	12.4	12.4	15.0
Others	3.0	4.0	4.0	3.9	3.6	4.3	4.9	4.8	4.7	4.7
Total mine production	204.8	191.5	188.1	192.3	199.2	180.3	187.0	151.0	191.5	188.0
Autocatalyst scrap										
North America	16.4	17.3	12.2	14.0	14.8	12.8	14.4	13.2	10.9	10.9
Europe	7.7	9.2	8.0	9.3	10.8	9.7	11.7	13.5	11.9	12.7
Japan	2.0	2.1	1.8	1.9	1.7	1.8	1.9	2.1	2.2	2.0
China	0.2	0.2	0.3	0.4	0.5	0.7	0.9	1.1	1.3	1.7
Other regions	2.1	2.5	2.1	2.5	3.2	3.7	3.8	4.1	4.6	5.1
Total autocatalyst scrap	28.3	31.3	24.5	28.1	31.0	28.8	32.7	34.0	30.9	32.4
Old jewellery scrap										
North America	0.7	1.3	1.0	0.4	0.3	0.3	0.3	0.3	0.2	0.2
Europe	0.3	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Japan	13.0	18.0	8.5	8.7	10.7	8.0	7.3	7.6	6.7	6.2
China	3.4	10.4	5.5	6.7	7.5	7.3	7.3	7.8	9.8	11.2
Other regions	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total old jewellery scrap	17.4	30.1	15.4	16.2	18.8	15.9	15.3	16.1	17.0	17.9
SUPPLY	250.5	252.9	228.0	236.7	249.0	225.0	234.9	201.1	239.4	238.3
Autocatalyst demand										
North America	24.2	17.5	10.9	12.0	14.9	14.6	14.4	15.7	15.1	13.8
Europe	65.6	56.9	39.9	44.5	45.7	39.6	37.7	40.7	44.2	46.3
Japan	16.7	17.0	10.6	13.5	11.4	12.1	11.3	10.6	10.6	10.3
China	6.4	5.7	5.6	6.7	5.8	5.5	7.0	8.3	8.0	9.2
Other Regions	14.9	14.0	12.1	17.1	18.3	20.7	21.6	21.4	22.0	22.6
Total autocatalyst demand	127.8	111.2	79.0	93.9	96.1	92.5	92.0	96.8	99.9	102.2
Jewellery demand										
North America	6.8	6.4	5.6	6.6	6.8	7.0	7.3	7.6	7.7	7.0
Europe	7.8	7.4	6.9	6.8	6.7	6.6	6.9	6.7	6.7	6.4
Japan	15.0	7.7	8.4	8.1	8.8	10.0	10.2	9.9	10.1	9.9
China	33.3	34.5	60.8	44.8	49.4	54.0	55.2	52.3	48.6	40.4
Other Regions	1.3	1.4	1.6	2.1	2.6	2.9	3.0	3.1	3.7	4.0
Total jewellery demand	64.1	57.4	83.3	68.5	74.3	80.4	82.6	79.6	76.7	67.7
Chemical demand										
North America	2.9	2.9	1.8	3.0	2.4	2.0	2.3	2.4	2.0	2.3
Europe	2.3	2.3	1.7	2.5	2.8	2.5	2.5	3.1	2.6	3.0
Japan	0.9	1.1	0.9	1.5	1.0	0.7	0.8	1.4	1.1	1.2
China	1.1	1.4	1.2	2.5	3.0	3.2	3.7	4.8	4.6	5.2
Other regions	4.3	2.9	3.1	5.5	6.0	4.1	4.2	6.7	4.4	5.4
Total chemical demand	11.5	10.6	8.8	15.0	15.1	12.4	13.4	18.5	14.8	17.2

APPENDIX 3 - PLATINUM SUPPLY AND DEMAND 2007-2016

(tonnes)	2007	2007	2008	2009	2010	2011	2012	2013	2014	2016
Electronics demand										
North America	2.3	1.4	1.1	0.9	0.7	0.3	0.2	0.1	0.1	0.1
Europe	0.9	0.5	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Japan	1.7	1.2	1.0	0.9	0.8	0.7	0.5	0.5	0.5	0.5
China	1.0	1.0	1.0	1.2	1.1	1.1	1.0	0.9	0.9	0.8
Other Regions	6.5	4.9	4.5	4.7	4.4	4.0	3.5	3.5	3.3	3.2
Total electronics demand	12.3	9.1	7.9	7.8	7.0	6.1	5.3	5.1	4.7	4.6
Glass demand										
North America	(0.1)	0.1	0.2	(0.2)	0.4	0.5	(0.0)	0.0	0.2	0.3
Europe	(0.3)	(0.2)	(0.5)	0.5	0.3	0.4	0.3	0.1	1.0	0.6
Japan	1.2	3.5	1.0	4.4	3.4	3.1	(2.9)	(3.6)	(1.2)	(1.0)
China	3.5	5.5	(2.2)	4.9	1.7	4.5	3.7	0.0	2.0	7.7
Other Regions	9.2	6.8	4.4	6.2	4.8	2.8	(0.5)	1.2	3.7	1.3
Total glass demand	13.4	15.8	2.8	15.7	10.5	11.2	0.7	(2.3)	5.7	9.0
Petroleum demand										
North America	1.8	0.8	1.8	0.9	0.9	1.3	1.6	1.0	1.1	1.5
Europe	1.4	1.2	1.2	1.1	0.5	0.5	0.1	0.7	1.7	0.8
Japan	0.4	0.8	0.3	0.6	0.3	0.3	(0.4)	0.2	(0.6)	0.1
China	0.2	0.7	0.1	0.2	0.2	0.3	0.5	0.2	0.1	0.2
Other Regions	1.0	2.4	1.7	2.3	2.6	1.58	1.5	1.6	0.7	1.0
Total petroleum demand	4.7	5.9	5.1	5.2	4.5	3.9	3.3	3.8	3.0	3.65
Retail investment										
North America	1.2	3.3	4.1	1.3	1.6	2.7	1.7	1.6	1.7	2.0
Europe	0.5	0.9	1.2	0.3	0.5	0.4	0.3	0.2	0.2	1.3
Japan	(1.0)	9.9	4.4	1.1	6.4	4.6	1.2	1.7	15.5	12.9
Other Regions	0.0	0.0	0.1	0.2	1.1	1.1	1.1	0.9	0.7	0.6
Total retail investment	0.7	14.1	9.8	3.0	9.7	8.8	4.2	4.4	18.1	16.8
Other industrial demand										
North America	6.3	5.7	5.0	5.4	6.2	7.4	7.7	8.5	8.5	9.4
Europe	5.1	5.1	4.7	5.1	5.7	6.3	6.5	6.9	5.9	6.1
Japan	1.7	1.4	1.7	1.9	2.2	2.3	2.5	2.4	2.6	2.6
China	0.5	0.5	0.9	1.3	1.6	1.6	1.9	2.1	2.5	3.2
Other Regions	1.2	1.2	1.3	1.7	2.0	1.8	1.8	1.8	1.7	1.8
Total other industrial demand	14.7	14.2	13.4	15.4	17.4	19.3	20.2	21.8	21.2	23.1
DEMAND	249.2	238.3	210.1	224.4	234.6	234.6	221.7	227.6	244.0	244.3
Physical Surplus/(Deficit)	1.3	14.5	17.9	12.2	14.4	(9.6)	13.2	(26.5)	(4.7)	(6.0)
Identifiable stock movements										
Industry Stocks	(6.2)	(9.3)	20.7	0.0	(3.1)	(9.3)	(31.1)	40.4	(1.6)	1.6
ETF release/(build)	(6.0)	(3.2)	(11.9)	(17.9)	(4.5)	(7.4)	(27.7)	(6.8)	8.1	0.2
Sub Total - Stock Movements	(12.3)	(12.5)	8.7	(17.9)	(7.6)	(16.8)	(58.8)	33.7	6.5	1.7
Net Balance	(11.0)	2.0	26.7	(5.6)	6.8	(26.4)	(45.7)	7.2	1.9	(4.3)

APPENDIX 4 - PALLADIUM SUPPLY AND DEMAND 2007-2016

(tonnes)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
Russia	94.8	84.0	83.3	84.7	84.1	81.6	78.6	80.3	80.1	78.6
South Africa	83.3	73.6	77.2	82.3	83.5	74.4	75.6	62.5	82.5	76.8
Canada	17.7	16.3	8.7	11.0	17.4	17.3	16.5	18.0	16.1	15.9
United States	13.2	11.9	12.7	11.6	12.4	12.3	12.6	12.5	12.6	13.1
Zimbabwe	4.1	4.3	5.5	6.9	8.1	8.0	9.8	10.1	10.0	12.1
Others	6.1	8.3	9.3	9.2	7.8	8.4	8.1	7.6	7.4	7.7
Total mine production	219.3	198.5	196.6	205.6	213.4	202.1	201.2	190.9	208.8	204.1
Autocatalyst scrap										
North America	20.3	24.7	21.9	25.9	29.9	28.7	30.9	35.0	29.4	30.1
Europe	6.2	8.5	7.5	9.5	11.1	9.8	10.4	12.2	10.3	11.2
Japan	1.8	2.2	2.2	2.6	2.4	2.6	3.1	2.9	2.7	2.6
China	0.2	0.3	0.5	0.7	1.0	1.5	1.9	2.5	3.0	4.2
Other Regions	1.2	1.6	1.4	2.0	2.6	3.2	3.1	3.8	4.5	5.4
Total autocatalyst scrap	29.8	37.3	33.5	40.7	47.1	45.8	49.4	56.4	49.9	53.5
Old jewellery scrap										
North America	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Europe	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3
Japan	2.0	2.6	0.8	1.0	1.2	0.9	0.9	0.9	0.9	0.7
China	3.4	2.7	2.2	4.0	5.9	5.3	5.6	6.1	6.8	7.2
Other Regions	0.1	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total old jewellery scrap	5.7	6.0	3.6	5.6	7.7	6.9	7.2	7.7	8.3	8.6
SUPPLY	254.8	241.7	233.7	251.9	268.2	254.8	257.7	255.0	267.0	266.1
Autocatalyst demand										
North America	49.3	39.8	27.6	38.0	40.8	50.0	51.2	51.8	54.7	52.0
Europe	39.4	36.9	32.9	43.4	49.7	48.5	47.9	51.1	56.9	60.3
Japan	27.9	28.8	21.8	26.3	23.9	28.9	28.2	28.8	27.0	26.7
China	15.0	14.9	24.3	32.1	34.0	38.2	43.6	47.7	51.3	60.7
Other Regions	17.6	19.3	18.9	25.1	25.5	26.8	27.3	27.5	27.6	29.2
Total autocatalyst demand	149.2	139.6	125.4	164.9	174.0	192.5	198.3	206.7	217.4	228.9
Jewellery demand										
North America	3.1	4.1	4.2	3.6	2.6	2.4	2.3	2.0	1.7	1.6
Europe	4.0	4.3	4.0	4.3	4.5	4.6	4.6	4.7	4.6	4.6
Japan	3.1	2.0	1.5	1.5	1.5	1.6	1.7	1.6	1.5	1.4
China	25.7	26.0	20.6	12.8	10.6	8.4	6.4	5.3	1.6	0.4
Other Regions	4.0	3.9	4.2	2.6	1.7	1.5	1.3	1.2	1.3	1.3
Total jewellery demand	39.8	40.3	34.5	24.8	20.9	18.5	16.3	14.9	10.7	9.3
Dental demand										
North America	6.1	6.1	5.9	5.9	5.5	5.3	5.1	4.6	4.2	3.9
Europe	2.6	2.7	2.8	3.0	2.8	2.6	2.2	2.0	1.8	1.7
Japan	10.0	10.0	9.5	9.0	8.8	8.6	8.2	7.9	7.6	7.3
China	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Other Regions	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
Total dental demand	19.1	19.3	18.7	18.4	17.6	17.0	15.9	14.8	14.0	13.3

APPENDIX 4 - PALLADIUM SUPPLY AND DEMAND 2007-2016

(tonnes)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Chemical demand										
North America	1.9	1.6	1.3	1.6	1.7	1.7	1.7	1.7	1.8	2.0
Europe	6.2	5.9	4.9	5.0	5.0	5.0	5.0	5.0	5.1	5.3
Japan	0.7	0.7	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.7
China	1.2	1.4	1.0	1.4	2.1	2.4	3.1	2.4	1.8	2.7
Other Regions	2.1	2.0	1.7	2.8	2.5	2.0	2.3	2.6	2.9	2.8
Total chemical demand	12.1	11.6	9.5	11.4	11.9	11.7	12.8	12.3	12.3	13.5
Electronics demand										
North America	9.6	10.1	8.9	10.4	10.2	10.3	9.0	8.9	7.8	7.1
Europe	5.9	6.3	5.8	6.8	6.9	7.0	6.4	6.3	5.2	4.4
Japan	10.0	10.8	9.8	11.6	11.6	11.9	10.7	10.6	9.3	8.1
China	4.5	5.1	5.1	6.6	7.0	7.7	8.6	8.4	7.5	7.1
Other Regions	9.6	9.6	9.0	9.7	10.5	9.7	8.1	8.0	7.5	7.1
Total electronics demand	39.7	41.9	38.6	45.1	46.2	46.7	42.9	42.2	37.3	33.6
Retail investment										
North America	1.1	2.1	4.4	2.1	1.5	0.8	0.9	1.1	1.1	1.0
Europe	0.3	0.8	0.9	0.4	0.4	0.3	0.2	0.2	0.2	0.2
Other regions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
Total retail investment	1.4	2.9	5.3	2.5	1.9	1.2	1.2	1.4	1.4	1.4
Other industrial demand (including petroleum)										
North America	1.9	1.8	1.6	2.1	2.2	2.4	2.5	2.6	2.7	2.6
Europe	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.6
Japan	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
China	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Other Regions	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Total other industrial demand	2.8	2.8	2.6	3.1	3.2	3.4	3.4	3.6	3.6	3.5
DEMAND	264.1	258.4	234.6	270.3	275.8	290.9	290.8	295.9	296.7	303.5
Physical Surplus/(Deficit)	(9.3)	(16.7)	(0.9)	(18.4)	(7.6)	(36.2)	(33.1)	(41.0)	(29.7)	(37.3)
Identifiable stock movements										
Russia	28.0	39.8	34.2	24.9	24.9	12.4	6.2	0.0	0.0	(3.1)
Stillwater	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry Stocks	0.0	0.0	0.0	0.0	(1.6)	(3.1)	(15.6)	18.7	(4.7)	(0.3)
ETF release/(build)	(8.7)	(11.9)	(15.8)	(33.9)	16.6	(13.9)	(0.0)	(28.0)	22.6	19.8
Sub Total - Stock Movements	19.3	28.0	18.5	(9.0)	39.9	(4.6)	(9.3)	(9.3)	18.0	16.4
Net Balance	10.0	11.3	17.6	(27.4)	32.3	(40.8)	(42.4)	(50.3)	(11.8)	(20.9)

APPENDIX 5 - RHODIUM SUPPLY AND DEMAND 2007-2016

(000 ounces)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
South Africa	658	631	683	653	647	587	599	449	624	615
Russia	104	89	96	94	95	94	91	87	88	87
Canada	20	23	14	10	24	25	24	22	24	23
United States	4	4	3	3	3	3	3	3	3	3
Zimbabwe	15	15	19	24	27	31	35	36	35	41
Total mine production	801	762	815	784	796	741	752	598	775	771
Autocatalyst scrap										
North America	103	116	88	108	124	101	114	144	113	134
Europe	50	60	53	62	72	64	75	83	68	74
Japan	29	33	30	35	34	37	38	42	43	42
China	0	0	0	0	1	1	2	2	3	4
Other regions	20	25	22	26	34	42	44	50	57	64
Total autocatalyst scrap	203	234	193	232	265	245	272	322	284	318
SUPPLY	1,004	995	1,009	1,016	1,061	985	1,024	920	1,058	1,089
Autocatalyst demand										
North America	313	226	147	145	168	180	186	177	176	175
Europe	313	305	238	250	256	225	213	194	198	200
Japan	201	196	136	136	110	121	106	98	92	88
China	-	36	53	67	65	68	77	94	97	111
Other regions	176	180	169	193	157	154	140	116	111	109
Total autocatalyst demand	1,004	943	743	791	755	748	722	679	675	683
Chemical demand										
North America	20	20	18	13	16	17	17	17	18	18
Europe	18	17	16	17	17	17	17	16	16	17
Japan	8	8	7	7	7	7	7	7	7	7
China	21	23	22	28	30	33	36	39	42	43
Other regions	7	6	5	7	8	7	7	9	8	9
Total chemical demand	73	73	69	71	78	81	84	88	90	94
Glass demand										
North America	3	3	1	12	10	15	11	8	3	4
Europe	-18	-19	7	-3	20	3	2	10	11	8
Japan	32	42	48	47	35	54	25	-4	1	2
China	0	1	3	9	5	32	18	21	14	49
Other regions	59	62	85	74	60	97	62	17	24	18
Total glass demand	76	89	143	140	129	201	118	51	53	81
Other demand										
North America	2	4	-5	11	12	16	19	17	41	14
Europe	11	12	4	10	11	14	17	14	25	18
Japan	5	29	6	8	7	13	17	17	20	8
China	4	120	17	7	3	26	35	42	33	-5
Other regions	1	7	1	2	2	3	4	4	4	1
Total other demand	23	171	24	38	35	72	92	95	124	37
DEMAND	1,176	1,276	979	1,040	998	1,102	1,015	912	941	895
Physical Surplus/(Deficit)										
ETF release/(build)	-	-	-	-	-	(17)	(36)	(49)	(4)	5
Net Balance	(172)	(281)	29	(23)	47	(152)	(40)	4	122	190

APPENDIX 6 - RHODIUM SUPPLY AND DEMAND 2007-2016

(tonnes)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mine production										
South Africa	20.5	19.6	21.2	20.3	20.1	18.3	18.6	14.0	19.4	19.1
Russia	3.2	2.8	3.0	2.9	2.9	2.9	2.8	2.7	2.7	2.7
Canada	0.6	0.7	0.4	0.3	0.7	0.8	0.8	0.7	0.8	0.7
United States	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zimbabwe	0.5	0.5	0.6	0.7	0.8	1.0	1.1	1.1	1.1	1.3
Total mine production	24.9	23.7	25.4	24.4	24.8	23.0	23.4	18.6	24.1	24.0
Autocatalyst scrap										
North America	3.2	3.6	2.7	3.4	3.9	3.1	3.5	4.5	3.5	4.2
Europe	1.6	1.9	1.7	1.9	2.2	2.0	2.3	2.6	2.1	2.3
Japan	0.9	1.0	0.9	1.1	1.1	1.1	1.2	1.3	1.3	1.3
China	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Other regions	0.6	0.8	0.7	0.8	1.1	1.3	1.4	1.6	1.8	2.0
Total autocatalyst scrap	6.3	7.3	6.0	7.2	8.2	7.6	8.5	10.0	8.8	9.9
SUPPLY	31.2	31.0	31.4	31.6	33.0	30.7	31.9	28.6	32.9	33.9
Autocatalyst demand										
North America	9.7	7.0	4.6	4.5	5.2	5.6	5.8	5.5	5.5	5.4
Europe	9.7	9.5	7.4	7.8	7.9	7.0	6.6	6.0	6.2	6.2
Japan	6.3	6.1	4.2	4.2	3.4	3.8	3.3	3.1	2.9	2.7
China	-	1.1	1.6	2.1	2.0	2.1	2.4	2.9	3.0	3.4
Other regions	5.5	5.6	5.3	6.0	4.9	4.8	4.4	3.6	3.5	3.4
Total autocatalyst demand	31.2	29.3	23.1	24.6	23.5	23.3	22.5	21.1	21.0	21.2
Chemical demand										
North America	0.6	0.6	0.6	0.4	0.5	0.5	0.5	0.5	0.6	0.6
Europe	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Japan	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
China	0.7	0.7	0.7	0.9	0.9	1.0	1.1	1.2	1.3	1.3
Other regions	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3
Total chemical demand	2.3	2.3	2.1	2.2	2.4	2.5	2.6	2.7	2.8	2.9
Glass demand										
North America	0.1	0.1	0.0	0.4	0.3	0.5	0.3	0.3	0.1	0.1
Europe	(0.6)	(0.6)	0.2	(0.1)	0.6	0.1	0.1	0.3	0.3	0.2
Japan	1.0	1.3	1.5	1.5	1.1	1.7	0.8	(0.1)	0.0	0.1
China	0.0	0.0	0.1	0.3	0.2	1.0	0.5	0.6	0.4	1.5
Other regions	1.8	1.9	2.6	2.3	1.9	3.0	1.9	0.5	0.7	0.6
Total glass demand	2.4	2.8	4.5	4.3	4.0	6.2	3.7	1.6	1.6	2.5
Other demand										
North America	0.1	0.1	(0.2)	0.3	0.4	0.5	0.6	0.5	1.3	0.4
Europe	0.3	0.4	0.1	0.3	0.3	0.4	0.5	0.4	0.8	0.6
Japan	0.2	0.9	0.2	0.3	0.2	0.4	0.5	0.5	0.6	0.3
China	0.1	3.7	0.5	0.2	0.1	0.8	1.1	1.3	1.0	(0.1)
Other regions	0.0	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.0
Total other demand	0.7	5.3	0.7	1.2	1.1	2.2	2.9	2.9	3.9	1.1
DEMAND	36.6	39.7	30.4	32.3	31	34.2	31.7	28.3	29.3	27.7
Physical Surplus/(Deficit)	(5.3)	(8.7)	0.9	(0.7)	2.0	(3.6)	0.3	0.2	3.6	6.0
ETF release/(build)	-	-	-	-	0.5	1.1	1.5	0.1	(0.2)	0.1
Net Balance	(5.3)	(8.7)	0.9	(0.7)	1.5	(4.7)	(1.2)	0.1	3.8	5.9



Where can you mine
the biggest profits in the
global metals markets?

Trusted metals insights and
solutions from **Thomson Reuters**

Our unique combination of news, research, data and tools,
gives you a sharper edge as you trade, invest and purchase
metals across the globe.

Learn more

financial.thomsonreuters.com/eikon-metals

The intelligence, technology and human expertise
you need to find trusted answers.



the answer company™

THOMSON REUTERS®