

## FOREWORD

This edition of *Platinum Quarterly* presents first quarter and updated annual platinum supply and demand forecasts for 2022. It also includes the WPIC's views on issues and trends relevant to those investors considering exposure to platinum as an investment asset during this time of significant geopolitical uncertainty and supply-chain challenges, plus an update on how our product partnerships continue to meet investors' needs and increase platinum investment. The *Platinum Quarterly* report and data (starting on page 6) are prepared independently for the WPIC by Metals Focus.

The geopolitical upheavals and supply chain disruptions in the first quarter of 2022 materially reduced both platinum supply and demand and strongly influenced the revised 2022 forecasts. Year-on-year quarterly supply and demand were down more than expected, at 13% and 26% respectively, but full year 2022 supply is forecast down 5% with demand 2% higher than 2021.

### 2022 supply/demand summary and security of supply concerns:

- The forecast 2022 platinum surplus has decreased modestly since our last forecast, with a reduced demand outlook more than offset by downgrades to the supply outlook from mines and recycling.
- Significant downward revisions to 2022 mine supply expectations, driven by operational constraints, COVID- and safety-related disruptions, and labour and power shortages.
- A mixed outlook for 2022 demand: Automotive and jewellery demand holding up relatively well despite supply chain challenges and China's zero-COVID policy. Industrial demand lower than record levels in 2021, but expected to remain the third strongest year on record. Investment demand for bar and coin remains elevated but is offset by weaker demand for ETFs and outflows from stocks held by exchanges.
- Security-of-supply concerns likely to override near-term market balances in the wake of Russia's invasion of Ukraine and given Russia's importance to the global supplies of mined palladium and, to a lesser extent, mined platinum. Concerns could increase platinum for palladium substitution efforts and potentially modify procurement and inventory management strategies.
- China imports in excess of identified 2021 demand, primarily due to speculative and quasi-speculative purchases, completely absorbed last year's estimated market surplus of 1.2 Moz. While too early to expect the same for 2022, due to typical seasonally low purchases in Q1'22, global security of supply concerns are supportive of further speculative purchases.

### Platinum supply and demand – quarter one and updating 2022 forecasts

#### Q1 2022 surplus of 167 koz mainly on residual pandemic effects and Russian invasion of Ukraine

Total platinum demand fell 10% (-168 koz) quarter-on-quarter in Q1'22, with strong automotive demand offset by an expected decline in industrial demand from record levels in 2021, as well as continued weakness in jewellery and negative platinum investment.

The strength in automotive demand is notable considering production capacity constraints due to the ongoing semiconductor shortages and the negative effects of Russia's invasion of Ukraine, and reflects increased loadings and ongoing substitution for palladium in gasoline vehicles. Jewellery demand remains weak, with strength in all regions partly offset by ongoing COVID lockdowns and competition from gold jewellery in China. Meanwhile, industrial demand was down versus Q1'21 as expected due to fewer capacity additions, especially in glass, although overall it remains at historically strong levels.

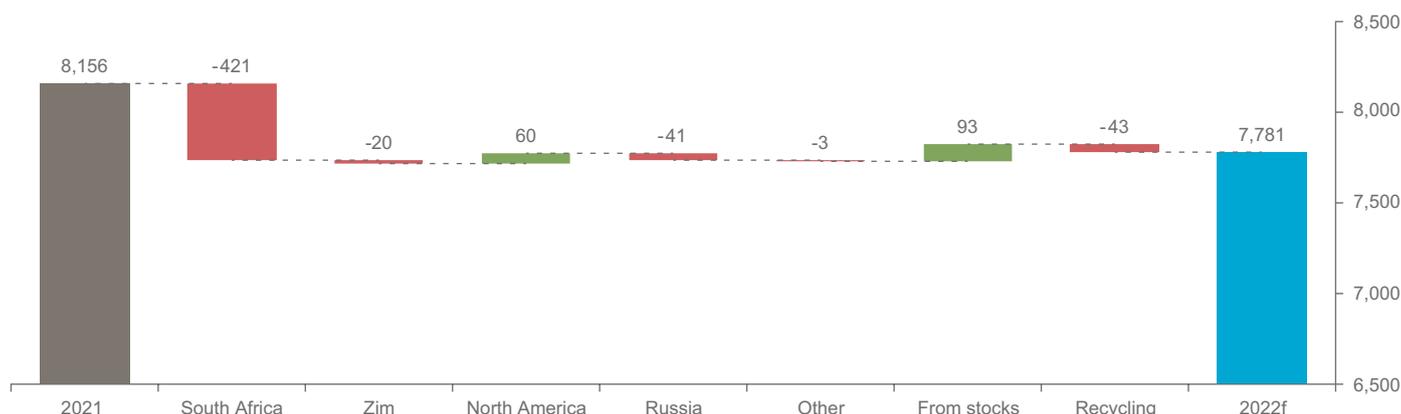
Investment demand was negative during the quarter with positive bar and coin demand offset by negative ETF demand and outflows from stocks held by exchanges. Historically strong retail bar and coin demand in all regions was partly offset by disinvestment in Japan, where locally elevated platinum prices on yen weakness prompted expected profit taking, while the picture for ETF demand was dominated by significant liquidations in one European ETF. While total platinum demand was weaker, total supply also declined, down 20% (-414 koz) quarter-on-quarter due to no additional unwind of the 2021 ACP inventory and lower South African mine supply as COVID, safety stoppages and other production challenges impacted mine supply, and reduced vehicle scrappage rates and jewellery trade ins constrained recycling supply. The net result was a quarterly surplus of 167 koz, down 60% from the surplus reported for Q4'21.

## Updating 2022 forecasts – forecast platinum surplus trimmed

Looking at 2022, mine supply challenges are expected to continue but the availability of scrapped vehicles for recycling supply is expected to improve as the year unfolds, while quarterly automotive, jewellery and industrial demand are forecast to remain broadly at Q1'22 levels, with some of the negative investment demand reported in Q1'22 expected to reverse.

Starting with mine supply, Anglo American Platinum, Impala Platinum and Northam Platinum have all lowered production guidance due to their own specific operational constraints, compounded by COVID disruptions, increased safety-related production stoppages, community unrest and supply chain procurement challenges. The production outlook for Nornickel has also been reduced due to the supply chain challenges it is likely to face as a result of sanctions against Russia. These may impact Nornickel's ability to source mining equipment and consumables from Western suppliers (although Nornickel itself has not been sanctioned as yet). The net impact is a reduction in forecast 2022 total mining supply to 5,872 koz, down 7% (-425 koz) year-on-year and 247 koz lower than previous expectations. Recycling supply expectations have also been trimmed by 2% year-on-year to 1,909 koz (-153 koz), primarily due to reduced scrappage rates limiting raw material supply as consumers are forced to run existing vehicles for longer due to the constrained supply of new vehicles.

Annual total supply and changes 2021 to 2022f (koz)



Source: Metals Focus

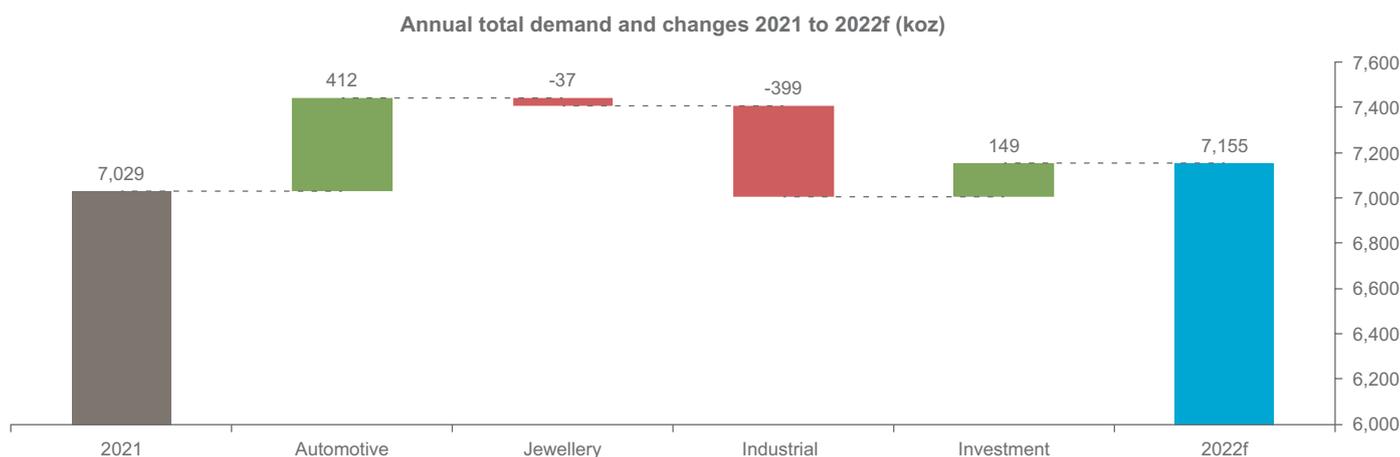
Despite Russia's invasion of Ukraine negatively impacting European automaker manufacturing supply chains, as well as exacerbating the semiconductor shortage (Ukraine was a major supplier of the neon gas needed for semiconductor manufacturing), automotive demand for platinum is reduced by only 74 koz from previous expectations, and is now forecast to total 3,055 koz in 2022, +16% (412 koz) year-on-year. This reflects a view that the semiconductor shortage will ease as the year unfolds, as well as increased loadings and substitution offsetting a weaker outlook for the number of vehicles to be produced.

Jewellery demand is expected to decline 2% year-on-year (-37 koz) as severe measures to combat COVID outbreaks impede retail activity in China, offsetting stronger demand year-on-year from every other region.

Industrial demand for platinum is expected to decline 16% year-on-year (-399 koz) to 2,109 koz. This is down from the record level reached in 2021 which was boosted by significant capacity additions, especially in glass, but it still remains the third strongest year ever, underlining the continued growth in platinum's importance for industrial applications.

The weak investment environment seen in Q1'22 is expected to partially reverse through the rest of 2022. Bar and coin investment is forecast to total 254 koz, down 78 koz from 2021 due to the higher dollar platinum price coupled with the weaker yen leading to profit taking selling back in Japan, partially offsetting stronger demand in Europe and North America. ETF holdings are expected to reduce by 50 koz in 2022, reflecting an anticipated recovery from the outflows of 169 koz seen in Q1'22. The reduction in ETF holdings in the quarter related primarily to liquidations from a specific European ETF with liquidations also seen from other precious metal ETFs from the same issuer, despite investors finding hard assets attractive due to surging inflationary worries and elevated geopolitical and economic uncertainties. Stocks held by exchanges are expected to continue the trend seen in 2021 of being used as a source of metal to satisfy demand in the London and Swiss markets, and to decline by 100 koz.

The net impact is a projected 2022 surplus of 627 koz, down from the previous estimate of 652 koz as the reduced demand projections are more than offset by the downgrades in both primary and secondary supply forecasts.



Source: Metals Focus

## The platinum investment case – addressing security of supply in an uncertain world

While the outlook for 2022 is for another year of a platinum market surplus, we note that there are reasons to anticipate that the behaviour of market participants may be influenced more by longer term security of supply concerns than by near-term market dynamics, particularly in the light of the ongoing deterioration in international relations following Russia’s invasion of Ukraine. These concerns could have a direct impact on both automaker and industrial consumer procurement strategies, platinum for palladium substitution in gasoline vehicles, support for green hydrogen production, and investment flows. Furthermore, security of supply concerns seem supportive of a continuation of the quasi-speculative purchases in China which were substantial enough to completely absorb the significant 1.2 Moz market surplus reported for 2021.

Russia is a major supplier of extractive raw materials to global markets, accounting for 17% of annual natural gas production, 11% of crude oil, 6% aluminium, 24% battery grade nickel, over 40% of mined palladium supply and 10% of mined platinum supply. While sanctions applied by the West against Russia in retaliation for its unprovoked invasion of Ukraine have not explicitly targeted Russia’s commodity exports, with the exception of a phased banning of Russian oil imports by the EU and others, the exclusion of Russian banks from the SWIFT international payments system makes transacting with Russian counterparts increasingly challenging, but still not logistically impossible (putting aside moral questions). Furthermore, when considering longer term off-take agreements, there should be significant concerns regarding the potential non-performance of Russian supply agreements given the potential for unilateral action to be taken by either side, as well as in the light of the Kremlin’s recent decree prohibiting the fulfilling of obligations and concluding deals with unfriendly foreign individuals and legal entities. Western organisations with exposure to commodities, where Russia is a major supplier, are likely to be reviewing their supply chains and potentially looking to provide additional protection against supply disruption through expanding buffer inventories. This is particularly true for palladium given Russia’s significant contribution to global mine supply, and to a lesser extent its contribution to platinum mine supply. This should drive additional platinum for palladium substitution but also stress short-term platinum availability.

Looking at the structure of platinum supply agreements, we think that the majority of automotive companies in the West will probably feel that they remain well protected by existing agreements, which typically extend up to three years into the future. However, it seems probable that the financial institutions backing those agreements will be more concerned about the viability of longer term supply agreements and financial contracts, and that the financing cost of these contracts are likely to increase to reflect expected longer term metal scarcity as well as inflationary concerns. These factors could push end users to look for different supply arrangements such as direct off-take agreements from suppliers, particularly if they want confidence in the country of origin of purchased materials. Equally, it is possible that industrial users of platinum might look to add to buffer inventories to protect against possible supply disruptions.

Automakers, in particular, are also likely to be putting further efforts into examining the potential to substitute platinum for palladium in gasoline vehicles (on a 1:1 basis), to further reduce reliance on Russian supplies, and also because it makes economic sense at the current price differential of >US\$1,300/oz. We strongly believe that up to 75% of the palladium in gasoline vehicle catalysts can be substituted by platinum without a loss of thermal stability. However, we conservatively show scenarios of 30% and 50% substitution and assume that substitution occurs on only the c.20% of annual vehicle sales that are newly launched models. Based upon a scenario of production of 59M gasoline vehicles in 2022 across all vehicle categories, these two substitution levels could save automakers between US\$671M and US\$1,118M per year. This would result in additional annual platinum demand of between 512 koz and 853 koz, which at the upper end would move the market towards a deficit over the course of 2022.

A further consequence of Russia's invasion of Ukraine is the efforts announced by the European Commission to reduce the bloc's reliance on Russian energy supplies, as part of which it plans to replace 25-50 Bm<sup>3</sup> of Russian natural gas with green hydrogen by 2030. We estimate that this equates to 7.3-14.6 Mt of hydrogen p.a. although the Commission has a target of 20 Mt including both domestic production and imports. This is an ambitious target, which at the upper end would require the installation of 255 GW of electrolyser capacity in only eight years. This seems like a stretch target to us, but we believe that 115 GW might be possible. Assuming a 50:50 mix of alkaline and PEM electrolyser deployment, this would equate to additional annual platinum demand of 234 koz by 2030. We note the ancillary benefit of large-scale hydrogen production and distribution is the potential acceleration of the commercial adoption of FCEVs, a significant component of future platinum demand growth. Indeed, WPIC's forecasts show that FCEV platinum demand has the potential to match current automotive demand for platinum as soon as 2033 if there is a broad-based commercial adoption of the technology, which the accelerated development of hydrogen infrastructure in Europe would be highly supportive of.

While security of supply concerns have the potential to increase demand and result in temporary or permanent increases in working inventory, there is also the potential for imports into China, in excess of estimated demand, to absorb any market surplus, just as it did in 2021. Our published estimates, based primarily on trade data and historic buying patterns in China, indicate that China imported over 600 koz more than identified demand in 2020 and over 1,200 koz more in 2021, which in 2021 was sufficient to completely absorb the estimated market surplus. These 'excess' platinum imports are primarily for speculative and quasi-speculative purposes by entities and individuals involved in platinum industrial fabrication. They could also include bona-fide increases in working stock levels and are expected to be captive within China and could one day be used to supply local demand, but not anytime soon unless, as was seen with past 'excess' palladium imports, the platinum price was to double. Given the ongoing security of supply concerns, particularly in the wake of Russia's invasion of Ukraine, the environment appears supportive of continued speculative purchases in China. However, so far in 2022 trade data shows that China's imports broadly match estimated consumption, although we note that this is also fairly typical of China's previous seasonally weaker imports in the first quarter of the year.

### WPIC initiatives highlights

Global security concerns and inflationary risks only strengthen platinum's credentials as a robust investment asset to protect against uncertain times and as an investment for the future. This is particularly true given the metal's critical importance in the production and use of green hydrogen, which has a key role to play in domesticating energy security for Western countries pivoting away from an over-reliance on Russian energy supplies as well as reducing carbon emissions in the move towards net-zero. This outlook reinforces our focus on increasing the number and impact of our product partnerships in our four key target markets, China, Japan North America and Europe and we continue to work closely with our partners to increase the awareness of platinum investment products available to investors worldwide and support a strong level of marketing activities.

In Europe we strengthened our group of partners through the addition of ProAurum, one of the largest precious metal dealers in Germany. WPIC is helping ProAurum to communicate the platinum investment case to its investors through the provision of bespoke monthly content.

North American and European physical markets showed little movement in the beginning of the year, however with the price dropping below \$1,000/oz, there was healthy demand for platinum and market sentiment remains bullish, with sales volumes picking up towards the tail end of the quarter and into Q2'22.

In China we were delighted to onboard two new partners during the first quarter, both fabricators based in Shenzhen. They will add platinum to their portfolios to improve profit margins and business diversity. China has been particularly impacted by concerns of rising inflation and economic uncertainty, which have resulted from tightening COVID restrictions. This has engendered a risk-off sentiment that has boosted retail sales of platinum investments with our partners recording year-on-year sales growth over Q1'22.

In Japan, the picture was somewhat different, with strong local platinum prices, in yen, prompting profit taking over the first quarter. Our recently agreed partnership with JBMA continues to strengthen our content distribution in Japan, whilst our new partner Rakuten Securities has started publishing WPIC insights on its website for Japanese investors. In addition, we also established a footprint in South Korea and started providing WPIC reports in Korean via social media for local investor development.

Finally, it would be remiss not to highlight Her Majesty the Queen's Platinum Jubilee, marking 70 years on the throne. In honour of this historic occasion, WPIC is presenting the All England Lawn Tennis Club with two specially-commissioned commemorative platinum coins to be used for the Ladies' and Gentlemen's singles finals coin tosses at this year's Wimbledon Championships.

**Paul Wilson, CEO**

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### Contents

Foreword	<b>P1</b>	Expanded Tables	<b>P18</b>
Summary Table	<b>P6</b>	Glossary of Terms	<b>P23</b>
First Quarter 2022 Review	<b>P7</b>	Copyright and Disclaimer	<b>P27</b>
2022 Outlook	<b>P12</b>		

# PLATINUM QUARTERLY Q1 2022

**Table 1: Supply, demand and above ground stocks summary**

	2019	2020	2021	2022f	2021/2020 Growth %	2022f/2021 Growth %	Q4 2021	Q1 2022
<b>Platinum Supply-demand Balance (koz)</b>								
<b>SUPPLY</b>								
<b>Refined Production</b>	<b>6,075</b>	<b>4,989</b>	<b>6,297</b>	<b>5,872</b>	<b>26%</b>	<b>-7%</b>	<b>1,695</b>	<b>1,279</b>
South Africa	4,374	3,298	4,678	4,258	42%	-9%	1,274	861
Zimbabwe	458	448	485	465	8%	-4%	127	121
North America	356	337	273	333	-19%	22%	64	84
Russia	716	704	652	611	-7%	-6%	178	163
Other	170	202	208	205	3%	-1%	52	51
<b>Increase (-)/Decrease (+) in Producer Inventory</b>	<b>+2</b>	<b>-84</b>	<b>-93</b>	<b>+0</b>	<b>N/A</b>	<b>N/A</b>	<b>-39</b>	<b>+0</b>
<b>Total Mining Supply</b>	<b>6,077</b>	<b>4,906</b>	<b>6,204</b>	<b>5,872</b>	<b>26%</b>	<b>-5%</b>	<b>1,656</b>	<b>1,279</b>
<b>Recycling</b>	<b>2,136</b>	<b>1,930</b>	<b>1,953</b>	<b>1,909</b>	<b>1%</b>	<b>-2%</b>	<b>453</b>	<b>415</b>
Autocatalyst	1,590	1,442	1,464	1,418	2%	-3%	333	299
Jewellery	476	422	422	422	0%	0%	102	99
Industrial	69	66	67	69	1%	3%	17	17
<b>Total Supply</b>	<b>8,213</b>	<b>6,836</b>	<b>8,156</b>	<b>7,781</b>	<b>19%</b>	<b>-5%</b>	<b>2,109</b>	<b>1,695</b>
<b>DEMAND</b>								
<b>Automotive</b>	<b>2,869</b>	<b>2,402</b>	<b>2,643</b>	<b>3,055</b>	<b>10%</b>	<b>16%</b>	<b>680</b>	<b>725</b>
Autocatalyst	2,869	2,402	2,643	3,055	10%	16%	680	725
Non-road	†	†	†	†	†	†	†	†
<b>Jewellery</b>	<b>2,099</b>	<b>1,820</b>	<b>1,923</b>	<b>1,886</b>	<b>6%</b>	<b>-2%</b>	<b>499</b>	<b>437</b>
<b>Industrial</b>	<b>2,127</b>	<b>1,978</b>	<b>2,508</b>	<b>2,109</b>	<b>27%</b>	<b>-16%</b>	<b>624</b>	<b>533</b>
Chemical	694	596	688	613	15%	-11%	200	111
Petroleum	219	109	172	193	58%	12%	57	44
Electrical	144	130	135	127	4%	-6%	32	30
Glass	236	407	715	331	75%	-54%	121	138
Medical and Biomedical	249	235	244	257	4%	5%	67	65
Other	584	500	555	588	11%	6%	147	144
<b>Investment</b>	<b>1,237</b>	<b>1,544</b>	<b>-45</b>	<b>104</b>	<b>N/A</b>	<b>N/A</b>	<b>-108</b>	<b>-167</b>
Change in Bars, Coins	266	578	332	254	-43%	-23%	95	60
Change in ETF Holdings	991	507	-238	-50	N/A	N/A	-155	-169
Change in Stocks Held by Exchanges	-20	458	-139	-100	N/A	N/A	-48	-58
<b>Total Demand</b>	<b>8,331</b>	<b>7,743</b>	<b>7,029</b>	<b>7,155</b>	<b>-9%</b>	<b>2%</b>	<b>1,695</b>	<b>1,528</b>
<b>Balance</b>	<b>-119</b>	<b>-908</b>	<b>1,128</b>	<b>627</b>	<b>N/A</b>	<b>-44%</b>	<b>413</b>	<b>167</b>
<b>Above Ground Stocks</b>	<b>3,531**</b>	<b>2,624</b>	<b>3,752</b>	<b>4,379</b>	<b>43%</b>	<b>17%</b>		

Source: Metals Focus 2019 - 2022.

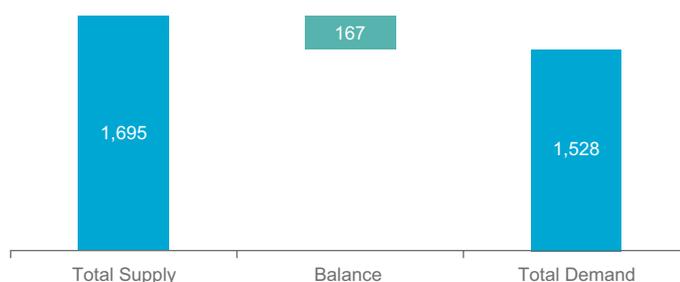
Notes:

- \*\*Above Ground Stocks 3,650 koz as of 31 December 2018 (Metals Focus).
- † Non-road automotive demand is included in autocatalyst demand.
- All estimates are based on the latest available information, but they are subject to revision in subsequent quarterly reports.
- The WPIC did not publish quarterly estimates for 2013 or the first two quarters of 2014. However, quarterly estimates from Q3 2014, to Q4 2017 are contained in previously published Platinum Quarterly's which are freely available on the WPIC website.

## 2022 FIRST QUARTER PLATINUM MARKET REVIEW

At the start of Q1'22 most regions were at various stages of a post-COVID economic recovery. However, Russia's invasion of Ukraine at the end of February sent shockwaves through the markets. The PGM industry in particular is geographically exposed, due to the significant contribution Russia makes to the supply of raw materials (especially for palladium). Despite the automotive sector finding itself at the behest of yet another wave of supply shortages and lower production, platinum demand from this sector remained flat year-on-year as tighter emissions supported higher metal loadings. Industrial demand experienced a sharp decline from record levels, falling by 25% (-175 koz) year-on-year, as there was no repeat of the exceptionally high capacity installations in the glass sector seen in Q1'21. Investment demand saw net outflows for the third consecutive quarter, as ETF holdings declined by 169 koz. With most demand segments lower, total demand fell 26% (-541 koz) year-on-year, but this was offset by a drop in both refined mine production (-185 koz) and secondary supply (-103 koz). Compared to the Q4'21, the market surplus of 167 koz was 60% lower, reflecting weakened demand as well as supply.

**Chart 1: Supply-demand balance, koz, Q1 2022**



Source: Metals Focus

### Supply

Refined platinum production declined 13% (-185 koz) year-on-year to 1,279 koz, primarily on lower output from South Africa.

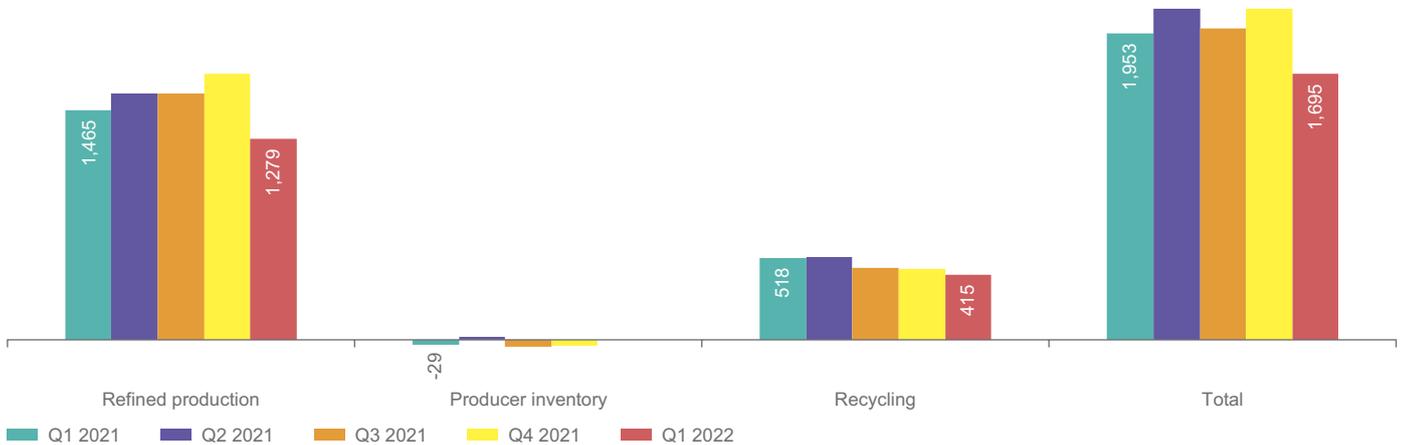
South African production fell 16% (-167 koz) year-on-year in part due to the completion in 2021 of the release of semi-finished inventory built up during the Anglo Convertor Plant (ACP) shutdown of 2020. Maintenance schedules also constrained processing availability in Q1'22 as Implats undertook a rebuild of its number 3 furnace. Operations faced headwinds during Q1'22 as COVID-19 and geopolitical events stressed supply chains, impacting equipment deliveries and so disrupting mine output. Safety-related stoppages also continued to weigh on output. Production at Mogalakwena, Anglo American Platinum's flagship mine, was curtailed by heavy rainfall in the period.

Russian output declined 11% (-21 koz) year-on-year compared to Q1'21, which was buoyed by a release from semi-finished inventory due to the commissioning of a new production line at Nornickel. Other regions remained largely flat year-on-year.

### Recycling

In Q1'22, global platinum recycling fell considerably short of Q1'21 dropping by 20% year-on-year (-103 koz) to 415 koz, as a result of the chip shortage and China's zero-COVID policy; resulting in the lowest output since Q2'20. Autocatalyst recycling accounted for most of the weakness in the global total, falling by 22% (-84 koz) year-on-year to 299 koz. With constrained new car production and longer lead times for deliveries, lower volumes of end-of-life vehicles are feeding through to scrap yards. Elsewhere, platinum jewellery recycling declined 16% (-19 koz) to 99 koz as COVID lockdowns restricted consumer movement in China resulting in weak jewellery demand and in turn, undermining scrap collection opportunities., as consumers often trade older pieces in when purchasing new ones.

Chart 2: Platinum supply, koz

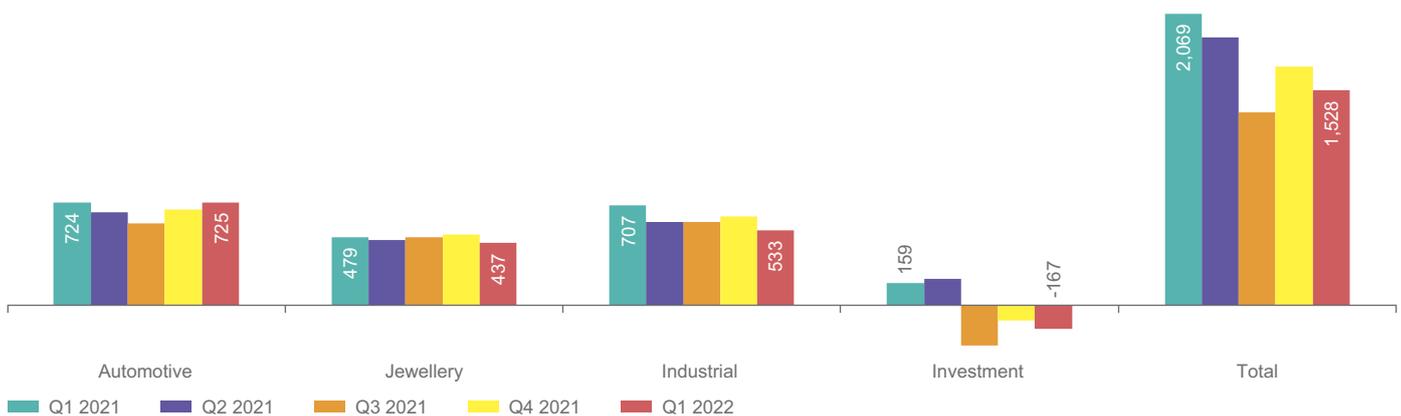


Source: Metals Focus

Demand

Total demand in Q1'22 declined 26% (-541 koz) year-on-year to 1,528 koz. Key contributors to this performance were the third consecutive quarter of both ETF liquidations and exchange stock outflows. Industrial demand was lower, as the glass industry's platinum requirements, whilst still above historical levels, normalised after a period of notable expansions. Jewellery demand, heavily dependent on China, was affected by COVID restrictions, which contributed to a 9% drop (-42 koz) in the global total.

Chart 3: Platinum demand, koz



Source: Metals Focus

Automotive demand

In Q1'22, both light and heavy-duty vehicle (LDV and HDV) production fell year-on-year, as supply chain shortages hampered automakers' ability to deliver against continued pent-up demand. Within the LDV segment, shortages of chips and other parts, zero COVID protocols in China, along with production disruption in Europe (due to Russia's invasion of Ukraine), all weighed on the sector, resulting in a 4% LDV production decline on Q1'21. While the same factors impacted HDVs, a further headwind to production stemmed from the significant pre-buy of China V vehicles last year, ahead of the implementation deadline of China VI regulation in July 2021. For Q1'22, global HDV production was down 27% year-on-year and in China it was down 51%. Despite these markedly lower numbers, total platinum automotive demand was flat on Q1'21 (725 koz) mainly due to higher loadings in China and growing substitution.

On a regional basis, the European automotive market was the most affected by the war in Ukraine. Platinum demand fell as both LDV and HDV production came under extreme pressure, with some plants closed in response to war-induced shortages. North American demand was less affected, with demand declining more modestly. Japan, struggling with Omicron contagion also recorded a decline in Internal Combustion Engine (ICE) production which weighed on platinum demand. However, declines in platinum demand due to lower vehicle production was almost fully offset by the significant platinum demand growth in China. This was driven by a step change in loadings brought about by the transition to China 6 for LDVs and China VI for HDVs, along with further substitution of palladium with platinum, despite the lower vehicle production volumes in China. To put the significant increase in platinum loadings per vehicle in context, automotive production in China is regionally weighted to Guangdong, Jilin, Shanghai, Hubei and Guangxi, which at different times during the quarter experienced partial or provincial wide lockdown contributing to the HDV production decline of 51% year-on-year. In other regions demand lifted slightly.

### **Jewellery demand**

Jewellery demand continued its downward trajectory as its core market, China, faces several obstacles. Global platinum jewellery demand declined by 9% (-42 koz) year-on-year to 437 koz.

In China, platinum fabrication in Q1'22 fell by more than a third year on year, earlier in the quarter driven by competition from robust gold jewellery sales and later on due to the negative impact of the Omicron outbreak. This marks the lowest quarterly demand on record, even lower than Q1'20, at the then peak of the COVID pandemic in China.

European demand rose to levels above a pre-pandemic Q1'19. Growth came from both a resurgent bridal sector and healthy sales from the top-end brands (Q1'22 hallmarking was up 110% for UK jewellery and 22% for Swiss watches). Our sources report that the Ukraine crisis has not impacted sales as of yet.

North American offtake also grew due to buoyant bridal demand, residual retailer restocking, expenditure diversion from travel and price differentials to gold. Gains would have been greater but for the damage to consumer confidence from high inflation and in particular rising energy costs, and concerns about the economic cost of the Ukraine conflict.

While Japanese jewellery demand grew slightly year-on-year, this came from a low base and fell short of our earlier expectations. The lacklustre performance can be attributed to competition from gold, which is enjoying a boost in the current economic environment from asset-jewellery purchases and new retail avenues, such as live-streaming sales. Platinum is also highly exposed to the bridal sector which did not fare well this quarter, at least in part due to the Omicron outbreak.

Indian jewellery fabrication also rose. The increase was driven by manufacturers building stocks to showcase at various jewellery shows. However, while fabrication rose, consumption was down, due to a relative lack of festive and wedding days and a cautious approach adopted by consumers due to rising inflation and increased commodity price volatility.

### **Industrial demand**

Industrial demand contracted by 25% (-175 koz) against Q1'21 as fewer capacity expansions in glass and chemical plants were recorded when compared to Q1'21. The declines were partially offset by the 21% increase (+8 koz) in the petroleum industry, which performed better in Q1'22 compared to a COVID-impacted Q1'21.

### **Petroleum**

Platinum demand rose by 21% (+8 koz) year-on-year, due to a relatively low base in Q1'21, especially in Europe and North America, where refining output were still negatively affected by the pandemic in early 2021. The increase therefore reflects a return to more normal levels. In contrast demand decreased by 22% (-13 koz) quarter-on-quarter to 44 koz in Q1'22. The pullback was largely due to the high base in Q4'21, when new capacity units were completed in countries such as Uzbekistan and China.

While the Russian-Ukraine war led to sharp gains in energy prices, along with exceptionally high price volatility during Q1'22, its impact on platinum offtake in this quarter was limited. In spite of disruption to Russian oil supplies, a more cautious outlook for oil consumption (in the wake of slowing world GDP growth), steady output increases from OPEC members and massive stock releases from major governments have limited appetite for capacity expansions.

### **Chemical**

Platinum chemical offtake fell by 45% (-90 koz) quarter-on-quarter and 7% (-9 koz) year-on-year to 111 koz in Q1'22. The pull-back was partly due to a lack of new petrochemical units being added in the first three months of 2022. This means that platinum demand within the petrochemical industry was driven by top up replacement during catalyst change-outs. The nitric acid industry also struggled in Q1'22. It is worth noting that soaring natural gas prices had already resulted in temporary shutdowns of fertilizer plants (nitric acid is the key chemical in the manufacture of fertilizers) in Europe in Q4'21. Russia's invasion of Ukraine has resulted in further major disruptions to the global fertilizer and agricultural industry, given that both countries are key producers and suppliers of fertilizer materials. By contrast, platinum demand from the silicone industry remained buoyant, due to higher silicone use from a wide range of end-uses.

### **Medical**

As non-COVID health service capacity is recovering to near pre-pandemic levels, demand for platinum in Q1'22 was up by 15% (+8 koz) on Q1'21.

### **Glass**

Limited new additions to LCD tank and fiberglass capacity in China resulted in a 56% (-179 koz) reduction in platinum demand year-on-year to 138 koz in Q1'22. The decrease was due to unusually high demand in Q1'21, as investments and start-ups of new plants that had been postponed due to pandemic-related constraints in 2020 finally materialized. Corning and IRICO had the largest new LCD tank installations during the first quarter and are expected to add new capacity in Q2 this year. Investment activity in the glass industry remains focused on China.

### **Electrical**

Demand from the electrical segment declined by 9% (-3 koz) year-on-year, mostly affected by falling hard disk drive (HDD) shipments. This in turn reflected sluggish sales performance in the consumer electronics markets, as well as seasonal downward inventory adjustment in anticipation of a slower quarter. Moreover, recent economic uncertainties due to geopolitical conflicts and China's zero-COVID policy have led to a drop in consumer confidence and a reduction in non-essential spending, which prolonged the replacement cycle of electronic products, and further weighed on platinum offtake in this segment. Natural demand saturation for consumer electronics and IT equipment after the pandemic-induced buying spree will also have played a part.

### **Other**

Demand from other industrial applications remained mostly flat in Q1'22. In the spark plugs and sensors segment, the impact of vehicle production cuts was offset by strong sales in the aftermarket parts segment, with the lack of new cars stimulating vehicle maintenance activities and increased demand for replacement parts. In addition, the growing number of sensors in new vehicles also benefited platinum use.

### **Investment demand**

Bar and coin demand increased by 192% (+40 koz) albeit off a very low base in Q1'21, which suffered due to the unusually high liquidations seen in Japan last year. North American retail investment was little changed in Q1'22 year-on-year. That said, it underperformed relative to gold and silver, both of which benefited from robust buying as a safe haven and a hedge against inflation.

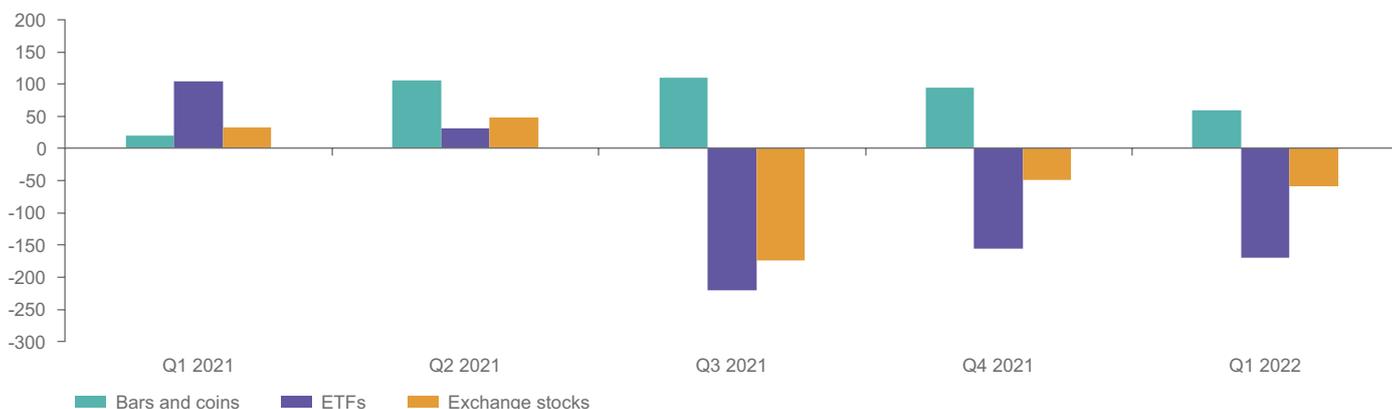
By contrast, Japan suffered from liquidations during the first three months of 2022, especially in March, resulting in net disinvestment of 53 koz. Even so, this compared favourably with a year ago, when in Q1'21 we had seen net selling back of 107 koz. During Q1'22, dollar platinum prices rallied to their highest since May last year and were sustained in Japan by yen weakness in March, which encouraged profit taking. It is worth noting also that this behaviour was not isolated to platinum – indeed net selling was far higher for gold, for which a combination of yen weakness and a rally in its dollar price resulted in local prices rising to all-time highs.

In Europe, sales of coins and bars fell year-on-year. To a large part, this was due to physical precious metals investors focusing on gold during the quarter, in the face of the Ukrainian crisis. A relatively high base last year, when demand had been boosted by a positive narrative on platinum's fundamentals and growing availability of platinum bullion products was another factor contributing to the year-on-year change. Related to these two points, as mints, refineries and bullion dealers have been preoccupied with increasing gold product availability in Q1'22, this affected platinum product availability to some extent.

In contrast to Q4'21, which saw similarly sized liquidations in ETFs from most regions, Q1'22 liquidations stemmed mainly from Europe, where one of the ETF issuers suffered atypical outflows in most of its precious metals ETFs.

In stocks held by exchanges, the outflow from NYMEX halted around 18<sup>th</sup> March when Exchange for Physical (EFP) premiums spiked, leading to inflows which have been maintained since then, ultimately resulting in a net change of -58 koz for the quarter.

**Chart 4: Platinum Investment, koz**

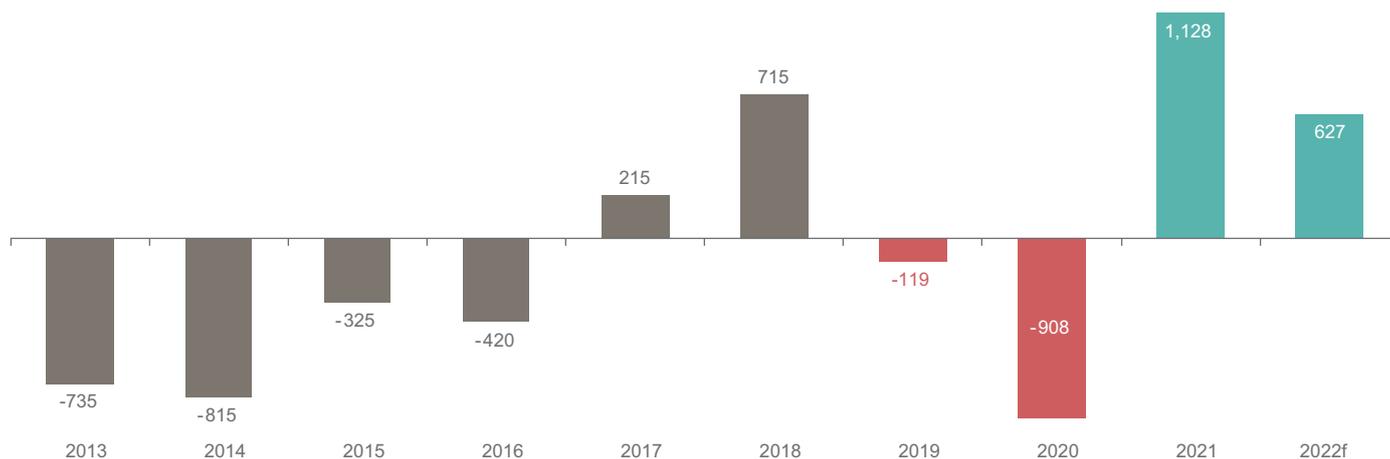


Source: Metals Focus

## 2022 OUTLOOK

In 2022, we expect that the wider markets' volatility that we have seen over the last two years will persist, in part due to the uncertainties of the conflict in Ukraine. In view of the onset of the war, the sharp escalation in supply disruptions leading to further inflationary pressures and tightening of monetary policy across a number of key economies, the IMF downgraded its forecast for global economic growth for the year to 3.6%. Even so, we still forecast a modest growth in platinum demand of 2% (+126 koz) year-on-year, although this reflects markedly different trends in a number of key segments. Among these, most importantly, we forecast automotive demand to increase by 16% (+412 koz), on expectations of a recovery in production and higher vehicle loadings. In contrast, industrial demand will be 16% (-399 koz) lower from record levels in 2021, as we do not anticipate a repetition of the capacity expansions in the glass and chemical sector. While we expect to see further outflows in both ETFs and Exchange Stocks, this will be offset by bar and coin demand, although lower than 2021 levels. On the supply side, mine supply is forecast to decline by 5% (-332 koz), mainly due to lower output from South Africa. Secondary supply will be constrained by reduced scrappage rates and lower jewellery sales. This will result in a market surplus of 627 koz, down notably on 2021, but still the third highest in this series.

**Chart 5: Supply-demand balance, koz, 2013-2022f**



Source: Metals Focus

It is hard to predict the extent to which this surplus will weigh on the platinum price. As discussed in the previous *Platinum Quarterly*, in 2020 and 2021 there was sizeable speculative and quasi-speculative buying of platinum bullion within China, in large part by entities and individuals involved in platinum industrial fabrication. The table below features Metals Focus' estimates of this stock build. In 2021 the stock build in fact exceeded the global market surplus. Metal held in China is not readily available to the international bullion market and, as a result, this shift of inventory into China at times created tightening physical market conditions, in spite of the global market being in surplus. If such activity continues in 2022, it should lend support to platinum. Although the COVID-spread in China coupled with its government's zero-COVID policy are no doubt a concern, the sharp rise in SGE trading activity and jump in imports in March, as prices moved lower, indicate there is still healthy appetite for platinum in the country.

### Estimated Speculative Stock Build in China, (koz)

	2020	2021
Platinum Quarterly Global Balance	-908	1,128
Estimated Chinese Speculative Stock Build	624	1,200
Implied balance after speculative stock build	-1,531	-72

**Supply**

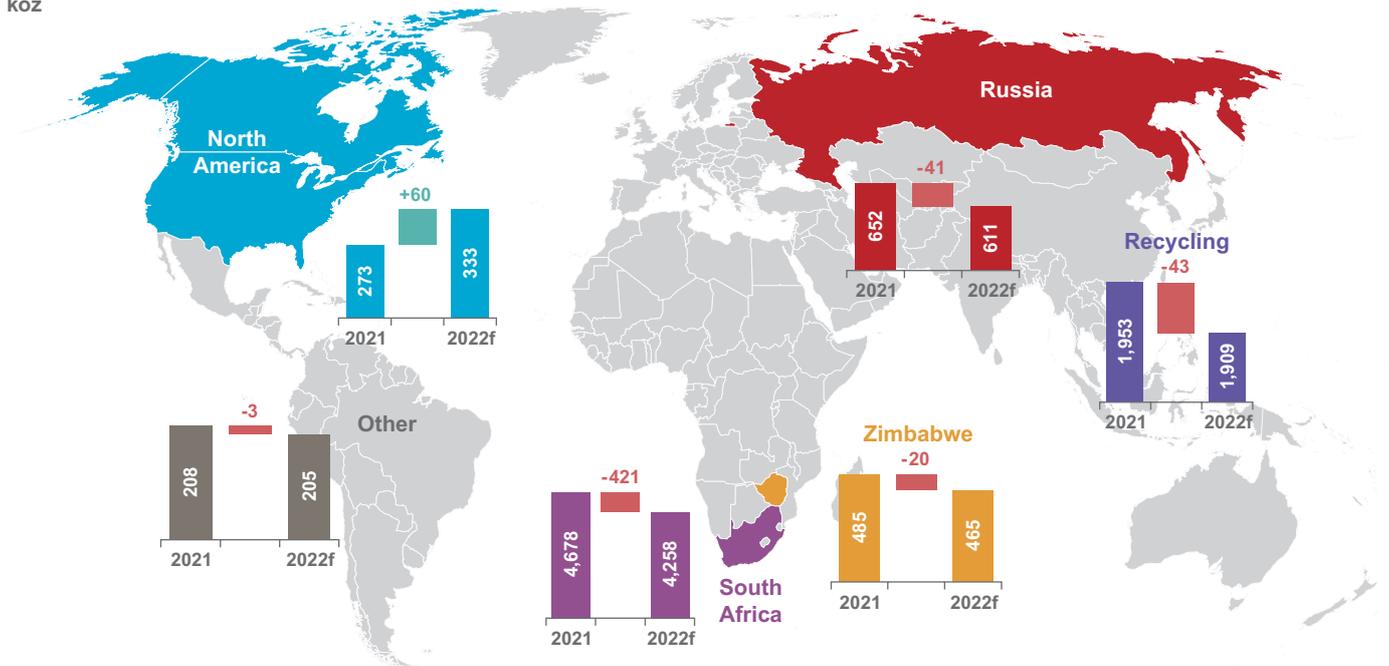
We have significantly revised our 2022 forecast downwards, primarily due to expectations of much lower output from South Africa. Three major producers, Amplats, Implats and Northam have lowered their guidance. Although subject to individual operational constraints, common headwinds of increased safety incidents and resultant production stoppages, community unrest and supply chain procurement challenges were cited.

The three-yearly South African wage negotiations between unions and platinum miners has begun, however if normal timelines are maintained, any potential strike will not materialise until early-2023. Workers at Sibanye-Stillwater's gold operations are currently striking due to a wage dispute. The two major unions released a statement detailing plans to extend the strikes to the company's Rustenburg and Marikana PGM operations. At the time of writing Sibanye-Stillwater has not received a notification of a secondary strike at its PGM operation and has subsequently raised its offer to gold workers. Any strike at Sibanye-Stillwater's PGM operations would put 800 koz of annual platinum production at risk.

We have also lowered our outlook for Russia. While Nornickel, which accounts for almost all Russian platinum production, remains unsanctioned, the operating environment in Russia has become increasingly challenging due to the geopolitical situation. The company is in the process of modernising operations and so is becoming increasingly dependent on Western suppliers, some of which have announced a pause in deliveries to Russia. While Nornickel has announced challenges in procurement of equipment and consumables the company reiterated its production guidance as it seeks to minimise the impact by sourcing from alternative suppliers.

Overall, platinum mine supply is forecast to decline 7% (-425 koz) year-on-year to 5,872 koz due to the depletion of Anglo American Platinum semi-finished inventory that boosted refined volumes in 2021, while planned smelter maintenance in South African and Russia reduces processing availability. South Africa will account for the bulk of the fall, with a forecast decline of 9% (-421 koz) to 4,258 koz. Output from North America is expected to grow 22% (+60 koz) as Vale's Sudbury production normalises following the strike in 2021. However, regional labour shortages continue to impact operations and present a downside risk.

**Chart 6: Changes in supply, 2021 vs. 2022f**  
koz



Source: Metals Focus

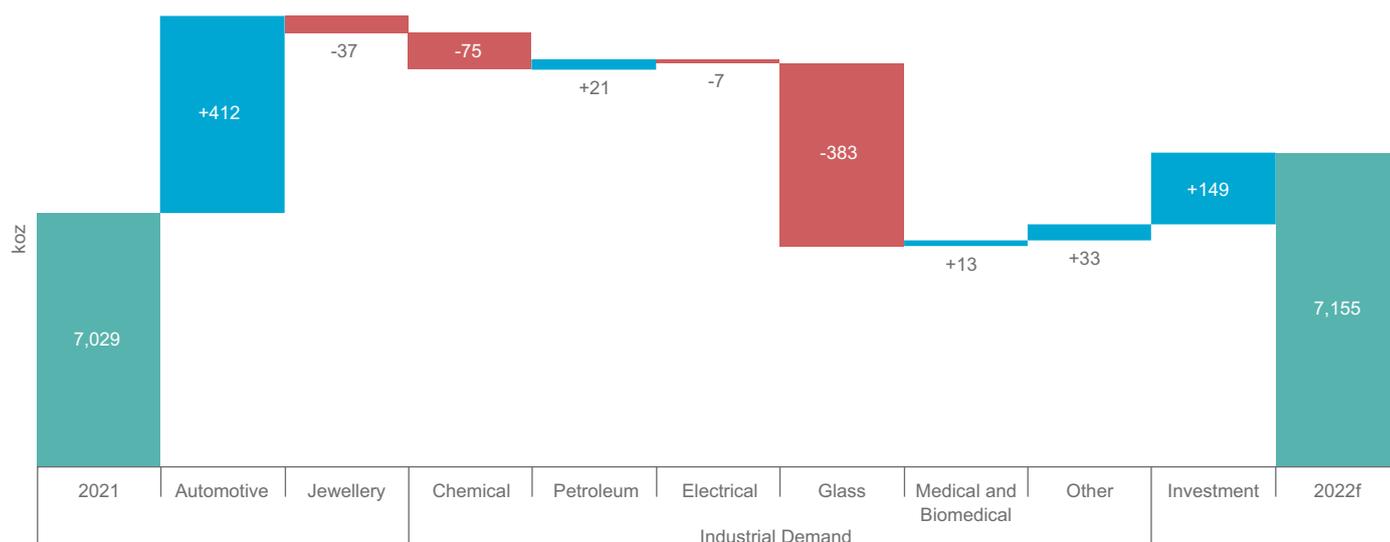
## Recycling

Full year platinum recycling is forecast to decline modestly by 2% (-43 koz) year-on-year to 1,909 koz. Following weak Q1'22 recycling rates, this implies that the rest of the year will generate a meaningful recovery in scrap supply. For the autocatalyst sector, this will largely reflect improved auto sales as the year progresses, which in turn will generate greater availability of end-of-life vehicles for salvage yards. For the jewellery sector, expectations of a return to more normal conditions in China, as COVID restrictions are eventually lifted, will see pent-up selling back of old jewellery re-emerge.

## Demand

For the full year, we expect demand to grow marginally by 2% (+126 koz), as the strength in autocatalyst demand (+412 koz) is tempered by declines in jewellery and industrial demand. In the investment market, while we expect bar and coin demand to decline 23% (-78 koz), and stocks held by exchanges to continue to fall, ETF holdings are expected to remain largely flat compared with end-2021, implying a positive inflow following the Q1'22 outflows.

Chart 7: Changes in demand by category, 2021 vs. 2022f



Source: Metals Focus

## Automotive demand

While we expect the disruption to production caused by the chip shortage to gradually recede during 2022, the impact of China's lockdown response to COVID, and the growing impact of the Russia-Ukraine war undermines the previous outlook for both light and heavy-duty vehicle output. Directionally, light-duty vehicle production is expected to improve, but this growth is now tempered to 6% year-on-year, resulting in a global production number of 82M units, down from 85M at the start of the year. HDV production, meanwhile, is expected to weaken, as forward buying in 2021 and worsening supply chain conditions result in a 5% decline. However, the rise in LDV units produced, higher loadings due to tighter emission regulation and continued platinum substitution, at the expense of palladium, will see platinum demand increase by 16% (+412 koz).

The proximity of Europe to the current conflict has added uncertainty to the vehicle production outlook for the region. Given that we still forecast LDV production growth but see a continued shift to pure battery electric vehicles (BEVs) and a decline in diesel passenger vehicle market share in the year, we forecast a modest improvement. In North America, pent up demand and easing of the chip shortages support a double-digit production increase that will result in platinum demand rising.

Vehicle production in China will be constrained this year, with the LDV production outlook flat and HDV production declining compared to 2021. However, more than 80% of trucks and buses manufactured in 2022 will be China VIa certified. Compliant after-treatment systems contain substantially higher PGM loadings compared to China V ones. In addition, in the gasoline light passenger vehicle segment a growing proportion of production will adopt the use of trimetal catalyst systems, which contain a higher ratio of platinum to palladium compared with previous systems. The combined impact of these two developments will see total Chinese demand grow by 50%.

In other regions, we also forecast stronger demand growth mainly as production recovers from the pandemic and supply chain shortages recede.

**Jewellery demand**

Global jewellery demand will decline 2% (-37 koz) to 1,886 koz in 2022, the lowest level in our series as platinum loses ground to gold jewellery in some of its key markets.

In China platinum jewellery sales will post further notable losses in Q2'22 as the severe measures to combat COVID outbreaks impede retail activity. Sales are expected to gradually pick up in the second half of the year driven by improving market sentiment as pandemic damage is expected to ease. We expect demand from this region to decline further for the full year. In Japan we expect further gains, however the disappointing start to the year and continued decline of the yen (that pushes local platinum prices up) all suggest that demand will likely remain far off its pre-pandemic levels.

Europe demand should rise this year thanks to a jump in the number of weddings, price-led gains from gold in bridal and further growth for the luxury brands. However, gains are at risk from a broadening of the Ukraine conflict and any hard landing for China's economy.

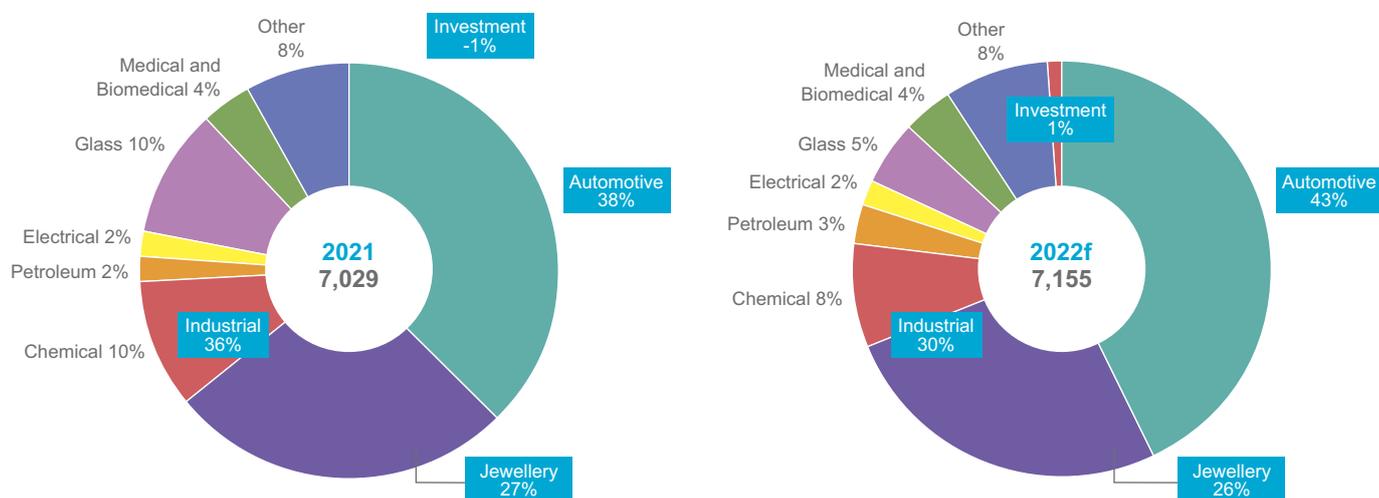
North American demand is forecast to inch up this year helped by a projected jump of around a third in the number of weddings and a still wide price discount to gold. These factors will be partly offset by counter high inflation, an end to re-stocking and an anticipated surge in travel expenditure over the summer.

In contrast, in India we expect to see a normalisation of economic activity, with fabrication expected to grow to a record high.

**Industrial demand**

After a record high total in 2021, industrial demand for platinum is expected to decline 16% (-399 koz) to 2,109 koz this year, mostly due to lower requirements from the glass sector. Higher inflation, increased energy and commodity costs will also weigh on demand from this sector.

**Chart 8: Demand end-use shares, 2021 vs. 2022f**



Source: Metals Focus

### **Petroleum**

The Russia-Ukraine war and the COVID outbreak have created new uncertainties in the global oil market. Even so, the recovery in global oil demand (and hence refining output) is still expected to reach pre-pandemic levels in late 2022, albeit at a slightly slower pace than previous anticipated. This growth is also expected to be accompanied by new refining capacity additions, which once again will be led by China. This explains why we still expect a 12% rise (+21 koz) in platinum offtake. That said, absolute volumes in 2022 are still expected to fall short of pre-COVID levels seen over 2017-2019. To a large extent, this reflects the fact that the pandemic has resulted in heavy cuts to investment in new projects (with China being the notable exception). Moreover, oil companies are facing increasing pressure to shift away from fossil fuels to low or zero carbon products.

### **Chemical**

Demand is forecast to fall by 11% (-75 koz) year-on-year to 613 koz. Our projections for 2022 have been revised slightly lower since the previous report, as the Russia-Ukraine war has caused severe disruptions to the global fertilizer industry. Instead of seeing gradual improvements following an already challenging 2021, demand from this industry is now expected to weaken further in 2022. The petrochemical sector, which contributed the bulk of gains in recent years, will also record lower demand reflecting, a slowing pace of capacity additions in China. By contrast, firmer demand for silicone products should underpin platinum offtake, itself a result of the ongoing global economic recovery.

### **Glass**

As expected in 2021, we continue to forecast significantly lower platinum demand from the glass industry for 2022. This naturally follows exceptionally strong demand last year and is consistent with past cycles of capacity investment. Capacity expansions/investments are concentrated to take advantage of economies of scale and are often followed by periods of lower investment and this is precisely what we are seeing at the moment. We forecast that platinum demand from the glass industry will halve to 331 koz in 2022.

One emerging risk to our glass demand forecast is the possibility that the spread of COVID-19 in China coupled with its zero-COVID policy delay even the limited number of plants that are planned to come onstream this year. Pressure on margins in the face of rising input costs may also discourage new investments. However, we are confident that such headwinds will merely push demand forward by one or more quarters and will not be permanent – the outlook for both LCD glass and composites remains bright and that will inevitably require new capacity to be built.

### **Medical**

As the world continues to vaccinate and the impact of Omicron subsides, COVID patients will take up less hospital bed capacity, allowing healthcare services to start tackling the significant, COVID-exacerbated, elective procedures backlog. In-hospital cancer treatments are also expected to improve compared to 2020 and 2021. For these reasons, we forecast year-on-year growth of 5% (+13 koz), an increase of 3% (+8 koz) against pre-pandemic 2019.

### **Electrical**

Due to inflationary pressures, rising living costs and growing pressure on corporate budgets, especially in the near term, the consumer electronics market will remain under pressure, resulting in downward inventory adjustments continuing into Q2'22. That said, the overall market will gradually recover in the second half of the year. However, due to weaker momentum in the nearline storage market, as well as the continued replacement by faster solid-state drives (SSD) in high-efficiency and mission-critical storage products, global HDD shipments are expected to shrink further. Gains from the rising adoption of high-capacity drives, with higher metal loadings per disk, will not make up for the loss in lower unit shipments. As such, platinum electrical demand is forecast to decline by 6% (-7 koz) in 2022.

### **Other**

With the gradual improvement of auto chip supply and resumption of business activity, platinum offtake is expected to increase benefiting from robust aftermarket demand, and rising vehicle output in the second half. Downside risks could lie in lower vehicle production due to geopolitical conflicts, as well as the operational constraints from China's COVID containment measures.

### **Investment demand**

For the year as a whole, bar and coin demand is forecast to decline by 23% (-78 koz). Taking a look at the regional aspects, North America is forecast to rise to the highest total in our series. In spite of a slight drop in Q1'22, retail interest over the next nine months is expected to improve, reflecting the wider interest in precious metals across the region, which should generate additional positive interest for platinum.

In sharp contrast, Japan is forecast to see net selling in 2022; this will be the worst performance for Japan in our dataset. This reflects the significant weakening of the yen, down 18% in Q1'21, and expectations of further yen weakness in Q2'22, which should see Japanese retail investors remain net suppliers to the market. By contrast, H2'22 is expected to see modest levels of buying return, as the yen eventually stabilises. However, we cannot see this managing to offset the first half liquidations, not least as we have a positive outlook for dollar-platinum prices in H2'22.

European investment is expected to weaken for the second consecutive year. The factors that drove the Q1'22 decline, including investors converting some liquid assets into cash due to heightened global risks, are likely to persist for at least the next few months. That said, absolute platinum volumes are projected to remain healthy, as surging inflationary worries, doubts over fiat currencies and elevated geopolitical and economic uncertainties will favour hard assets.

While ETF holdings recorded a higher outflow in Q1'22 than Q4'21 we expect to see modest inflow in ETF holdings over the remainder of this year resulting in a 50 koz full year outflow.

Despite the spike in EFPs that incentivised deliveries into the NYMEX exchange from mid-March, we have seen active futures contract prices shift back to a discount to spot, which lead us to expect further withdrawals from NYMEX-approved warehouses. In addition, should China and Hong Kong imports remain strong during this year we can expect further incentive for withdrawals.

### **ABOVE GROUND STOCKS**

With the decline in industrial and investment demand softening the impact of lower supply, above ground stocks will increase to 4,379 koz, equivalent to 7.3 months of demand. This will reflect the platinum market recording another sizeable surplus of 627 koz, albeit considerably lower than 1,128 koz recorded in 2021. It is important to note that, following China's stock building in 2020 and 2021, a substantial portion of this is now held in that country.

The WPIC definition of above ground stocks is the year-end estimate of the cumulative platinum holdings not associated with exchange-traded funds, metal held by exchanges or working inventories of mining producers, refiners, fabricators or end-users.

# PLATINUM QUARTERLY Q1 2022

**Table 2: Supply, demand and above ground stocks summary – annual comparison**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022f	2021/2020 Growth %	2022f/2021 Growth %
<b>Platinum Supply-demand Balance (koz)</b>												
<b>SUPPLY</b>												
<b>Refined Production</b>	<b>6,070</b>	<b>4,875</b>	<b>6,160</b>	<b>6,045</b>	<b>6,130</b>	<b>6,125</b>	<b>6,075</b>	<b>4,989</b>	<b>6,297</b>	<b>5,872</b>	<b>26%</b>	<b>-7%</b>
South Africa	4,355	3,135	4,480	4,265	4,385	4,470	4,374	3,298	4,678	4,258	42%	-9%
Zimbabwe	405	405	405	490	480	465	458	448	485	465	8%	-4%
North America	355	395	365	390	360	345	356	337	273	333	-19%	22%
Russia	740	740	710	715	720	665	716	704	652	611	-7%	-6%
Other	215	200	200	185	185	180	170	202	208	205	3%	-1%
<b>Increase (-)/Decrease (+) in Producer Inventory</b>	<b>-215</b>	<b>+350</b>	<b>+30</b>	<b>+30</b>	<b>+30</b>	<b>+10</b>	<b>+2</b>	<b>-84</b>	<b>-93</b>	<b>+0</b>	<b>N/A</b>	<b>N/A</b>
<b>Total Mining Supply</b>	<b>5,855</b>	<b>5,225</b>	<b>6,190</b>	<b>6,075</b>	<b>6,160</b>	<b>6,135</b>	<b>6,077</b>	<b>4,906</b>	<b>6,204</b>	<b>5,872</b>	<b>26%</b>	<b>-5%</b>
<b>Recycling</b>	<b>2,000</b>	<b>2,055</b>	<b>1,720</b>	<b>1,860</b>	<b>1,915</b>	<b>1,955</b>	<b>2,136</b>	<b>1,930</b>	<b>1,953</b>	<b>1,909</b>	<b>1%</b>	<b>-2%</b>
Autocatalyst	1,120	1,255	1,185	1,210	1,325	1,420	1,590	1,442	1,464	1,418	2%	-3%
Jewellery	855	775	515	625	560	505	476	422	422	422	0%	0%
Industrial	25	25	20	25	30	30	69	66	67	69	1%	3%
<b>Total Supply</b>	<b>7,855</b>	<b>7,280</b>	<b>7,910</b>	<b>7,935</b>	<b>8,075</b>	<b>8,090</b>	<b>8,213</b>	<b>6,836</b>	<b>8,156</b>	<b>7,781</b>	<b>19%</b>	<b>-5%</b>
<b>DEMAND</b>												
<b>Automotive</b>	<b>3,130</b>	<b>3,245</b>	<b>3,245</b>	<b>3,360</b>	<b>3,300</b>	<b>3,100</b>	<b>2,869</b>	<b>2,402</b>	<b>2,643</b>	<b>3,055</b>	<b>10%</b>	<b>16%</b>
Autocatalyst	2,990	3,095	3,105	3,225	3,160	2,955	2,869	2,402	2,643	3,055	10%	16%
Non-road	140	150	140	135	140	145	†	†	†	†	†	†
<b>Jewellery</b>	<b>2,945</b>	<b>3,000</b>	<b>2,840</b>	<b>2,505</b>	<b>2,460</b>	<b>2,245</b>	<b>2,099</b>	<b>1,820</b>	<b>1,923</b>	<b>1,886</b>	<b>6%</b>	<b>-2%</b>
<b>Industrial</b>	<b>1,580</b>	<b>1,700</b>	<b>1,845</b>	<b>1,955</b>	<b>1,825</b>	<b>2,015</b>	<b>2,127</b>	<b>1,978</b>	<b>2,508</b>	<b>2,109</b>	<b>27%</b>	<b>-16%</b>
Chemical	535	540	515	560	570	565	694	596	688	613	15%	-11%
Petroleum	50	60	205	220	100	235	219	109	172	193	58%	12%
Electrical	195	215	205	195	210	205	144	130	135	127	4%	-6%
Glass	145	205	235	255	205	250	236	407	715	331	75%	-54%
Medical and Biomedical	220	225	240	235	235	235	249	235	244	257	4%	5%
Other	435	455	445	490	505	525	584	500	555	588	11%	6%
<b>Investment</b>	<b>935</b>	<b>150</b>	<b>305</b>	<b>535</b>	<b>275</b>	<b>15</b>	<b>1,237</b>	<b>1,544</b>	<b>-45</b>	<b>104</b>	<b>N/A</b>	<b>N/A</b>
Change in Bars, Coins	-5	50	525	460	215	280	266	578	332	254	-43%	-23%
Change in ETF Holdings	905	215	-240	-10	105	-245	991	507	-238	-50	N/A	N/A
Change in Stocks Held by Exchanges	35	-115	20	85	-45	-20	-20	458	-139	-100	N/A	N/A
<b>Total Demand</b>	<b>8,590</b>	<b>8,095</b>	<b>8,235</b>	<b>8,355</b>	<b>7,860</b>	<b>7,375</b>	<b>8,331</b>	<b>7,743</b>	<b>7,029</b>	<b>7,155</b>	<b>-9%</b>	<b>2%</b>
<b>Balance</b>	<b>-735</b>	<b>-815</b>	<b>-325</b>	<b>-420</b>	<b>215</b>	<b>715</b>	<b>-119</b>	<b>-908</b>	<b>1,128</b>	<b>627</b>	<b>N/A</b>	<b>-44%</b>
<b>Above Ground Stocks</b>	<b>3,405*</b>	<b>2,590</b>	<b>2,265</b>	<b>1,845</b>	<b>2,060</b>	<b>2,775</b>	<b>3,531**</b>	<b>2,624</b>	<b>3,752</b>	<b>4,379</b>	<b>43%</b>	<b>17%</b>

Source: Metals Focus 2019 - 2022, SFA (Oxford) 2013 - 2018.

Notes:

1. Above Ground Stocks: \*4,140 koz as of 31st December 2012 (SFA (Oxford)). \*\*3,650 koz as of 31 December 2018 (Metals Focus).
2. † Non-road automotive demand is included in autocatalyst demand.
3. Data from Metals Focus and SFA (Oxford) may not have been prepared on the same or directly comparable basis.
4. Prior to 2019 SFA data is independently rounded to the nearest 5 koz.

# PLATINUM QUARTERLY Q1 2022

Table 3: Supply and demand summary – quarterly comparison

	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q1'22/Q1'21 Growth %	Q1'22/Q4'21 Growth %
<b>Platinum Supply-demand Balance (koz)</b>											
<b>SUPPLY</b>											
<b>Refined Production</b>	<b>1,248</b>	<b>942</b>	<b>1,496</b>	<b>1,303</b>	<b>1,465</b>	<b>1,566</b>	<b>1,571</b>	<b>1,695</b>	<b>1,279</b>	<b>-13%</b>	<b>-25%</b>
South Africa	843	521	1,062	873	1,028	1,175	1,201	1,274	861	-16%	-32%
Zimbabwe	108	110	115	115	118	125	116	127	121	2%	-5%
North America	98	87	71	82	83	75	51	64	84	1%	31%
Russia	150	175	196	182	184	137	153	178	163	-11%	-9%
Other	50	49	52	51	52	53	51	52	51	-1%	-1%
<b>Increase (-)/Decrease (+) in Producer Inventory</b>	<b>+54</b>	<b>+25</b>	<b>-112</b>	<b>-51</b>	<b>-29</b>	<b>+18</b>	<b>-43</b>	<b>-39</b>	<b>+0</b>	<b>N/A</b>	<b>N/A</b>
<b>Total Mining Supply</b>	<b>1,302</b>	<b>967</b>	<b>1,384</b>	<b>1,252</b>	<b>1,435</b>	<b>1,584</b>	<b>1,529</b>	<b>1,656</b>	<b>1,279</b>	<b>-11%</b>	<b>-23%</b>
<b>Recycling</b>	<b>448</b>	<b>376</b>	<b>533</b>	<b>574</b>	<b>518</b>	<b>527</b>	<b>455</b>	<b>453</b>	<b>415</b>	<b>-20%</b>	<b>-8%</b>
Autocatalyst	361	263	394	423	384	412	334	333	299	-22%	-10%
Jewellery	70	97	121	134	118	98	104	102	99	-16%	-4%
Industrial	17	15	17	17	16	17	17	17	17	6%	0%
<b>Total Supply</b>	<b>1,750</b>	<b>1,343</b>	<b>1,917</b>	<b>1,826</b>	<b>1,953</b>	<b>2,110</b>	<b>1,984</b>	<b>2,109</b>	<b>1,695</b>	<b>-13%</b>	<b>-20%</b>
<b>DEMAND</b>											
<b>Automotive</b>	<b>643</b>	<b>390</b>	<b>648</b>	<b>720</b>	<b>724</b>	<b>659</b>	<b>579</b>	<b>680</b>	<b>725</b>	<b>0%</b>	<b>7%</b>
Autocatalyst	643	390	648	720	724	659	579	680	725	0%	7%
Non-road	†	†	†	†	†	†	†	†	†	N/A	N/A
<b>Jewellery</b>	<b>393</b>	<b>388</b>	<b>510</b>	<b>529</b>	<b>479</b>	<b>463</b>	<b>482</b>	<b>499</b>	<b>437</b>	<b>-9%</b>	<b>-12%</b>
<b>Industrial</b>	<b>567</b>	<b>386</b>	<b>502</b>	<b>524</b>	<b>707</b>	<b>588</b>	<b>588</b>	<b>624</b>	<b>533</b>	<b>-25%</b>	<b>-15%</b>
Chemical	179	113	126	178	119	210	158	200	111	-7%	-45%
Petroleum	33	18	21	36	37	39	39	57	44	21%	-22%
Electrical	32	29	33	36	33	35	35	32	30	-9%	-5%
Glass	146	62	127	73	318	112	164	121	138	-56%	14%
Medical and Biomedical	59	59	59	59	57	59	61	67	65	15%	-2%
Other	118	104	136	143	143	132	132	147	144	0%	-3%
<b>Investment</b>	<b>67</b>	<b>383</b>	<b>960</b>	<b>135</b>	<b>159</b>	<b>187</b>	<b>-282</b>	<b>-108</b>	<b>-167</b>	<b>N/A</b>	<b>N/A</b>
Change in Bars, Coins	300	122	97	60	21	107	110	95	60	192%	-37%
Change in ETF Holdings	-213	123	522	76	105	31	-219	-155	-169	N/A	N/A
Change in Stocks Held by Exchanges	-20	138	342	-1	33	49	-173	-48	-58	N/A	N/A
<b>Total Demand</b>	<b>1,669</b>	<b>1,547</b>	<b>2,619</b>	<b>1,908</b>	<b>2,069</b>	<b>1,897</b>	<b>1,368</b>	<b>1,695</b>	<b>1,528</b>	<b>-26%</b>	<b>-10%</b>
<b>Balance</b>	<b>81</b>	<b>-204</b>	<b>-702</b>	<b>-82</b>	<b>-116</b>	<b>214</b>	<b>616</b>	<b>413</b>	<b>167</b>	<b>N/A</b>	<b>-60%</b>

Source: Metals Focus 2020 - 2022.

Notes:

1. † Non-road automotive demand is included in autocatalyst demand.

# PLATINUM QUARTERLY Q1 2022

Table 4: Supply and demand summary – half-yearly comparison

	H2 2019	H1 2020	H2 2020	H1 2021	H2 2021	H2'21/H2'20 Growth %	H2'21/H1'21 Growth %
<b>Platinum Supply-demand Balance (koz)</b>							
<b>SUPPLY</b>							
<b>Refined Production</b>	<b>3,100</b>	<b>2,191</b>	<b>2,799</b>	<b>3,030</b>	<b>3,266</b>	<b>17%</b>	<b>8%</b>
South Africa	2,293	1,364	1,934	2,203	2,475	28%	12%
Zimbabwe	228	218	230	243	242	5%	0%
North America	173	185	153	159	115	-25%	-28%
Russia	324	325	379	321	331	-13%	3%
Other	83	99	103	105	103	0%	-1%
<b>Increase (-)/Decrease (+) in Producer Inventory</b>	<b>+16</b>	<b>+79</b>	<b>-162</b>	<b>-11</b>	<b>-82</b>	<b>N/A</b>	<b>N/A</b>
<b>Total Mining Supply</b>	<b>3,116</b>	<b>2,269</b>	<b>2,637</b>	<b>3,019</b>	<b>3,184</b>	<b>21%</b>	<b>5%</b>
<b>Recycling</b>	<b>1,047</b>	<b>823</b>	<b>1,106</b>	<b>1,044</b>	<b>908</b>	<b>-18%</b>	<b>-13%</b>
Autocatalyst	775	625	817	796	668	-18%	-16%
Jewellery	237	167	255	216	206	-19%	-4%
Industrial	35	32	34	33	34	0%	5%
<b>Total Supply</b>	<b>4,163</b>	<b>3,092</b>	<b>3,743</b>	<b>4,064</b>	<b>4,093</b>	<b>9%</b>	<b>1%</b>
<b>DEMAND</b>							
<b>Automotive</b>	<b>1,362</b>	<b>1,034</b>	<b>1,368</b>	<b>1,383</b>	<b>1,260</b>	<b>-8%</b>	<b>-9%</b>
Autocatalyst	1,362	1,034	1,368	1,383	1,260	-8%	-9%
Non-road	†	†	†	†	†	N/A	N/A
<b>Jewellery</b>	<b>1,025</b>	<b>780</b>	<b>1,039</b>	<b>942</b>	<b>981</b>	<b>-6%</b>	<b>4%</b>
<b>Industrial</b>	<b>1,034</b>	<b>952</b>	<b>1,026</b>	<b>1,295</b>	<b>1,213</b>	<b>18%</b>	<b>-6%</b>
Chemical	351	293	304	330	358	18%	9%
Petroleum	109	51	57	76	96	67%	27%
Electrical	73	61	68	68	67	-2%	-2%
Glass	84	208	200	429	285	43%	-34%
Medical and Biomedical	124	117	117	117	127	8%	9%
Other	292	222	279	275	279	0%	1%
<b>Investment</b>	<b>324</b>	<b>449</b>	<b>1,094</b>	<b>345</b>	<b>-390</b>	<b>N/A</b>	<b>N/A</b>
Change in Bars, Coins	74	422	156	127	205	31%	61%
Change in ETF Holdings	254	-90	597	136	-374	N/A	N/A
Change in Stocks Held by Exchanges	-4	118	341	82	-221	N/A	N/A
<b>Total Demand</b>	<b>3,746</b>	<b>3,216</b>	<b>4,527</b>	<b>3,966</b>	<b>3,063</b>	<b>-32%</b>	<b>-23%</b>
<b>Balance</b>	<b>417</b>	<b>-124</b>	<b>-784</b>	<b>98</b>	<b>1,030</b>	<b>N/A</b>	<b>&gt;±300%</b>

Source: Metals Focus 2019 - 2022.

Notes:

1. † Non-road automotive demand is included in autocatalyst demand.

# PLATINUM QUARTERLY Q1 2022

**Table 5: Regional demand – annual and quarterly comparison**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022f	2021/2020 Growth %	2022f/2021 Growth %	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	
<b>Platinum gross demand (koz)</b>																		
<b>Automotive</b>	3,130	3,240	3,250	3,350	3,290	3,090	2,869	2,402	2,643	3,055	10%	16%	724	659	579	680	725	
North America	425	465	480	410	390	390	343	300	383									
Western Europe	1,350	1,395	1,450	1,630	1,545	1,325	1,457	1,099	1,006									
Japan	585	585	510	450	435	425	309	247	265									
China	130	125	145	195	230	220	185	280	381									
India	165	170	180	170	175	195	††	††	††									
Rest of the World	475	500	485	495	515	535	574	475	608									
<b>Jewellery</b>	2,945	3,000	2,840	2,505	2,460	2,245	2,099	1,820	1,923	1,886	6%	-2%	479	463	482	499	437	
North America	200	230	250	265	280	280	341	277	409									
Western Europe	220	220	235	240	250	255	237	196	260									
Japan	335	335	340	335	340	345	372	316	298									
China	1,990	1,975	1,765	1,450	1,340	1,095	871	832	703									
India	140	175	180	145	175	195	102	48	94									
Rest of the World	60	65	70	70	75	75	176	151	159									
<b>Chemical</b>	535	540	515	560	570	565	694	596	688	613	15%	-11%	119	210	158	200	111	
North America	55	55	55	50	50	50	77	91	98									
Western Europe	110	105	75	110	115	105	125	115	121									
Japan	10	10	10	15	15	15	66	62	65									
China	195	215	230	225	220	215	236	185	251									
Rest of the World	165	155	145	160	170	180	190	144	153									
<b>Petroleum</b>	50	60	205	220	100	235	219	109	172	193	58%	12%	37	39	39	57	44	
North America	40	25	-25	90	55	55	30	5	32									
Western Europe	-45	-20	70	10	5	20	14	11	18									
Japan	10	-35	5	0	-40	5	7	6	12									
China	80	-5	45	80	45	10	66	35	42									
Rest of the World	-35	95	110	40	35	145	103	52	67									
<b>Electrical</b>	195	215	205	195	210	205	144	130	135	127	4%	-6%	33	35	35	32	30	
North America	10	15	15	10	15	15	38	35	35									
Western Europe	5	10	10	10	10	10	27	23	25									
Japan	15	15	15	15	15	15	20	16	17									
China	75	70	70	80	90	85	28	31	31									
Rest of the World	90	105	95	80	80	80	31	25	26									
<b>Glass</b>	145	205	235	255	205	250	236	407	715	331	75%	-54%	318	112	164	121	138	
North America	5	10	0	20	5	5	7	-37	17									
Western Europe	-10	15	10	5	5	35	59	25	5									
Japan	0	-25	-5	-10	-10	0	-40	-66	-22									
China	90	115	130	150	110	80	180	360	713									
Rest of the World	60	90	100	90	95	130	30	126	3									
<b>Medical</b>	220	225	240	235	235	235	249	235	244	257	4%	5%	57	59	61	67	65	
<b>Other industrial</b>	435	455	445	490	505	525	584	500	555	588	11%	6%	143	132	132	147	144	
<b>Bar &amp; Coin Investment</b>	-5	50	525	460	215	280	266	578	332	254	-43%	-23%	21	107	110	95	60	
North America							159	242	264									
Western Europe							52	75	61									
Japan							46	240	-26									
Rest of the World							9	21	33									
<b>ETF Investment</b>	905	215	-240	-10	105	-245	991	507	-238	-50	N/A	N/A	105	31	-219	-155	-169	
North America							125	524	-6									
Western Europe							509	237	59									
Japan							-13	58	-23									
Rest of the World							370	-312	-268									
<b>Change in Stocks Held by Exchanges</b>	35	-115	20	85	-45	-20	-20	458	-139	-100	N/A	N/A	33	49	-173	-48	-58	
<b>Investment</b>	935	150	305	535	275	15	1,237	1,544	-45	104	N/A	N/A	159	187	-282	-108	-167	
<b>Total Demand</b>	8,590	8,090	8,240	8,345	7,850	7,365	8,331	7,743	7,029	7,155	-9%	2%	2,069	1,897	1,368	1,695	1,528	

Source: Metals Focus 2019 - 2022, SFA (Oxford) 2013 - 2018.

Notes:

1. † Non-road automotive demand is included in autocatalyst demand.
2. †† India automotive demand is included in Rest of the World.
3. Data from Metals Focus and SFA (Oxford) may not have been prepared on the same or directly comparable basis.
4. Prior to 2019 SFA data is independently rounded to the nearest 5 koz.

## PLATINUM QUARTERLY Q1 2022

**Table 6: Regional recycling – annual and quarterly comparison**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022f	2021/2020 Growth %	2022f/2021 Growth %	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022
<b>Platinum recycling supply (koz)</b>																	
<b>Automotive</b>	1,120	1,255	1,185	1,210	1,325	1,420	1,590	1,442	1,464	1,418	2%	-3%	384	412	334	333	299
North America							520	458	459								
Western Europe							808	747	767								
Japan							116	110	112								
China							35	36	37								
Rest of the World							110	90	89								
<b>Jewellery</b>	855	775	515	625	560	505	476	422	422	422	0%	0%	118	98	104	102	99
North America							3	3	3								
Western Europe							4	4	3								
Japan							187	162	160								
China							276	248	250								
Rest of the World							5	5	5								
<b>Industrial</b>	25	25	20	25	30	30	69	66	67	69	1%	3%	16	17	17	17	17
North America							15	12	12								
Western Europe							11	10	11								
Japan							34	34	34								
China							7	7	8								
Rest of the World							2	2	2								

Source: Metals Focus 2019 - 2022, SFA (Oxford) 2013 – 2018.

## GLOSSARY OF TERMS

### Above ground stocks

The year-end estimate of the cumulative platinum holdings not associated with exchange-traded funds; metal held by exchanges or working inventories of mining producers, refiners, fabricators or end-users. Typically, unpublished vaulted metal holdings from which a supply-demand shortfall can be readily supplied or to which a supply-demand surplus can readily flow.

### ADH

Alkane dehydrogenation: catalytic conversion of alkanes to alkenes. Broad term encompassing BDH and PDH.

### BDH

Butane dehydrogenation; catalytic conversion of isobutane to isobutylene.

### Bharat

The Government of India introduced Bharat emission standards (BSES) to reduce and regulate the output of air pollutants from internal combustion and spark-ignition engine equipment, including motor vehicles.

### Bharat Stage V/VI standards (BS-V, BS-VI)

Early in 2016 the Indian government announced the intention to 'leapfrog' Bharat Stage V and move directly to Bharat Stage VI, equivalent to Euro 6, in 2020. This intention, despite lockdown, has not been altered.

### China Vehicle Emission Standards

China's vehicle emission standards are set nationally by the Ministry of Environmental Protection and are regionally and locally enforced by Environmental Protection Bureaus.

A number of cities and provinces in China continue the historic practice of early introduction of new standards.

### China 6

As of December 2016, China adopted China 6 standards that apply nationwide to light-duty passenger vehicles from July 2020 (China 6a) and July 2023 (China 6b). These standards incorporate elements of Euro 6 and U.S. Tier 2 regulations for tailpipe and evaporative emissions. China 6b includes mandatory on-road emissions testing modelled after the EU RDE regulation (also known as Euro 6d TEMP) with a few enhancements and modifications. A number of cities and provinces adopted China 6b in July 2019 and many automakers have proceeded to adopt China 6b early for all their production.

### China VI

In June 2018, China finalized China VI standards that will apply to new heavy-duty diesel vehicles nationwide in two stages.

The first stage, China VI-a, originally targeted to have become applicable by July 2020 for new models but has been delayed by 6 months to January 2021, and all new HDVs targeted for compliance in July 2021. The second stage, China VI-b will apply to gas engines nationwide starting in January 2021 and all new HDVs in July 2023.

### Compounds (Platinum based)

Platinum combines with other elements to form chemical mixtures that are used as catalysts in chemical processes as well as in plating, metal deposition and other industrial processes.

### Diesel oxidation catalyst (DOC)

A DOC oxidises harmful carbon monoxide and unburnt hydrocarbons, produced by incomplete combustion of diesel fuel, to non-toxic carbon dioxide and water.

### Diesel particulate filter (DPF) and catalysed diesel particulate filter (CDPF)

A DPF physically filters particulates (soot) from diesel exhaust. A CDPF adds a PGM catalyst coating to facilitate oxidation and removal of the soot. The terms are often used interchangeably.

### Electrolysis of water

Water electrolyzers are electrochemical devices used to split water molecules into hydrogen and oxygen. An electrical current is applied to the electrolyser cell, and water is split into oxygen and hydrogen. The electrolysis system comprises of the system, the stack and the cell.

### Emissions Legislation

Regulations that necessitate the fitment of autocatalyst systems dealing with the treatment of vehicle tailpipe emissions such as carbon monoxide (CO), particulate matter, hydrocarbons and oxides of nitrogen (NO<sub>x</sub>). There are a range of standards specific to various regions and countries with varying minimum emissions targets and deadlines for compliance.

### EPA

Environmental Protection Agency regulating the US vehicle and engine emission standards for pollutants.

### ETF

Exchange-traded fund. A security that tracks an index, commodity, or basket of assets. Platinum ETFs included in demand are backed by physical metal (LPPM good delivery bars stored in a secure vault approved by the listing exchange).

### Euro V/VI emission standards

EU emission standards for heavy-duty vehicles. Euro V legislation was introduced in 2008-09 and Euro VI in 2013/2014; similar standards have later been adopted in some other countries.

### Euro 5/6 emission standards

EU emission standards for light-duty vehicles. Euro 5 legislation was introduced in 2009-11 and Euro 6 in 2014/2015. The limits set in Euro 6 have remained unchanged, but the measuring methods have become more stringent progressively including Euro 6 a, b, c, d and Euro 6d-Temp, now in place. For CO<sub>2</sub>, the laboratory based WLTP and for NO<sub>x</sub> RDE.

### FCM

Fuel Consumption Monitoring describes the recording of actual consumption during the life of the vehicle. Applicable under Euro 6d to all new vehicles from 1/01/2020 and all new registrations from 1/01/2021.

### Forward prices

The price of a commodity at a future point in time. Typically comprises of the spot price as well as the risk-free interest rate and cost of carry.

### GTL

Gas-to-liquids is a process that converts natural gas to liquid hydrocarbons such as gasoline or diesel fuel.

### HAMR

Heat-Assisted Magnetic Recording. A magnetic recording technology which involves spot-heating the drive platters with laser beam.

### HDD

Hard disk drive. Data storage device that stores digital data by magnetic platters.

### HDV

Heavy-duty vehicle.

### Hydrogen Production Methods

In recent years, colours have been used to refer to different hydrogen production routes. There is no international agreement on the use of these terms as yet, nor have their meanings in this context been clearly defined but the following colour key provides a guideline of most widely use reference to the various production methods

white – naturally occurring or produced as industrial by-product

black or brown – coal gasification

grey – steam methane reforming

turquoise – methane pyrolysis

blue – steam methane reforming plus carbon capture

green – water electrolysis with renewable energy sources

pink – nuclear power

yellow – solar power or mix of multiple sources.

### ICE

Internal combustion engine.

### IoT

Internet of Things. Networking system that allows data to be sent to and received from objects and devices through internet.

### ISC

In Service Conformity which requires vehicles to not only conform with exhaust emission standards when they are new but also while in use.

### Jewellery alloys

The purity of platinum jewellery is invariably expressed in parts per 1,000. For example, the most common variant, pt950, is 95% fine platinum, with the rest of the jewellery alloy made up of other metals such as cobalt or copper. Different markets would typically prescribe the purity levels for qualification and hallmarking of the jewellery as platinum jewellery.

### Jewellery demand

Captures the first transformation of unwrought platinum into a semi-finished or finished jewellery product.

### Koz

Thousand ounces.

### LCD

Liquid-crystal display used for video display.

### LCV

Light commercial vehicle.

### Lean NO<sub>x</sub> traps (LNT)

Platinum/rhodium-based, catalyses the chemical reduction of NO<sub>x</sub> in diesel engine exhaust to harmless nitrogen.

### Lease rates

The lease rate is defined as the rate at which the owner of the commodity lends or sells it and buys it back from the borrower in the market. LPPM.

### The London Platinum and Palladium Market (LPPM)

It is a trade association representing the interests of the platinum and palladium market. It provides guidance and benchmarks on the form and governance of platinum and palladium delivered to the market and publishes a list of the companies that comply with the guidelines and purity. This list is known as the Good Delivery List. As at May 2020 the Good Delivery Lists consists of 31 platinum refiners, 28 palladium refiners, 15 full members, 41 associate members, 45 affiliate members and 2 affiliated exchange members.

### MAMR

Microwave-Assisted Magnetic Recording. A magnetic recording technology by writing in the drive platters with a microwave field.

### Metal-in-concentrate

PGMs contained in the concentrate produced after the crushing, milling and froth flotation processes in the concentrator. It is a measure of a mine's output before the smelting and refining stages.

### MLCC

Multi-layer ceramic capacitors. A number of individual thin film capacitors stacked as a whole.

### moz

Million ounces.

### NEDC

New European Driving Cycle vehicle emissions test set out in United Nations Vehicle Regulation 101 maintained by the United Nations Economic Commission for Europe and updated and reviewed from time to time. The WLTP is aimed to significantly enhance and replace this regulation.

### Net demand

A measure of the requirement for new metal, i.e., net of recycling.

### Non-road engines

Non-road engines are diesel engines used, for example, in construction, agricultural and mining equipment, often using engine and emissions technology similar to on-road heavy-duty diesel vehicles.

### Ounce conversion

One metric tonne = 1,000 kilogrammes (kg) or 32,151 troy ounces.

### oz

A unit of weight commonly used for precious metals.  
1 troy oz = 31.103 grams.

### PDH

Propane dehydrogenation, where propane is converted to propylene.

### PEM Electrolyser Technology

One of four key water electrolyser technologies. The electrode on oxygen side (anode) contains iridium oxide while the electrode on hydrogen side (cathode) typically contains platinum. Transport layers are platinum-coated sintered porous titanium, and the bipolar plates would typically have platinum on with other metals.

### PGMs

Platinum group metals.

### PMR

Precious metals refinery.

### Pricing benchmarks

A price for a commodity that is traded on a liquid market that is used as a reference for buyers and sellers. In the case of platinum, the most commonly referenced benchmark is the LBMA Platinum Price, which is administered and distributed by the London Metals Exchange. The LBMA Platinum Price is discovered through an auction process.

### Producer inventory

As used in the supply-demand balance, the change in producer inventory is the difference between reported refined production and metal sales.

### PX

Paraxylene is a chemical produced from petroleum naphtha extracted from crude oil using a platinum catalyst. This is used in the production of terephthalic acid which is used to manufacture polyester.

### Refined production

Processed platinum output from refineries typically of a minimum 99.95% purity in the form of ingot, sponge or grain.

### RDE

The Real Driving Emissions (RDE) test measures the pollutants such as NO<sub>x</sub>, emitted by cars while driven on the road. It is in addition to laboratory tests. RDE testing was implemented in September 2017 for new types of cars and has applied to all registrations from September 2019.

### Secondary supply

Covers the recovery of platinum from fabricated products, including unused trade stocks. Excludes scrap generated during manufacturing (known as production or process scrap). Autocatalyst and jewellery recycling are shown in the country where the scrap is generated, which may differ from where it is refined.

### Selective catalytic reduction (SCR)

Selective Catalytic Reduction (SCR) is an emissions control technology system that injects a liquid-reductant agent (urea) into the outlet stream of a diesel engine. The automotive-grade urea, known by the trade name AdBlue. The system typically requires a platinum bearing DOC ahead of the SCR unit.

### SGE

Shanghai Gold Exchange.

### SSD

Solid-state drive. Data storage device that uses memory chips to store data, typically using flash memory.

### Stage 4 regulations

Non-road mobile machinery (NRMM) is regulated by increasingly stringent regulations set out in tiers from Stage 1 to 5. This was last reviewed in May 2018 with deadlines set for 2020 and 2021. A submission by industry bodies requesting a delay in implementation as yet to be ruled on.

### Three-way catalyst

Used in gasoline cars to remove hydrocarbons, carbon monoxide and NO<sub>x</sub>. Largely palladium-based now, they also include some rhodium.

### US Vehicle Emission Standards

US vehicle and engine emission standards for pollutants, are established by the US Environmental Protection Agency (EPA) based on the Clean Air Act (CAA). The State of California has the right to introduce its own emission regulations. Engine and vehicle emission regulations are adopted by the California Air Resources Board (CARB), a regulatory body within the California EPA. Vehicles can in every year be certified in different emission classes, called "bins". The fleet average emissions over all "bins" are then regulated and reduced from year to year. To achieve the required fleet average, every year more vehicles have to be registered in the lower bins.

### Tier 3

Emission regulation issued by EPA. The regulation defines common targets until 2025 in the USA.

### Tier 4 stage

Non-road mobile machinery (NRMM) is regulated by increasingly stringent regulations set out in tiers from Stage 1 to 5. This was last reviewed in May 2018 with deadlines set for 2020 and 2021. A submission by industry bodies requesting a delay in implementation yet to be ruled on.

### Washcoat

The layer that contains the active catalytic materials, such as PGMs, that is applied on the inactive, often ceramic, substrate within an autocatalyst block or component.

### WIP

Work in progress.

### WLTP

Worldwide Harmonised Light Vehicle Test Procedure is a laboratory test to measure pollutant emissions and fuel consumption. WLTP replaces the New European Driving Cycle (NEDC). It became applicable to new car types from September 2017 and new registrations from September 2018.

### WPIC

The World Platinum Investment Council.

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