

04 December 2023

**Quintessentially
PGMs**

Market Research Team

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KEY TAKEAWAYS

For more than six months since our last issue, the PGM prices have been following a downward trend as palladium has been suffering from destocking by OEMs and fabricators, while the platinum price has also been falling as risks of South African primary production cuts because of electricity undersupply, have not realised. Moreover, the general macroeconomic sentiment continues to pressure commodity prices as financial regulators of the major world economies remain hawkish.

Palladium. Palladium demand is expected to marginally fall by 1% YoY in 2023, as ICE-powered vehicles production growth and continuing hybridisation will be offset by falling demand in electronics and residual palladium-with-platinum substitution, launched in previous years because of the significant price spread. The peak level of substitution has already been reached this year, as narrowed price spread leaves no incentives for a short-term substitution and, moreover, some OEMs have already started to commit to reverse platinum-with-palladium substitution in the mid-term.

Record-high net short positions coupled with metal destocking by the OEMs and fabricators, which is coming to an end now, have been pressuring the palladium price since the end of 2022. That, along with supply chain disruptions, led to a 15% YoY secondary production fall in 2023, which was a key factor in changing the market balance. Moreover, given current precious metals prices, major PGM mines in South Africa and North America are expected to incur losses next year (and some already are loss-making at current prices) if they opt to sustain current production levels. Hence, we expect supply cuts in 2024 if the current price environment persists.

Taking into account the persisting market deficit (-0.4 Moz in 2024) and potential restocking, there is a significant risk of a short squeeze on the palladium market in H1 2024 as the major PGM producers reduce their output.

Palladium, YoY change	2023E	2024E
Demand ex. investment	-0.1 Moz -1%	-0.2Moz -2%
Supply ex. stocks sales	-0.5Moz -5%	+0.4Moz +5%

Platinum. We expect the platinum market to flip into a fundamental deficit this year. The increase of primary supply, mainly attributed to the resilience of the South African mining companies to electricity disruptions, will not be enough to offset the rising automotive and industrial demand for platinum, as well as lower recycling.

As for 2024, we expect the platinum deficit to remain at current levels with a downside risk for the primary production to in South Africa and North America on the back of cost optimisation of the loss-making mines.

Platinum, YoY change	2023E	2024E
Demand ex. investment	+0.6Moz +8%	+0.1Moz +2%
Supply ex. stocks sales	-0.0Moz -1%	+0.4Moz +2%

We expect the **rhodium** market to remain in marginal deficit this year as it benefits from the automotive production recovery, while the recycling fall will be offset by an increase in the primary production.

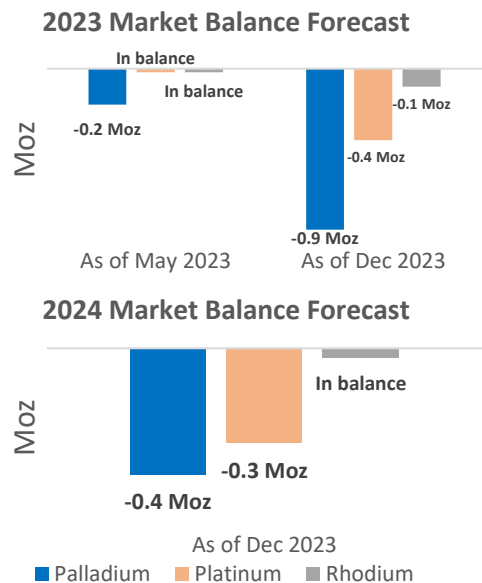
Rhodium prices failed to recover after the stocks' sell-offs in late Q1 2023 and eventually, rhodium gave away its position of the most "precious" metal to iridium, which was not a favourable development for the South African producers due to iridium's modest contribution to the basket price in the region. The price rally of the latest is generally explained by its wider use in the hydrogen electrolyzers' production.

MARKET BALANCE

We have revised the 2023 palladium market deficit from -0.2 Moz to -0.9 Moz as we have reviewed the secondary supply from 9% growth down to a 15% fall, while slightly lower than expected primary production from North America will be offset by a weaker electronics demand.

Meanwhile, we also expect the platinum market to record a -0.4 Moz deficit in 2023 contrary to our earlier expectations of a balanced market, due to lower secondary supply.

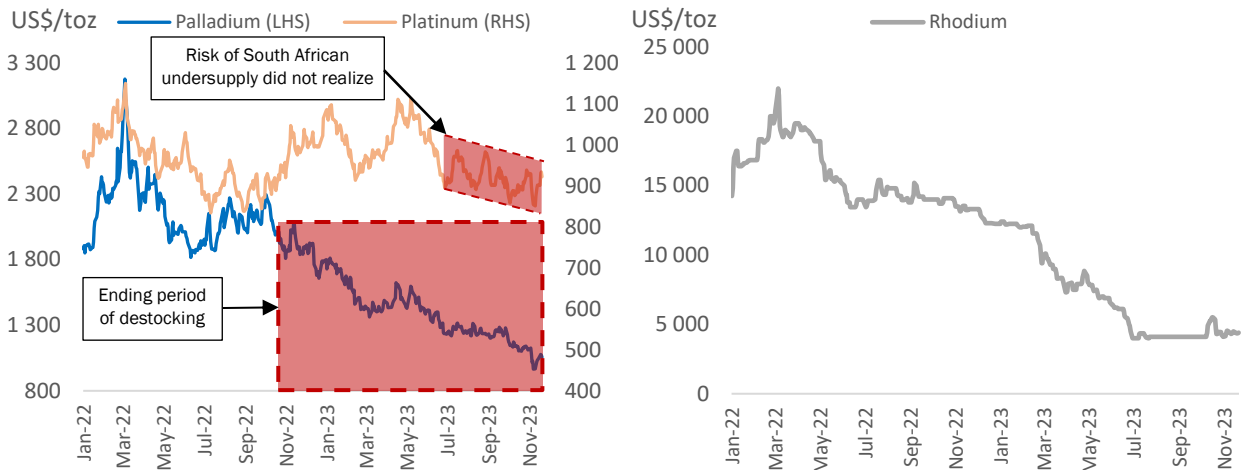
As for 2024, we expect the palladium deficit to narrow down to -0.4 Moz amid secondary supply recovery, while the platinum market will remain more or less unchanged at -0.3 Moz, as the recycling growth will be offset by an increase in industrial demand by the glass and electronics sectors. However, we see a significant risk from the primary supply from South Africa and North America amid potential cost optimisation at the low-margin mines.



Source: NN Analysis

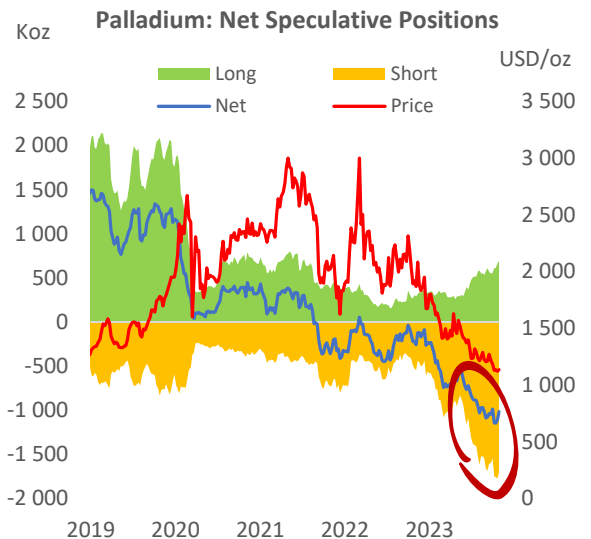
MARKET SENTIMENT

PGM Prices in 2022-2023 YTD



Source: LPPM, Johnson Matthey

Palladium. By the time of the release of our May issue, palladium gained momentum and started a horizontal movement, breaking the half-year downward trend. Moving between \$1400/toz and \$1600/toz price levels for two months, the chart formed the double head and shoulder technical analysis pattern, which led the palladium price into a narrower descending channel. On the back of continuous speculative pressure, the palladium price broke the long-term support level of \$1300/toz on June 22, recording more than a 4-year low, as speculative net-short positions reached 0.8 Moz. By the end of June, palladium found a support level at \$1225/toz and entered into a horizontal trend, fluctuating between \$1225/toz and \$1300/toz levels, as the data on the US labour market released in the beginning of July was in line with the forecast ranges, which stabilised the inflation expectations and reduced the price volatility. The horizontal movement continued until the beginning of October, when it made a stepdown to a lower price corridor, reaching its bottom at \$1125/toz and bouncing back thereafter. This occurred amid the FED representatives' statements regarding the higher-for-longer interest rates environment, which affected all the precious metals market (gold and silver suffered a 4% and 6% falls respectively in 5 trading days). The price plateaued at \$1125/toz up until November 7, when it fell by 4% to \$1080/toz. FED's hawkish statements yet again pressured all the precious metals (platinum and silver fell by 3%, gold slipped by 1%). However, palladium was especially sensitive as this led the metal's price below the psychological level of \$1100/toz, which triggered a 3-years-record daily open interest increase, dipping palladium down to \$965/toz. Nevertheless, right after that, palladium bounced back and stabilised above the \$1050/toz support level.

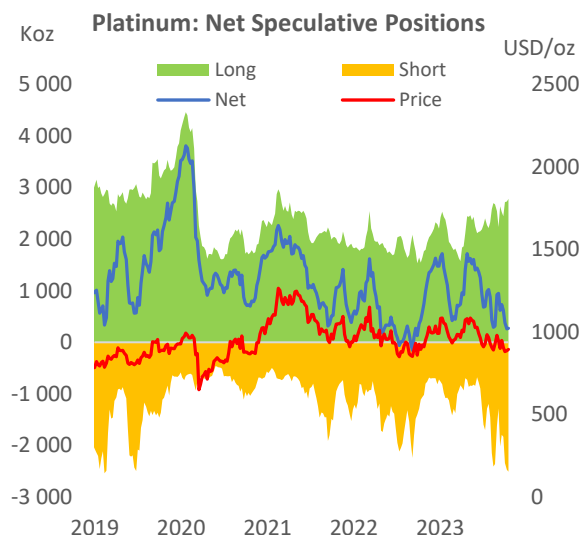


Source: CFTC

About 30% of the speculative short positions were opened within the \$1300-\$1500/toz price range and 20% — within the \$1100-\$1200/toz price range, which creates a potential for a price squeeze in 2024, when metal destocking by the OEMs and fabricators will come to an end. Moreover, the growing volume of palladium going from Russia to China and bypassing trading hubs will limit the metal's spot availability in 2024. Growing supply in the spot market in Hong Kong has previously reduced concerns about the unavailability of the metal and allowed destocking to take place and created the ground for a speculative short positions' build-up.

Platinum. Starting an upward movement from the level of \$1000/toz at the beginning of June and reaching the EMA 50, platinum price started to fall sharply, breaking the significant mid-term support at \$985/toz by the middle of June, following a further \$920/toz support break by the end of the month. Reaching the \$900/toz level and moving into an oversold zone, on the back of the positive

CPI data, platinum bounced back, closing above the \$985/toz level and touching EMA 200 on July 18. However, platinum failed to gain a foothold above \$985/toz, as weak macroeconomic indicators in China and hawkish statements by the ECB put noticeable pressure on platinum, gold and silver. The latter triggered massive platinum short positions build-up, shrinking speculative net long positions from 1.0 Moz at the end of July down to 0.3 Moz by the middle of August, when platinum tested the \$900/toz support level. 'Buy low (\$900/toz), sell high (\$1000/toz), which was the platinum investors agenda for almost three months, ended in late September, when this price correction across precious metals drove the price down to a \$875/toz support level.



Source: CFTC

GLOBAL PGM DEMAND

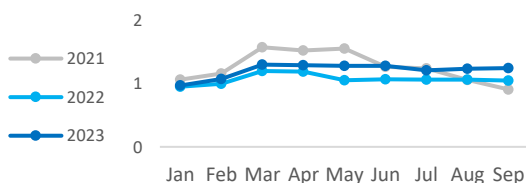
AUTOMOTIVE

We expect the global ICE-equipped (incl. (P)HEVs) light vehicles production in 2023 to increase by 3% to 76 million units (which will contribute to 7.7 Moz, 3.3 Moz and 0.9 Moz of palladium, platinum and rhodium use) with the sales lagging behind with only a 2% growth up to 74.8 million units. However, the auto market is not expected to recover to the pre-COVID level until 2025 the earliest. Slower paces of recovery were caused by the high cost of borrowing (expensive credits cooled down the demand) and the shift in the OEMs' auto sales strategy, as they had prioritised selling less cars with higher margins in the absence of price wars.

The destocking process among the OEMs and autocatalysts fabricators is coming to an end now and we estimate the total palladium stock use by the automotive market participants across the globe at just above 2 Moz, which used to be enough to cover the fundamental market deficits in 2022 and 2023.

Since our latest issue, **the US** ICE-powered light vehicles' sales continued its rapid growth on a year-on-year basis, recording a 13% YoY increase in 9M 2023. However, October sales virtually stagnated with a marginal 0.5% YoY growth only amid supply chain disruptions caused by labour strikes of United Auto Workers aimed at the assembly plants and distribution centers of Ford, Stellantis and General Motors.

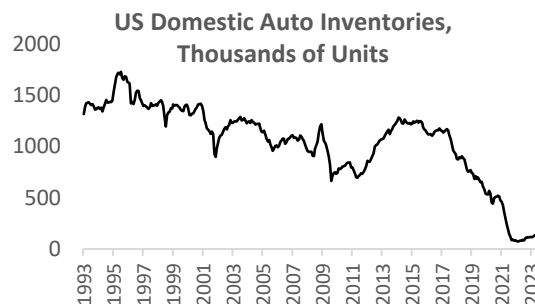
US: ICE-powered light vehicles sales, million units



Source: NN analysis

Nevertheless, the overall car availability recovery in the US is being observed now. After the North American car inventories reached their historical minimum of just below

65 thousand units in February 2022, it has been experiencing a gradual recovery, which accelerated this summer when the inventory rose almost 60 thousand units up to 208 thousand units in July-August.



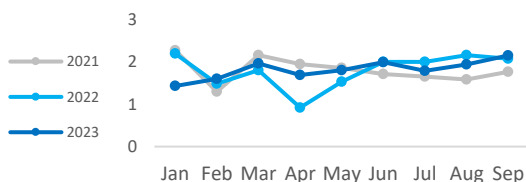
Source: Federal Reserve Bank of St. Louis

This year, we expect the North American ICE-equipped light vehicle production to increase by 5% YoY to 10.9 million units amid the chip shortage easing, which was the main factor of the last year's production slowdown.

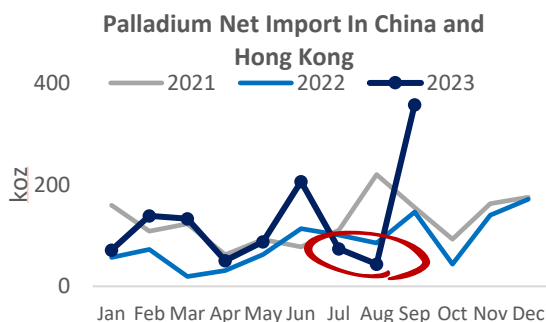
As for the longer term market perspectives, the less robust demand for BEVs is forcing major automakers to revise its electrification plans. Ford has already announced a \$12 billion capex and investment halt, amid its increasing losses per BEV and falling demand, in favour of ramping-up the hybrids' production. Another major US automaker General Motors has also postponed production of BEV trucks.

China experienced an 8% YoY increase in ICE-powered vehicles sales in H1 2023 mostly due to the low base of April 2022, when the COVID-related restrictions impacted the auto market. However, the trend reversed this summer because of the slowing economy, which also resulted in the palladium net import in China and Hong Kong declining on a year-on-year basis.

China: ICE-powered light vehicles sales, million units



Source: NN analysis



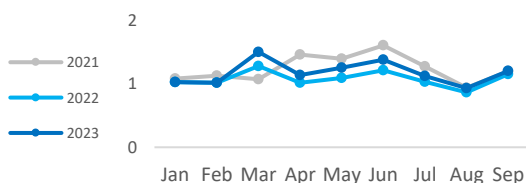
Source: Trade data

In 2023, the ICE-powered light vehicles production in China is expected to fall by 7% YoY to 21 million units due to a higher BEV penetration rate.

Despite loading optimisation in autocatalysts, local OEMs in China have already started to commit for the reverse substitution on up to 2 years horizon, which means that the platinum content in ICE-powered vehicles has already reached its peak and will decline noticeably over the years. Importantly, the re-introduction of palladium into autocatalysts will be happening at a higher pace than the initial palladium-with-platinum substitution as the palladium-dominated autocatalysts technology is already there.

European ICE-powered light vehicle sales rose by 9% YoY in 9M 2023 due to the supply chain disruptions' easing. At the same time, the diesel cars' market share continues to shrink, accounting now for only 14.1% of the EU sales, down from 17.2% in the same period last year.

Europe: ICE-powered light vehicles sales, million units



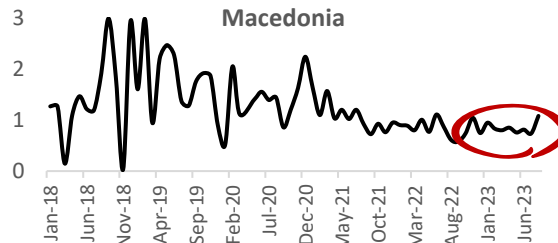
Source: NN analysis

We expect this year's ICE-equipped light vehicle production in Western Europe to rise by 1% YoY at 8.9 million units.

The platinum-to-palladium net import ratio in North Macedonia where a major European autocatalysts' plant is located has stabilised this year as palladium to

platinum price premium has been gradually shrinking over the year. Up until 2021, more platinum was imported on the back of growing substitution. Ever since, palladium and platinum were imported relatively equally (ratio value of 1) which signals no further significant change in substitution.

Pt-to-Pd Net Import Ratio in North Macedonia



Source: Trade data

As for the longer-term car market development, the EU Parliament has supported the amendments into the Euro 7 regulation, proposed by the auto lobby, effectively leaving the Euro 6 emission regulations for light duty vehicles unchanged. However, the final decision is to be made by the end of the year.

As for 2024, we expect the global ICE-powered light vehicles production to marginally decline by 1% to 75 million units, which will contribute to 7.5 Moz, 3.2 Moz and 0.9 Moz of palladium, platinum and rhodium use. Moreover, palladium with platinum substitution is coming to an end, and the trend is expected to reverse in the short term.

JEWELLERY AND OTHER INDUSTRIAL DEMAND

We have marginally lowered our expectations for the PGM use in jewellery this year from +1% YoY down to stagnation at 0.2 Moz of palladium and 1.7 Moz of platinum due to lower sales in China caused by slowed economy.

Even though the macroeconomic uncertainty continues to put pressure on the demand for luxury goods in Europe and the US, jewellery sales growth in India are expected to offset the demand fall in developed economies.

Palladium industrial demand is expected to slightly fall by 2% this year down to 1.5 Moz, while platinum industrial demand is expected to grow by 5% to 2.6 Moz.

We expect palladium and platinum demand in electronics to fall by 7% and 3% YoY respectively, as the palladium use suffers from a noticeable consumer electronics sales fall, while the continuous (since the beginning of 2022) fall of hard disk drive shipments still affects the platinum use. As for the medical sector, the use of palladium in this area will fall by 4% YoY as a result of a long-term trend of substitution, while the use of platinum will stagnate as a decrease in dental applications is expected to be offset by the overall healthcare accessibility improvement. Glass and chemical capacities expansion in China will positively impact the PGM use in these sectors, with the palladium and platinum demand in the chemical sector rising by 2% and 5% YoY respectively, while the platinum use in the glass industry will rise by 0.1 Moz to 0.4 Moz.

As for 2024, we expect the industrial demand for palladium and platinum to increase by 4% and 7% respectively on the back of a slight increase in the

chemical demand as well as the recovery in the demand by the electronics sector while platinum will also benefit from a higher use in the glass sector.

GLOBAL PGM SUPPLY

In 2023, the global primary refined palladium production is expected to fall by 2% to 6.4 Moz, while the platinum and rhodium output is expected to increase by 3% and 4% to 5.9 Moz and 0.8 Moz respectively. The palladium output fall should be attributed to a lower Nornickel's output because of the scheduled smelter maintenance while the smelting capacities' debottlenecking in South Africa will offset the temporary platinum and rhodium undersupply from Russia.

However, a noticeable recycling volumes' decline will put some pressure on the total PGM supply this year.

Even though the secondary PGM supply is expected to recover next year, we see significant primary production cuts risks in near- and mid-term. First of all, Eskom-related risks in South Africa are still there, as we see a potential for the electricity crisis aggravations after the president elections in the region. Secondly, the ongoing mining inflation and falling PGM prices put major PGM mines in North America and South Africa under economic pressure, which will force mining companies to shut down unprofitable shafts and fire thousands of workers.

RUSSIA

Due to the scheduled maintenance and repairs of flash smelting furnace #2 at Norilsk's Nadezhda Metallurgical Plant, the 2023 primary refined production of palladium and platinum from the Russian operations is expected to decrease by 8% and 2% to 2.6 Moz and 0.6 Moz respectively, which corresponds to the upper bound of our original guidance. However, as the furnace repair will continue into 2024, it will impact the next year's production as well.

Nornickel has inaugurated the Sulphur Program at the Nadezhda Smelter, marking the launch of the Russia's most ambitious environmental project to date. This project is aimed at drastically reducing sulphur dioxide air emissions in Norilsk, drastically improving the city's air quality. The Nadezhda Smelter's sulphur complex is coming to full-scale operations in phases. With its completion, Norilsk anticipates a minimum -20% reduction in the overall air pollutant emissions in 2024. By 2025, the city's factories project a -45% reduction in the sulphur dioxide air emissions, consulted to the 2015 levels. The project at the Nadezhda Smelter is an innovative state of the art technological process that converts sulphur dioxide into sulphuric acid. The acid is then neutralized using limestone to generate gypsum waste, which could be safely managed within a designated storage facility. Importantly, the Sulphur Programme has not impacted the PGM production volumes.

Nornickel reconfirms its long-term plans to increase the PGM production, which were announced in 2021, while their implementation timetable is being constantly adapted now to the rapidly changing macroeconomic and geopolitical conditions.

As for the minor Russian PGM producers, Eurasia Mining has not been producing PGM since the end of 2022. The

company is focused on the sales of its Russian assets, with no meaningful progress so far.

Also, there had been no operational updates from Russian Platinum and other greenfield PGM projects in Russia since our latest issue.

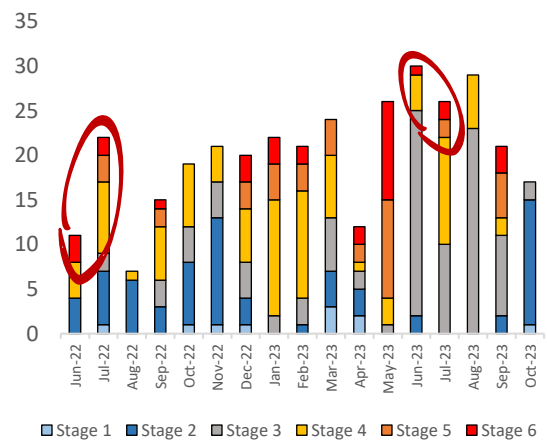
SOUTH AFRICA

We maintain our earlier estimates of the South African primary refined PGM output with the palladium, platinum and rhodium production increasing by 1%, 4%, and 5% to 2.4 Moz, 4.3 Moz and 0.6 Moz, respectively on the back of the smelting capacities debottlenecking. Risks, associated with the possible electricity crisis aggravation, has not been realised. The positive impact of the lower peak demand and higher wind-generated power resulted in a stable EAF (energy availability factor) during the winter months. Moreover, the 3-year wage deal with the unions also prevented further potential strikes at Eskom.

Even though the cumulative number of days of load-shedding in Jun-Aug 2023 increased by 45 days to 85 days compared to the same period in 2022, higher stages of load-shedding in the 2023 winter were experienced during 5 days (2 days of Stage 5 and 3 days of Stage 6), while in 2022 Stage 5 took place during 3 days and Stage 6 during 5 days, which means that the South African PGM producers experienced lower load curtailment power restrictions. This led to about 50 koz 3E PGM (platinum, palladium and rhodium) of production impact during Jun-Aug 2023 across all the South African PGM operations.

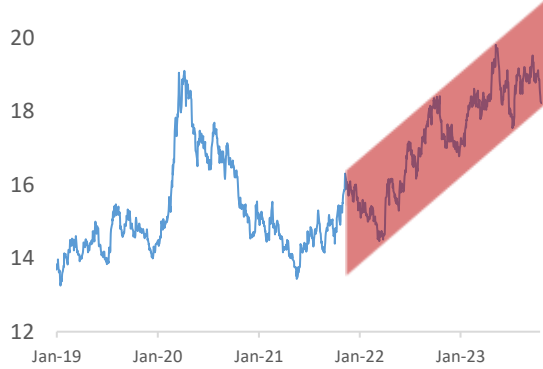
However, there is a risk that the energy crisis will still worsen in the near future since in the run-up to the April 2024 presidential elections in South Africa, Eskom's capacity could be strained to sweeten the electorate, which could lead to serious consequences in the winter of 2024.

Days of load-shedding



Source: EskomSePush

USD/ZAR exchange rate



Source: Exchange data

As for the South Africa macroeconomic environment, the rand exchange rate has continued its erratic trend since our last issue. The all-time low was reached at the end of May, followed by a rapid appreciation on the back of a weakening dollar in the first half of June. Returning to the USD/ZAR 19.15 resistance level (which was further tested 4 times) on July 6, the rand exchange rate once again experienced a rapid growth as the US dollar slipped amid the positive CPI data release. As the dollar bounced back, the rand entered a horizontal channel, trading between 18.5 and 19.15 since the beginning of August.

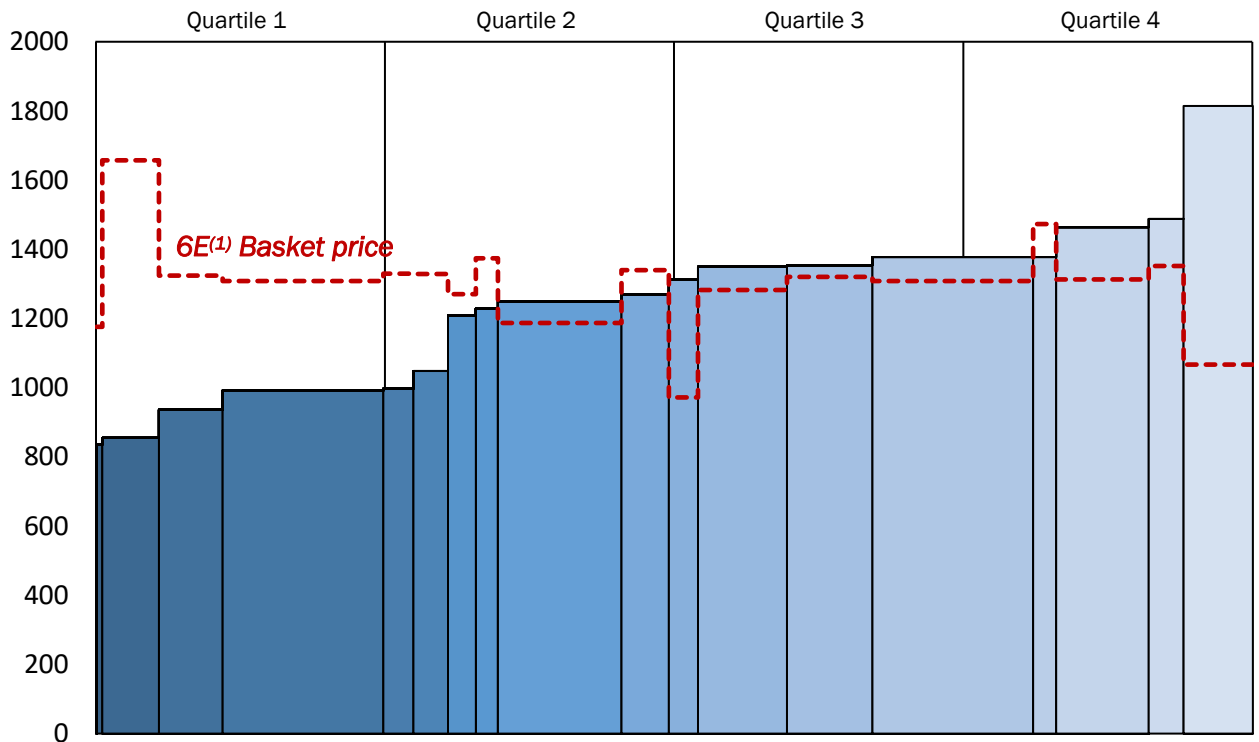
After raising the interest rate by 50bp in May, the South African Reserve Bank kept the rate on hold in both July and September, following the developed economies financial regulators' monetary policy rhetoric of keeping the rate unchanged with doors opened for further hikes.

Both decisions were made with two out of five members of the Committee voting for a 25bp increase, which indicates that the South African monetary policy softening is not at the table yet and further rate hikes are likely to happen.

Meanwhile, a relatively weak rand appears to be a life-saving remedy for many large South African PGM mines that are currently on the edge of profitability given the depressed PGM basket prices and ongoing mining inflation. Under the current economic and geopolitical situation, the South African rand is expected to appreciate in the medium term, negatively impacting the USD-denominated unit costs for the local mining companies.

We expect the 2024 primary PGM output in South Africa to increase marginally by 2% to 2.5 Moz of palladium, 4.4 Moz of platinum and 0.7 Moz of rhodium, as the production continues to recover after operational constraints. However, if the current PGM price environment continues into the next year, we estimate mines with the cumulative production of 1.4 Moz of palladium, 2.5 Moz of platinum, 0.3 Moz of rhodium and 0.6 Moz of minor PGMs to become economically unviable in 2024 if we don't see a significant rand depreciation and/or producers fail to reduce costs noticeably, which might also include production cuts via shafts closures.

All-in Sustaining Cost of Major African and North American PGM Mines



Source: NN analysis. Basket price assumptions - palladium \$1100/toz, platinum \$950/toz, rhodium \$4200/toz, gold \$2000/toz, iridium \$5000/toz, ruthenium \$465/toz; USD/ZAR = 17.95

Note 1: 6E - platinum, palladium, rhodium, ruthenium, iridium and gold

Cost optimisation programmes have already started this year, as **Sibanye-Stillwater**, announced two mature shafts closures (Simunye at Kroondal mine and 4B at Marikana) and two high-cost shafts restructurisation (Rowland at Marikana mine and Siphumelele at Rustenburg). This will lead to the PGM production cuts at Marikana (annual production of 200 koz of palladium, 450 koz of platinum and 70 koz of rhodium), which is positioned in the 4th quartile of the cost curve, as well as at Rustenburg (9M 2023 production: 153 koz of palladium, 291 koz of platinum and 44 koz of rhodium), which is in the 3rd quartile but has a less favourable metal composition of the ore.

In 9M 2023, Sibanye-Stillwater delivered 0.4 Moz of palladium, 0.8 Moz of platinum and 0.1 Moz of rhodium (+2%, +2% and +4% YoY respectively) from its South African operations, mainly due to a lower cable theft impact at Marikana and the mitigation of the load curtailment impact across the company's operations. However, the lower production guidance for 2024 is expected on the back of production cuts at unprofitable shafts.

Another company, which has already announced a cost optimisation program, is **Implats**. The largest PGM mine of the company – Impala Lease Area, which produces 0.3 Moz of palladium, 0.7 Moz of platinum and 0.1 Moz of rhodium annually, – is also coming under pressure of mining inflation and depressing PGM prices, which made the company initiate voluntary job cuts at several shafts of the mine.

In 9M 2023, the company increased its PGM production to 0.4 Moz of palladium, 0.8 Moz of platinum and 0.1 Moz of rhodium (+10% YoY, +13% YoY and +4% YoY) on the back of a low base of 2022 when Rustenburg's furnace Number 4 underwent maintenance as well as the acquisition of Impala Bafokeng (previously RBPlat).

As for **Amplats**, the company's 9M refined production fell by 6%, 15% and 15% YoY to 0.9 Moz, 1.2 Moz and 0.2 Moz for palladium, platinum and rhodium respectively. Nevertheless, despite water supply disruptions, which drove 6E PGMs (platinum, palladium, rhodium, ruthenium, iridium and gold) refined production down -9% YoY in Q3 2023, the production remains within the company's initial guidance for the CY2023 as the overall output's decline could be mainly explained by the expected lower grades at Mogalakwena. The lack of updates on the Mogalakwena expansion plans and no news on investments into Der Brochen signal that these projects have been postponed at the very least.

We also see **Amplats'** major PGM mines under threat of unprofitability next year. The newly appointed company's CEO who previously served for the company as a CFO for four years might be a signal of **Amplats'** adopting a cost-cutting strategy in the near future. The company has not yet announced plans on unprofitable shafts closures, but it made references about possible job cuts at its head offices in South Africa, which is likely to be a white-collar sacrifice to the trade unions ahead of the future mine workers' layoffs. Moreover, the disposal of Kroondal was yet another sign of an ongoing 'asset optimisation'.

Sustainable positioning of **Northam's** major PGMs mines (Zondereinde and Booyendal) on a cost curve is expected to allow the company to continue its long-term production growth. However, Eland mine, which currently produces 10 koz of palladium, 30 koz of platinum and 5 koz of rhodium annually and is planned to increase its production up to 30 koz of palladium, 120 koz of platinum and 15 koz of rhodium by 2028, might suffer financial losses amid the PGMs prices fall due to its high cost of

production. This might lead to a revision of the mine's plans for the output growth in the mid-term.

African Rainbow Minerals' Bokoni mine, which has been on care and maintenance since 2017 due to high cash costs, still expects to deliver first PGM ounces in late H1 2024. However, capital costs are to be revised up from the original 2021 estimates. Given that the current palladium and platinum spot prices do not differ noticeably from the 2017 average prices with only rhodium experiencing 4-fold increase, the economic viability of the project might come under risk as early as in 2024 with a potential production start delay. According to the current guidance, the project is expected to ramp up the PGM production to 150 koz 6E by 2026 with the expected metal split of 1:1.5:0.15 for palladium, platinum and rhodium respectively.

Since our last issue, no significant progress on other South African probable projects has been made. Recent PGM basket price falls coupled with the lack of processing capacities in the region make the launches of both greenfield and brownfield projects rather unlikely.

ZIMBABWE

The Zimbabwean 2023 primary PGM production is expected to marginally increase by 2% to 0.4 Moz, 0.5 Moz and 0.1 Moz of palladium, platinum and rhodium respectively.

Impala Platinum's 9M 2023 PGM output was in line with the same period of 2022 as falling grades at both **Zimplats** and **Mimosa** offset the energy supply improvement coupled with the low base of Q3 2022 when a scheduled furnace shutdown took place.

Anglo American Platinum's Unki PGM production didn't change noticeably in 9M 2023 compared to the same period of 2022 recording only a marginal 1% YoY output growth.

We expect Unki and **Mimosa**, which deliver 0.2 Moz of palladium, 0.2 Moz of platinum and 0.02 Moz of rhodium, to come under pressure by 2025 amid ongoing mining inflation, when PGM production in Zimbabwe is likely to reach its peak.

As for the probable projects in the region, the start of concentrate's production by **Karo**, which had been planned for 2024, was postponed until June 2025 the earliest due to the recent fall in the PGM prices. The **Karo** project's resources are split between platinum (45%), palladium (42%), rhodium (4%) and gold (9%). No operational updates on **Darwendale** project have become available since our last issue.

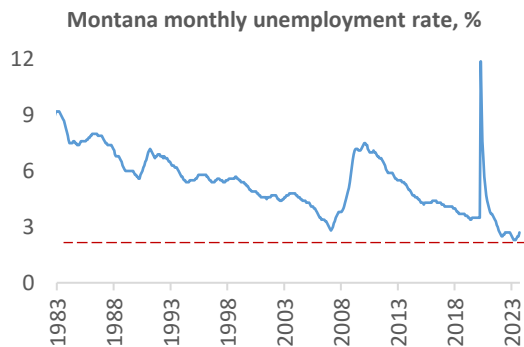
As for 2024, we expect the PGM production in Zimbabwe to increase by 2% to 0.5 Moz of palladium, 0.5 Moz of platinum and 0.1 Moz of rhodium. We see the Zimbabwean PGM production from the existing mines to reach its peak next year as the narrowing margins at Unki and Mimosa as well as a potential revision of capital expenditure at Zimplats might lead to production optimisation.

NORTH AMERICA

We expect the 2023 North American primary refined production to fall slightly by 4% and 3% YoY to 0.8 Moz of palladium and 0.3 Moz of platinum respectively.

Once again, **Stillwater's** PGM production fails to recover on a year-on-year basis due to a shaft incident in Q1 2023 and falling grades. We expect the mine to deliver 0.3 Moz of palladium and 0.1 Moz of platinum in 2023, in line with

the last year. Being loss-making throughout 9M 2023, Stillwater's margins were hit by both the basket price fall and the unit cost increase, primarily caused by operational incidents, which led to lower PGM production, as well as by labour cost rise, driven by low unemployment in the US and in Montana specifically.



Source: Federal Reserve Economic Data

The company has already announced almost 300 job cuts so far in its US operations, which is expected to lower costs of production, but will also affect PGMs output volumes.

As for another major PGM producer in this region, Impala Platinum, we expect its North American asset, **Impala Canada**, to increase its palladium production in 2023 by 20 koz to 245 koz, with platinum output staying at a 20 koz level. Even though Implats' Canadian mine has a more favourable position on a PGM cost curve than Stillwater, lower PGM concentrate payability will cause the mine to become loss-making in 2024 unless the price bounces back above \$1400/toz or sustaining capex is reduced.

Having said that, we expect both major North American PGM mines to become permanently loss-making in the short- to medium-term. Given the Sibanye's South African PGM mines unfavourable position on the cost curve, it will be hard to justify potential cross-subsidising for Stillwater within the company's PGM division and maintain it for a long period. Moreover, Sibanye's non-PGM operations also struggle in the current market environment. High production costs of the South African gold operations led to narrowed margins in H1 2023 and negative cash flows in Q3 2023 as all-in sustaining unit costs exceeded the average quarterly gold price by over \$130/toz. This, coupled with the loss-making Sandouville nickel refinery and increasing capital expenses for the Keliber lithium project, forced the company to issue \$500 million convertible bonds, which, on the one hand, allowed cheaper borrowing for the company amid severe market conditions (their bond enjoys a relatively low coupon of 4%-4.5% against the current corporate bond market average of 8%-9%) but, on the other hand, spooked the investors and provoked stocks sales and short positions build-up in anticipation of a share dilution. However, this might become an unwelcome precedent of a value-destructive capital-raising strategy, which could be used by other primary PGMs producers who are currently diversifying out of the PGMs.

We expect **Vale's** 2023 PGM output to remain at the last year's level, while **Glencore's** production from their own operations is expected to decrease by 20 koz and 10 koz to 60 koz and 20 koz of palladium and platinum respectively.

We expect the 2024 North American refined production to increase by 17% and 12% YoY to 1.0 Moz of palladium

and 0.3 Moz of platinum respectively on the back of a production recovery at the Stillwater mine. However, cost-driven production cuts at Impala Canada and Stillwater are likely to happen next year already.

In 2024, we expect the global primary PGM supply of palladium to stagnate at 6.4 Moz, as the lower output from Russia is to be offset by the recovery of the North American production, while platinum and rhodium are expected to increase by 2% and 1% YoY respectively amid the moderate growth in the African region. We also bear in mind a downside risk for the next year's primary PGM production due to the potential cost optimisation.

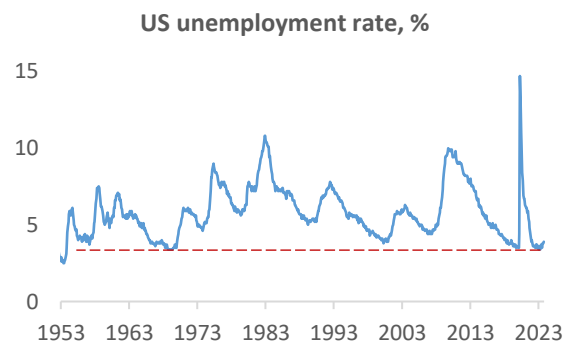
RECYCLING

In our last issue, we discussed how the current macroeconomic environment affects the PGM recycling market with the high inflation and expensive credit keeping the used vehicles on the road for longer. Since then, the interest rates in the US have increased by 25bp and, more importantly, both the European and the US regulators have adopted hawkish rhetoric signalling 'higher for longer' rates with the possibility of further hikes. This affects the prospects of the secondary supply growth both in the near- and mid-term.

Moreover, the extended process of the PGMs' destocking has delayed the anticipated price recovery. All that results in the ever persisting price incentives for the collectors to keep stockpiling the materials.

The largest regional spent-autocatalyst market of the US, which accounts for almost a half of the palladium and a third of the platinum global secondary supply, has also been affected by the introduction of a more stringent KYC procedure, which happened after a USD 500 million worth of the catalytic converters' theft.

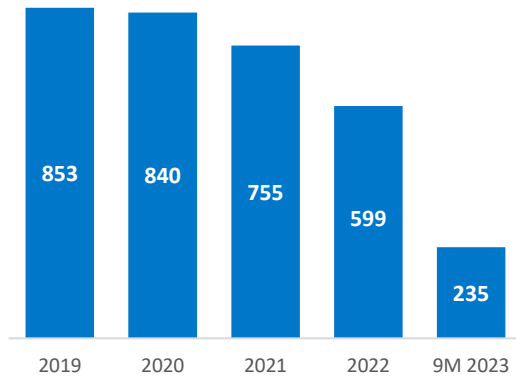
Moreover, low unemployment rate across the US makes hiring and retaining new employees a challenge for the recyclers.



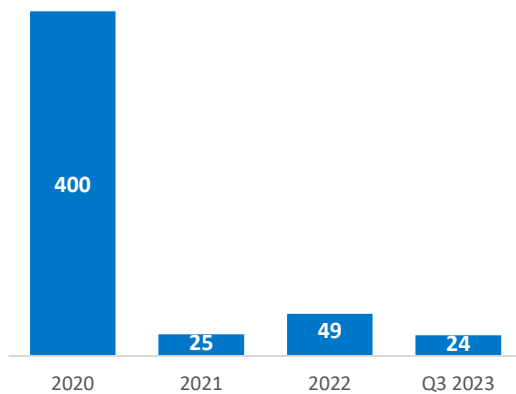
Source: Federal Reserve Economic Data

This was reflected in Sibanye's 9M 2023 recycling data, which experienced a 42% YoY drop in volumes to 235 koz of 3E ounces fed on the back of bottomed out inventories.

Sibanye-Stillwater's recycled production, 3E koz



Sibanye-Stillwater's recycle inventory, tonnes



Source: Sibanye-Stillwater

We also see a further downside risk for the PGM recycling in the US as currently, about 6% of the recycled catalytic converters are believed to be stolen, which might further strengthen the KYC policies and slow down the supply chain across the industry even more.

Meanwhile, the third largest (after the US and Europe) regional spent-autocatalysts market of China is expected to record almost a -20% YoY fall in the PGM recycling. This is partially caused by the government's measures to slow yuan devaluation, which restrict capital outflows, including those in the form of PGM scrap.

Nevertheless, we expect a meaningful recovery on a year-on-year basis in 2024, as the US and Chinese markets are expected to adapt to the new regulation policies. Moreover, potential monetary policy softening and the long-term trend of rising average PGM loadings per spent-autocatalyst will also benefit recycling business.

Taking these factors into account, we review our earlier expectations of a 9% secondary supply growth in 2023 and expect now a 15% fall – down to 2.2 Moz of palladium, 1.3 Moz of platinum, and 0.2 Moz of rhodium. As for 2024, we expect the PGM secondary supply to increase by 18%, 8% and 10% YoY to 2.5 Moz, 1.4 Moz and 0.2 Moz of palladium, platinum and rhodium respectively.

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GLOSSARY OF TERMS

Abbreviation	Term
(t)oz	Troy ounce
3E	Platinum, palladium, rhodium
6E	Platinum, palladium, rhodium, iridium, ruthenium, and gold
9M	9 months
BEV	Battery electric vehicle
CFTC	Commodity Futures Trading Commission
COVID-19 (COVID)	Coronavirus Disease 2019
CPI	Consumer price index
ECB	European Central Bank
EMA	Exponential Moving Average
EU	European Union
FED	Federal Reserve System
ICE	Internal combustion engine
koz	Thousand troy ounces
KYC	Know your customer
LHS	Left hand side
LPPM	London Platinum and Palladium Market
MMC	Mining metallurgical company
Moz	Million troy ounces
NYMEX	New York Mercantile Exchange
OEM(s)	Original equipment manufacturers
PGM(s)	Platinum group metals
PHEV	(Plug-in) hybrid electric vehicle
R&D	Research and development
RHS	Right hand side
YoY	Year-on-year
YTD	Year to date