

PRECIOUS FORECAST 2024



OUTLOOK 2024

Gold to hit record highs, but PGM prices could fall further as economic growth slows

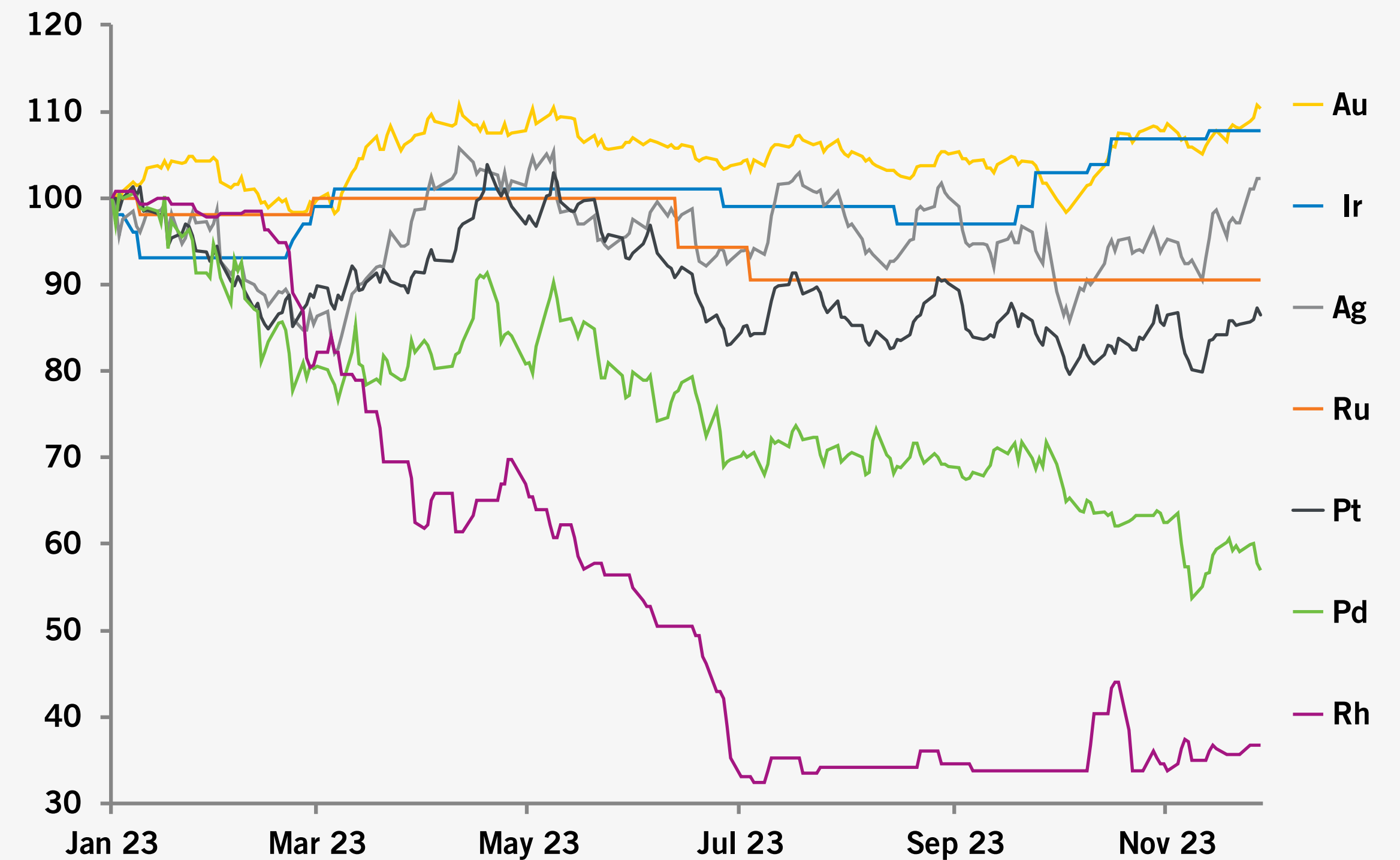
Economic growth has held up in the US and this has caused a shift in economic forecasts from a mild recession being expected this year to possibly no recession at all. However, it looks as if the economic risks are being underestimated. The US Treasury yield curve is inverted, which has historically been a reliable predictor of a recession in the US. The manufacturing sector continues to be weak in both Europe and the US. Central banks have raised interest rates to their highest levels in many years but did so very rapidly and the effects are still working their way through the wider economy. High inflation has eroded consumers' spending power and now higher interest rates have made borrowing more expensive, impacting mortgage rates and loans for new car purchases.

From a fundamental point of view, the PGM markets look tight as supply has underperformed expectations and automotive demand has been higher than anticipated this year. The rhodium and palladium prices have continued to fall as sales of stock added to the downward momentum. A weaker rand has removed some support for the platinum price. The iridium price has held up the best, as rising demand from the hydrogen economy added to traditional end-uses. However, recessions in the US and Eurozone in 2024 would mean the price risks are to the downside for the PGMs and platinum could once again trade at a premium to palladium.

The gold price has held up surprisingly well despite a stronger dollar and higher interest rates. Gold has benefited from safe-haven flows and demand has been helped by significant central bank purchases, led by China. China has also been a major contributor to jewellery and investment demand and this is likely to be the

case in 2024 as well. If a recession does occur, the dollar could weaken and that would help to propel the gold price to new highs. Silver's industrial side could be a drag on performance relative to gold even as the silver price follows gold higher.

Prices indexed to 1 Jan 2023



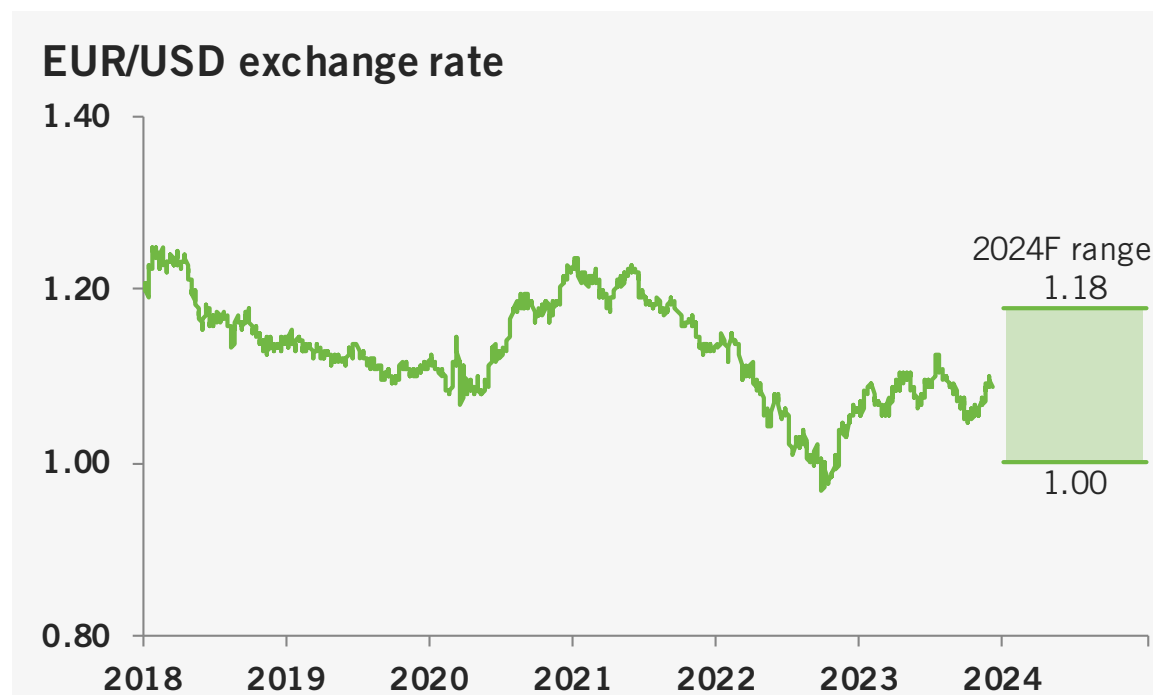
2023*	2024
Avg. 1.08	Forecast:
High 1.12	High 1.18
Low 1.05	Low 1.00
Change 0%	



EUR/USD

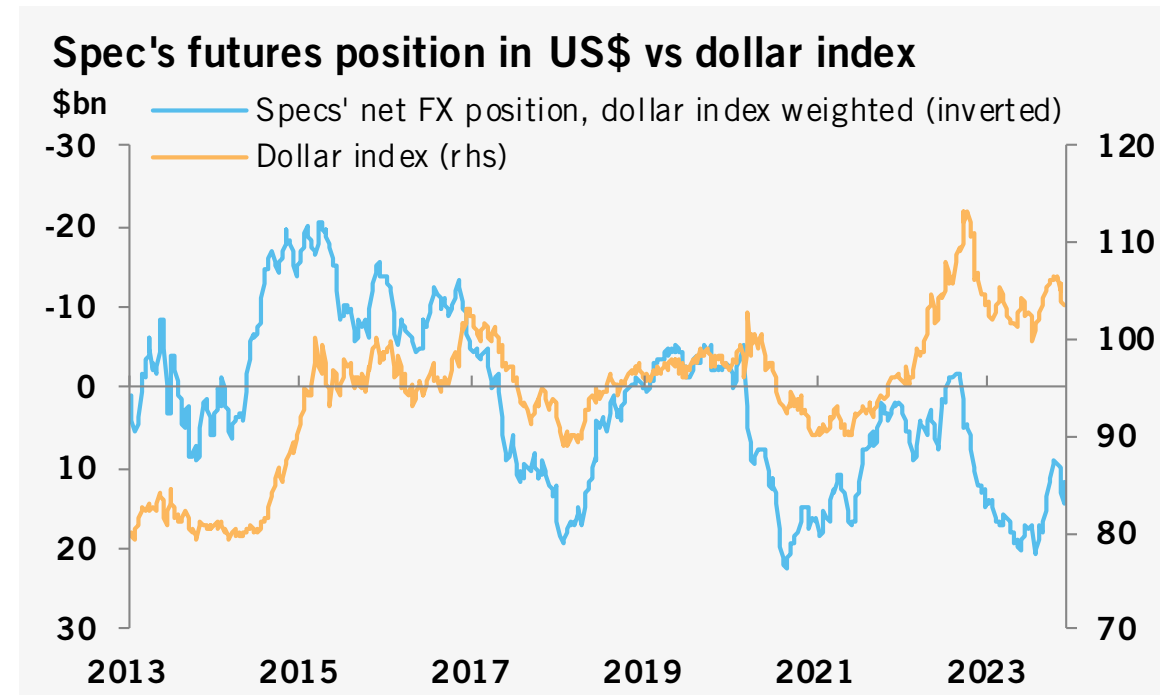
Dollar weakness to continue with exchange rate volatility

Interest rate cuts are on the horizon. The Fed and the ECB are saying that interest rate cuts are not going to happen for some time. However, inflation is now well below the level of interest rates and markets are anticipating a first rate cut by mid-2024. CPI inflation in the US eased to 3.2% in October, while in the Eurozone CPI was 2.9%. That compares to a 5.5% upper level for the Federal Funds Rate and 4.75% for the ECB's marginal lending facility. Unemployment has also been edging higher in the US. Although year-on-year GDP growth remained positive in Q3'23 in the US and Eurozone, a recession is looking increasingly likely for both regions. Manufacturing PMIs have been signalling contraction for months and services PMIs are showing contracting activity in the Eurozone and deteriorating in the US, which could mean that rate cuts are closer than the central banks are suggesting. That said, rate cuts may be slightly slower to occur while inflation is above the 2% target, but once they do happen the dollar could weaken.



Source: SFA (Oxford), Bloomberg

Speculative positioning in FX futures leaves some room for further dollar weakness. After reaching near record levels, the net long position in other currencies against the dollar halved while the dollar rallied in the second half of the year. The dollar has started to depreciate but the futures position against the dollar has not yet changed very much so there is room for it to expand as the dollar falls.



Source: SFA (Oxford), Bloomberg

A typical recession and interest rate cuts would weaken the dollar, but a return of financial sector instability would see a flight to the safety of the dollar. There was a modest rally in the dollar earlier this year when a few US banks and Credit Suisse went bust, and in 2008 during the credit crunch the dollar strengthened significantly. The euro is forecast to trade between 1.18 and 1.00. The larger trend appears to be to a weaker dollar. However, there is a risk that a flight to safety could strengthen the dollar.

01 OUTLOOK 2024

02 FORECAST EUR/USD

03 GOLD

2023*	2024
Avg. \$1,938/oz	Forecast:
High \$2,048/oz	High \$2,250/oz
Low \$1,818/oz	Low \$1,880/oz
Change +8%	

04 SILVER

05 PLATINUM

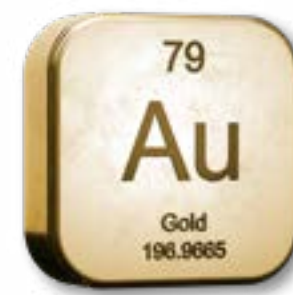
06 PALLADIUM

07 RHODIUM

08 RUTHENIUM

09 IRIDIUM

10 ABOUT HERAEUS



GOLD

Time for new all-time highs

The gold price has held up well in the face of high yields and dollar strength. As a result of the Fed’s monetary policy tightening, US bond yields have surged higher this year, and despite a decline since mid-2022, the US dollar has remained relatively strong. Gold’s historical negative correlation with these asset classes began to weaken early in 2023. Gold withstood the downward pressure well, including further (unsuccessful) attempts to hold above \$2,000/oz as the collapse of several regional US banks sent jitters through the global financial system. The fact that non-yielding bullion has performed this well despite what have historically been strong headwinds could provide a set-up for new all-time highs in 2024 as the case for the loosening of monetary policy builds.

Interest rates may have reached their peak. Less than two years after the Fed initiated its aggressive policy action, it is becoming more likely that the rate hike to 5.25-5.50% in July is the last of this cycle. Interest rate futures markets are pricing in up to 90 bp of interest rate cuts in the US and 80 bp in the Eurozone for 2024. As rates are cut, US yields are likely to fall in tandem, which should be positive for the gold price. Although central bankers are generally erring on the side of a ‘higher-for-longer’ policy, they may be forced to cut rates sooner than they expect if economic conditions worsen in H1’24. An early cut to rates could give gold more impetus to rally to new highs.

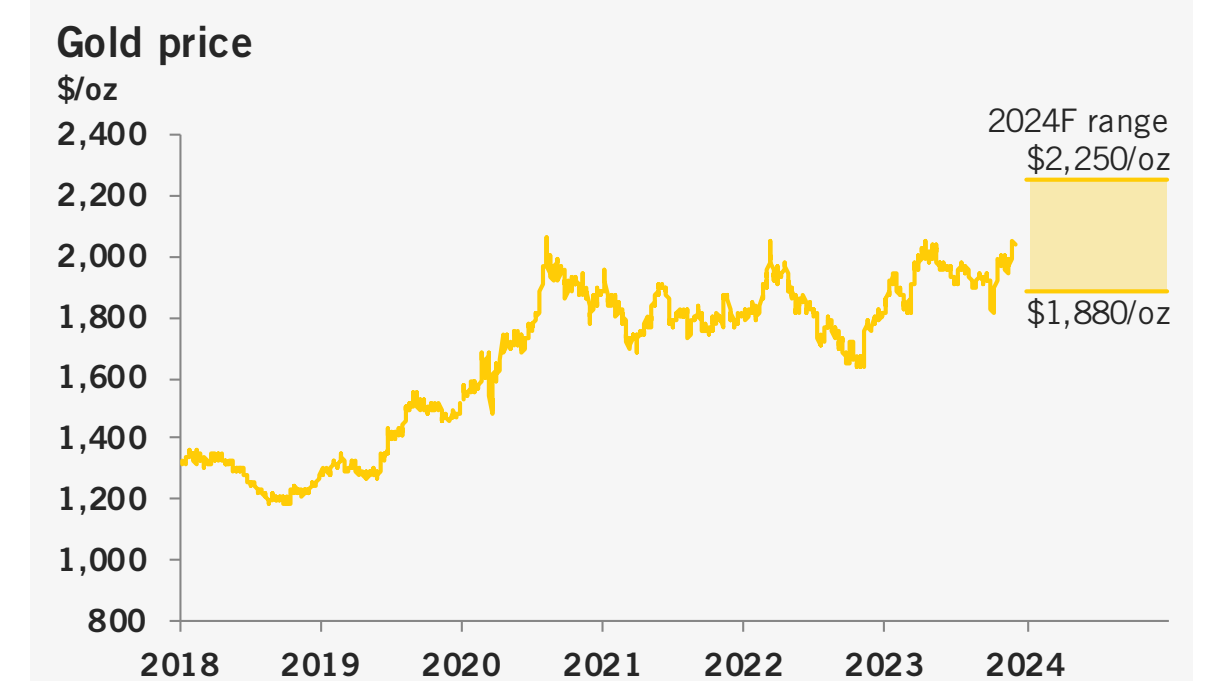
ETF investors joining the fray could be a catalyst. Retail and institutional gold investors have been steadily reducing their holdings in gold ETFs this

year and may need a catalyst in order to increase exposure to gold. Higher prices tend to prompt inflows into gold funds, though in 2023 this has not been the case. As of the end of November 2023, gold ETFs have seen net outflows of 6.5 moz (worth ~\$12.7 bn) despite the gold price appreciating by >8% year-to-date. Bar and coin demand has also been much lower in Europe this year but has been rising in China. If the gold price continues to climb then further growth in demand is possible next year.

India could be a bright spot for jewellery demand. Economic forecasts suggest the Indian economy could outperform most other large economies in 2024. Economic uncertainty and high prices for gold have impacted demand in the West this year, which is expected to be lower year-on-year in 2023. A recession in the next 12 months could hurt gold jewellery demand as consumer spending falls. In China, gold jewellery demand is expected to be higher this year after a weak 2022, and could improve further in 2024 if government policy measures help support the economy. The risk to Indian demand next year may be centred on price sensitivity. Sales in India tend to be boosted when prices fall. To overcome this effect, consumer mindsets must adjust to a higher overall price environment, which appears to be underway. Despite new highs in the rupee gold price this year, demand has been resilient and grown each quarter.

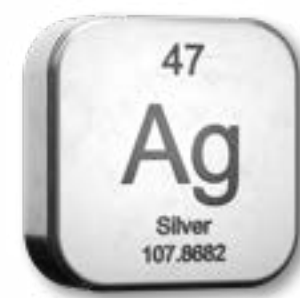
No let-up for central bank demand in sight. Buying trends in emerging markets may have become entrenched now, and robust demand from central

banks is expected to continue into 2024. So far this year central bank demand has kept pace with the record levels in 2022, and there is a chance of beating the 1,136 tonnes added to reserves last year. The People’s Bank of China has been steadily building up its gold reserves as part of a move away from holding dollars, adding 181 tonnes of gold in the first three quarters of the year.



Interest rates will be a primary driver of the gold price next year. The idea that there will not be a recession in the US has gained ground this year. However, the signal from the inverted US Treasury yield curve has been accurate in predicting recessions previously and there is no reason to suspect it will be wrong this time. When the Fed initiates cuts to interest rates, the gold price is expected to move higher as the dollar weakens and yields fall. **Gold is forecast to trade between \$1,880/oz and \$2,250/oz**, although, if the euro strengthens as anticipated, the gains will be greater in dollar terms than in euros.

2023*	2024
Avg. \$23.35/oz	Forecast:
High \$25.85/oz	High \$29.00/oz
Low \$20.05/oz	Low \$22.00/oz
Change -3%	



SILVER

Upside for silver price to be tempered by weak industrial outlook

Lower interest rates could be supportive for the silver price, but interest rate cuts typically indicate an economy that is struggling, leaving silver's precious and industrial characteristics at odds. Central banks may have ended their rate increases and markets are anticipating interest rate cuts starting in mid-2024. The dollar is expected to weaken following a cut to US interest rates, which could support the silver price.

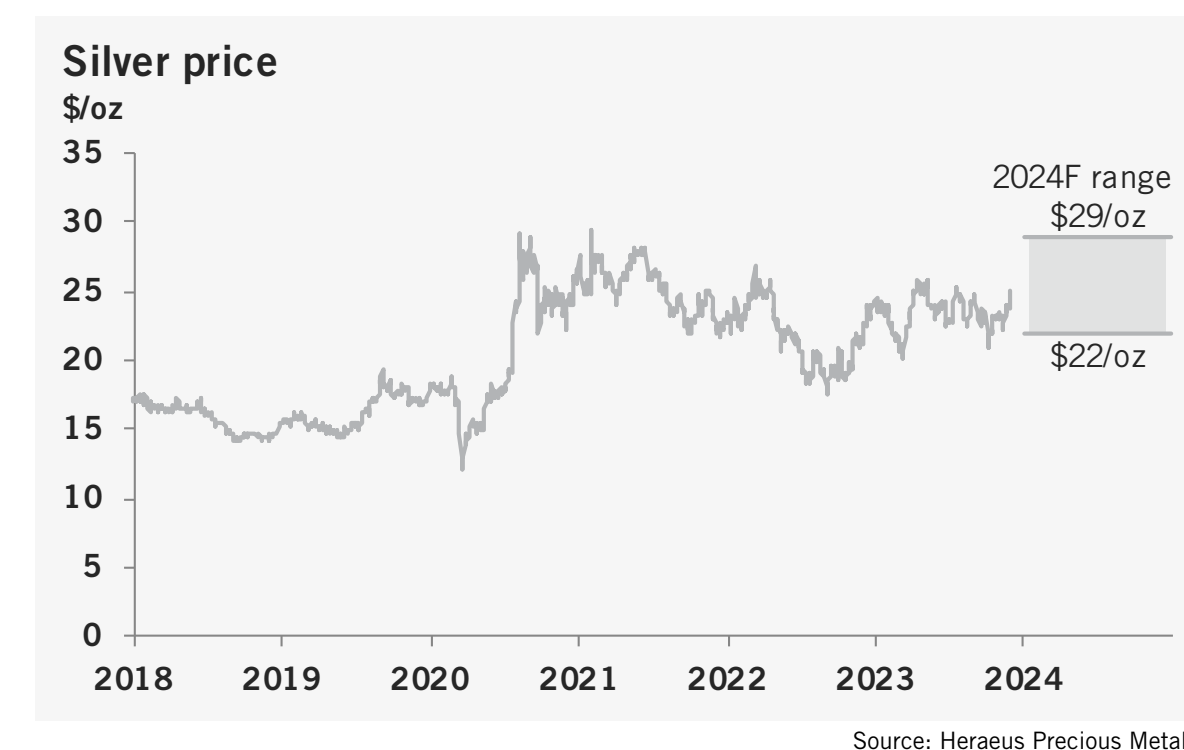
Silver's use in solar photovoltaics (PV) is still growing. This year solar installations are well ahead of schedule in China, and it is a foregone conclusion that we will see record silver solar demand by the end of 2023 despite thrifiting of silver loadings. Nearly 50% of new additions of solar capacity have been in China this year, the highest proportion since 2017, highlighting both the pace of China's domestic rollout and how Europe (as the second major market) is lagging. Photovoltaic silver demand could hit ~190 moz this year. Unfortunately, other demand areas have not been so robust. India is the main region for silver jewellery and silverware demand which has returned to more typical levels after a very strong year in 2022.

It will need more than photovoltaic demand to lift total silver usage next year. After such a strong year, 2024 may see slower growth in PV installations, but any growth will mean photovoltaic

demand will hit a new record. Tunnel oxide passivated contact (TOPCon) technology is expected to gain more market share over passive emitter and rear contact (PERC) solar cells which have been the industry standard since 2019. TOPCon cells contain more silver per watt than PERC cells. Growth in other industrial uses is less likely in a recessionary environment, and a rising silver price may also inhibit silver jewellery and silverware demand.

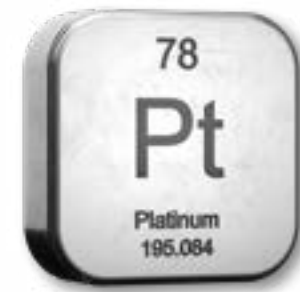
Physical silver demand has been robust in 2023, but it has not been quite as strong as last year when it was exceptionally high. Bar and coin demand has remained at a high level and although silver ETFs have seen net outflows so far this year, the pace has slowed. A further improvement in ETF investment would help support a higher price.

Mine production should be higher in 2024. Although silver mine supply is expected to fall this year, it should bounce back next year. The largest contributor to the decline in production, Newmont's Peñasquito mine, is now back in operation and ramping up to full capacity following a three-month labour stoppage earlier this year. The stoppage resulted in an estimated 16 moz in lost silver production. Lead, zinc and copper production are all forecast to show growth in 2023, which should also boost byproduct silver supply.



The silver price is likely to rise next year but underperform gold. Silver's industrial and precious aspects could pull in opposite directions. The silver price is expected to benefit from safe-haven buying, but this may be offset to some extent by the influence of industrial demand which is likely to fall as economic growth remains weak. The gold:silver ratio is above its long-term average, but it can move higher, as it has done in five of the last six US recessions as gold outperforms silver. **Silver is expected to trade in a range of \$22-29/oz during 2024.**

2023*	2024
Avg. \$978/oz	Forecast:
High \$1,132/oz	High \$1,100/oz
Low \$868/oz	Low \$800/oz
Change -14%	



PLATINUM

Economic uncertainty weighing on the price

Platinum is expected to continue to be in deficit in 2024. The forecast for the platinum market deficit in 2024 remains similar to this year at 445 koz. Global demand is projected to edge up to 7.5 moz next year, after robust growth this year was supported by gains in automotive and industrial demand. Meanwhile, primary supply has yet to return to pre-pandemic levels, and secondary supply is likely to suffer from lower vehicle scrappage levels.

Global platinum supply is forecast to slip slightly in 2024 to 5.6 moz. South African production is predicted to edge up as work-in-progress (WIP) stock, which has built up owing to a combination of processing plant maintenance and power shortages, is processed. This is reliant on Eskom, the state electricity supplier, being able to consistently provide sufficient power. The intensity of load-shedding has been decreasing in Q4'23, so that may be possible. Russian output is expected to dip next year as smelter maintenance reduces refined output. The fall in PGM prices in 2023 has been significant and has squeezed the margins of platinum producers, and mines in the fourth quartile of the cost curve are now loss-making. South African producers have already announced various cost-saving measures, and closure of unprofitable shafts and mines is a risk. These will take time to materialise but could potentially start next year, reducing output and deepening the deficit.

Secondary platinum supply from autocatalysts is predicted to remain weak. The volume of material recycled from autocatalysts is expected to be flat at best in 2024 owing to the high prices of new vehicles and the aftermath of the semiconductor chip shortage which have resulted in second-hand cars being kept on the

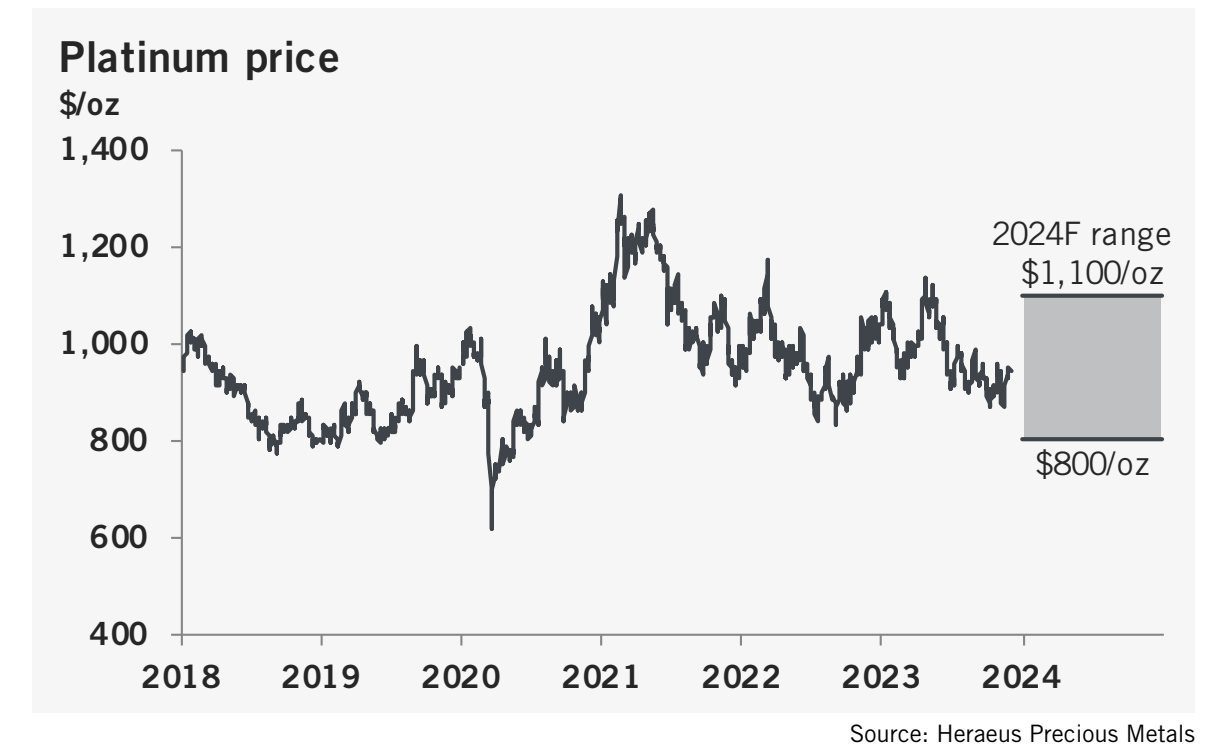
road for longer. Recessions in the Eurozone and the US would also tend to keep recycling depressed.

Global platinum autocatalyst demand is estimated to remain relatively stable at 3.5 moz (+1% year-on-year) next year after rising by 18% in 2023. Most of the growth this year comes from much higher year-on-year light-vehicle sales and more widespread substitution of platinum for palladium in gasoline autocatalysts. Demand is predicted to show slight growth next year as higher light-vehicle production and further expansion of the use of platinum-containing gasoline autocatalysts are somewhat offset by the growing market share of BEVs. Diesel's light-vehicle market share in Europe will continue to slip in 2024, having fallen to 12% in October 2023, eroding some platinum demand, and the region's heavy-duty sector is likely to come under pressure from weak growth in Q4'23 and into the first half of 2024.

Platinum demand from industrial end-uses is expected to remain steady next year at 2.3 moz. Platinum requirements in the glass industry are set to dip as the macroeconomic outlook in China is relatively weak. However, demand for petroleum catalysts in China and other regions is forecast to rise, as is electrical usage, helping to offset the drop from the glass sector.

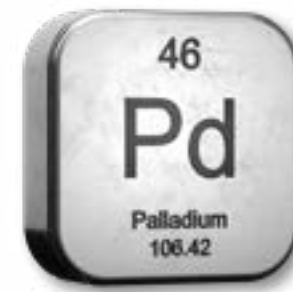
Jewellery demand could struggle next year. Consumption in China has been disappointing this year and has dragged down overall jewellery demand even though other regions have seen stable demand. The situation is not expected to improve in China next year and the weak economic situation in Europe and the US may also weigh on demand, although India could be a bright spot.

Investment has been relatively balanced but lower prices could sour sentiment. Year-to-date, platinum ETFs have seen net outflows of 20 koz. This is a moderation in outflows year-on-year, though if the platinum price falls lower in 2024 there could be more ETF disinvestment. Bar and coin demand remains positive even though Japanese investors sold some of their bar holdings in the second quarter when the price reached its high point for the year in yen terms.



Platinum is projected to trade between \$800/oz and \$1,100/oz in 2024. Despite a market in deficit, downside pressure from macroeconomic weakness is likely to keep the price in a similar trading range to this year. The rand has been depreciating so the currency has also failed to provide any price support. If producers announce mine closures, that could improve sentiment and help to support the price. At current levels, platinum is still cheap compared to gold, and a rally in the gold price could also help platinum move higher.

2023*	2024
Avg. \$1,381/oz	Forecast:
High \$1,810/oz	High \$1,200/oz
Low \$968/oz	Low \$700/oz
Change -39%	



PALLADIUM

Demand growth has stalled

The palladium market is predicted to have a substantial deficit next year. Secondary supply is expected to remain subdued while primary supply edges up owing to improved output in South Africa and North America. Demand is projected to fall owing to platinum substitution into gasoline autocatalysts, while there is little growth in ICE light-vehicle production anticipated as BEVs continue to gain market share and overall light vehicle production is only incrementally higher after this year's strong growth.

Palladium output is forecast to grow by 1% to 6.4 moz next year. Supply from Russia is estimated to be slightly lower in 2024 owing to smelter maintenance impacting refined production. Output in South Africa is likely to rise modestly as stockpiled material is processed. In North America, Stillwater mine is set to lift output, even taking recently announced cost cutting measures into account, owing to the ongoing recovery in production following incidents that reduced output in 2022 and 2023.

However, there are supply risks in 2024. In South Africa, the decline in the palladium and rhodium prices has hit companies' revenues and made the highest-cost mines loss-making. This could result in some production cuts, although these might take some time to have an impact because there is a requisite process of consultation to be followed before retrenchments are implemented. As primary palladium producers, North American mines are even more exposed to the palladium price. They are also loss-making at the current palladium price, so cuts to production could also be made there.

Secondary supply has underperformed expectations in 2023 and could remain subdued in 2024. The lack of new light-vehicle production in 2022 owing to the semiconductor chip shortage resulted in second-hand cars being more sought after. This pushed up second-hand vehicle prices and resulted in fewer vehicles than expected being scrapped over the last two years, despite much higher new vehicle production this year. Additionally, autocatalyst recycling in China has been put on hold until new policies are put in place to enable compliance with hazardous waste rules, which could take several months. China currently produces a relatively small amount of secondary palladium owing to the low loadings on the spent autocatalysts. There may continue to be some illicit recycling to avoid the existing rules. A recession in the US or Europe would also constrain scrappage rates.

Palladium automotive demand is forecast to drop by 3% to under 8 moz in 2024. Automotive demand was boosted in 2023 by much higher light-vehicle production than anticipated, as consumer demand remained strong and the shortage of semiconductor chips that had held back production in 2022 was mostly overcome. However, in 2024 light-vehicle production growth is expected to slow and BEVs are likely to take further market share which, along with wider use of gasoline autocatalysts that use some platinum to replace some palladium, means that palladium automotive demand is forecast to decline. There are downside risks to automotive demand. Borrowing costs have risen as central banks have raised interest rates and, since most new vehicle sales in the US are

financed, consumers' monthly repayments have jumped, reducing affordability. In a weaker economic environment in the US and Europe new vehicle sales could fail to meet expectations.

Industrial requirements for palladium are estimated to dip next year as efforts to reduce costs result in thrifting in electrical and dental demand, which is also shrinking owing to the use of alternative materials.



The palladium price is predicted to trade in a range between \$700/oz and \$1,200/oz in 2024. The palladium price still has room to fall further as it returns to historically normal levels from the extreme levels seen in recent years. There are risks to both demand and supply next year but the lack of demand growth takes away some price support even in a market that is expected to be in deficit.

PRECIOUS FORECAST 2024

- 01 OUTLOOK 2024
- 02 FORECAST EUR/USD
- 03 GOLD
- 04 SILVER
- 05 PLATINUM
- 06 PALLADIUM
- 07 **RHODIUM**
- 08 RUTHENIUM
- 09 IRIDIUM
- 10 ABOUT HERAEUS

2023*	2024
Avg. \$7,759/oz	Forecast:
High \$13,850/oz	High \$6,500/oz
Low \$4,450/oz	Low \$3,500/oz
Change -64%	



RHODIUM

Subdued demand and less price volatility

The rhodium market is forecast to be in a slight deficit in 2024. A minor decline in primary supply and a small fall in demand are expected next year, with the effect of shrinking the market deficit in rhodium.

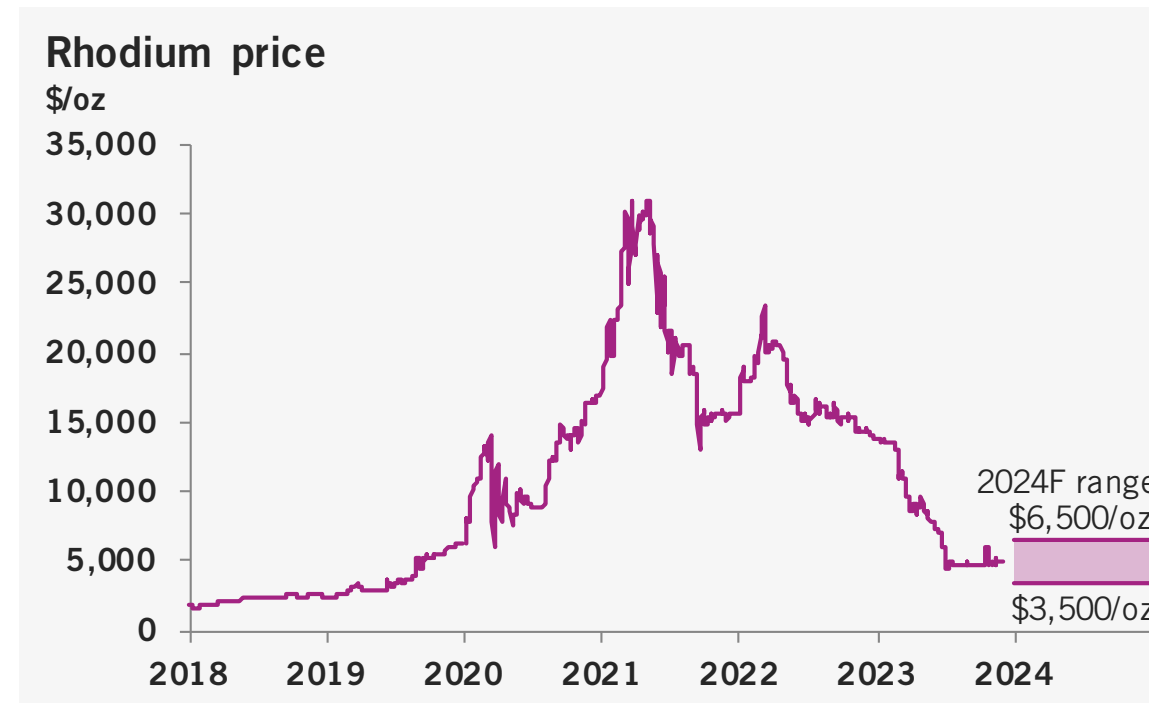
Primary rhodium supply is set to dip slightly next year but remain over 700 koz. South Africa is the largest producer of primary rhodium with 87% of the global total, and output is predicted to be marginally lower even with the processing of some stockpiled material. However, there is still a risk that Eskom could implement further power cuts that would impact PGM processing. Output is also at risk from production cuts in South Africa as falling PGM prices have reduced revenues and resulted in the highest-cost mines becoming unprofitable. The producers may act to rein in costs with the result that some production could be cut. Outside South Africa, primary rhodium production is likely to edge lower owing to the impact of smelter maintenance in Russia.

Secondary supply could continue to be weak. Lower vehicle scrappage rates this year have meant secondary supply has performed worse than forecast. The risk is that this could continue in 2024. Second-hand car prices remain elevated compared to pre-pandemic levels, and people may still be willing to hold on to older vehicles for longer. If either the US or Eurozone were to slip into recession in 2024 as anticipated, this would also depress scrappage rates and therefore secondary supply.

Rhodium automotive demand is forecast to drop by 5% to 955 koz in 2024. Rhodium autocatalyst demand is expected to decline as the countries with the tightest emissions standards, and therefore the highest autocatalyst rhodium loadings, are seeing the most rapid adoption rates of BEVs. The impact of tightening emissions standards has mostly run its course and there may be some slight thrifting.

Industrial demand for rhodium is predicted to increase next year, but this is smaller than the drop in autocatalyst demand and total demand will be slightly lower. The destocking of excess rhodium metal by Chinese glass manufacturers may have run its course, leading to a return to net purchases. Glass manufacturers have responded to the higher rhodium prices since 2019 by reducing the rhodium content and using more platinum in bushings. Greater rhodium usage is anticipated in other industrial sectors, adding to the expected increase in consumption.

The rhodium price is estimated to range between \$3,500/oz and \$6,500/oz in 2024. The relatively narrow expected trading range for rhodium is a reflection of a more 'normalised' rhodium market now that the price has returned to levels seen prior to the price spikes of 2020-2022. Weaker net demand year-on-year is likely to put pressure on the rhodium price, though the risk of a reduction in supply from mine closures in South Africa could provide some upside potential.



Source: Heraeus Precious Metals

PRECIOUS FORECAST 2024

01 OUTLOOK 2024

02 FORECAST EUR/USD

03 GOLD

04 SILVER

05 PLATINUM

06 PALLADIUM

07 RHODIUM

08 RUTHENIUM

2023*	2024
Avg. \$499/oz	Forecast:
High \$525/oz	High \$600/oz
Low \$475/oz	Low \$350/oz
Change -10%	

09 IRIDIUM

10 ABOUT HERAEUS



RUTHENIUM

Demand grows but market still in surplus

The ruthenium market surplus is predicted to shrink next year but economic weakness could weigh on the price. Supply is estimated to contract by 2% owing to some initial shaft closures in South Africa. Meanwhile, although demand in the electronic and chemical sectors is forecast to rise year-on-year, consumption will be below pre-pandemic levels.

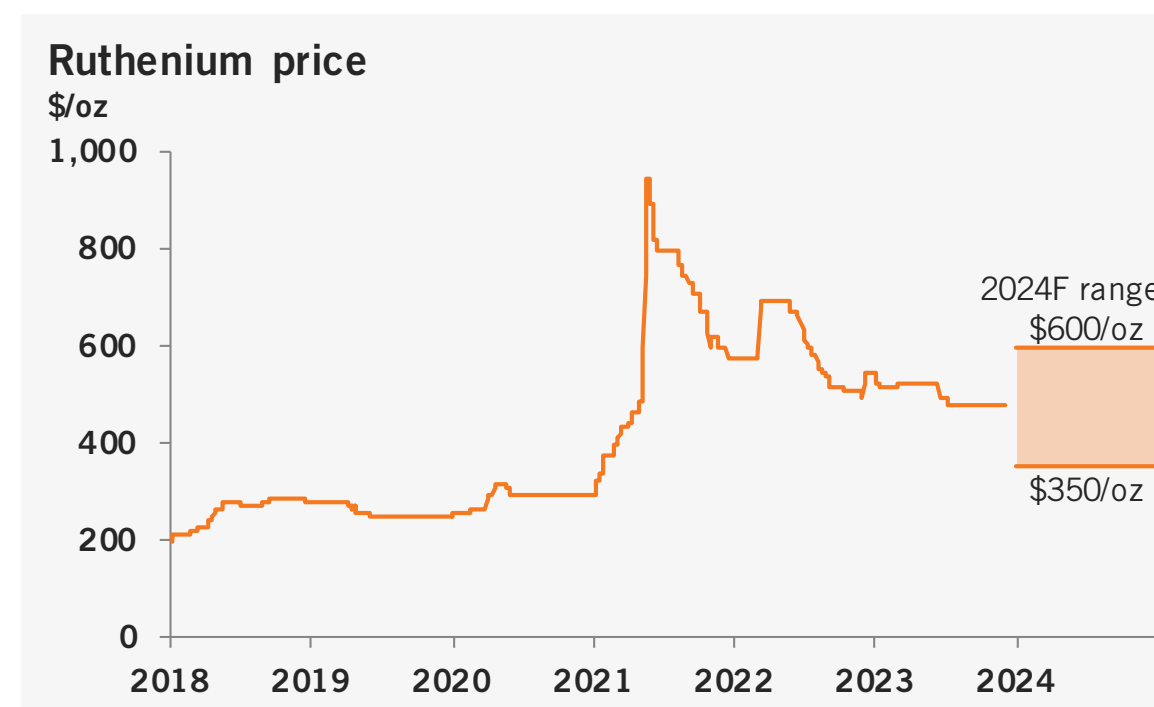
Ruthenium production is anticipated to be slightly lower next year, at 820 koz. Falling revenues have resulted in the highest cost areas of some mines in South Africa becoming uneconomic and some initial cuts to output have been made at two operations. There is a risk that additional cost-cutting measures could reduce output further next year. The outlook is also reliant on Eskom being able to provide sufficient electricity that neither ongoing production nor processing of stockpiled material is impacted. Russian production is likely to decline slightly owing to the impact of smelter maintenance in 2024. Elsewhere production is set to remain relatively stable.

Electrical sector demand is expected to rebound next year after weaker than anticipated demand for electronics resulted in a build-up of excess inventory this year. Hard-disk (HDD) demand for ruthenium is predicted to mount a mild recovery in 2024 as end-users begin to return to the market as buyers, having run down inventories during

2023. However, overall demand is likely to remain weak. Ruthenium-containing HDDs are threatened by non-ruthenium alternatives, though the rollout of the alternatives has been slower than expected, and thus demand may be sustained for longer. The risk to HDD demand is the potential for economic slowdown in major markets in 2024. In a much weaker economic environment, demand could drop year-on-year.

Other demand is also estimated to be higher in 2024. Chemical demand is projected to grow next year as usage is set to increase in various chemical processes in China. Demand growth in the chemical sector is also at risk from economic stagnation, particularly in China. Hydrogen-related requirements remain small relative to other end-uses, and growth is forecast to ease after a strong 2023.

Despite a tighter fundamental outlook, the ruthenium market is predicted to remain in surplus, which along with potential slower global growth, is expected to weigh on the ruthenium price in 2024. **Ruthenium is forecast to trade between \$350/oz and \$600/oz next year.**



Source: Heraeus Precious Metals

- 01 OUTLOOK 2024
- 02 FORECAST EUR/USD
- 03 GOLD
- 04 SILVER
- 05 PLATINUM
- 06 PALLADIUM
- 07 RHODIUM
- 08 RUTHENIUM
- 09 **IRIDIUM**

2023*	2024
Avg. \$5,087/oz	Forecast:
High \$5,500/oz	High \$6,500/oz
Low \$4,750/oz	Low \$4,000/oz
Change +8%	



IRIDIUM

Macroeconomic risks vs. a market in deficit

Iridium supply is expected to contract for the third year in a row in 2024. With South African miners' PGM revenues having fallen sharply in 2023, a small amount of production has already been removed by cost-cutting measures. With higher-cost mines and shafts likely to be loss-making next year, PGM miners will look to cut operating costs and capital expenditure in order to improve margins. If mining areas are shut, then iridium supply would be hit.

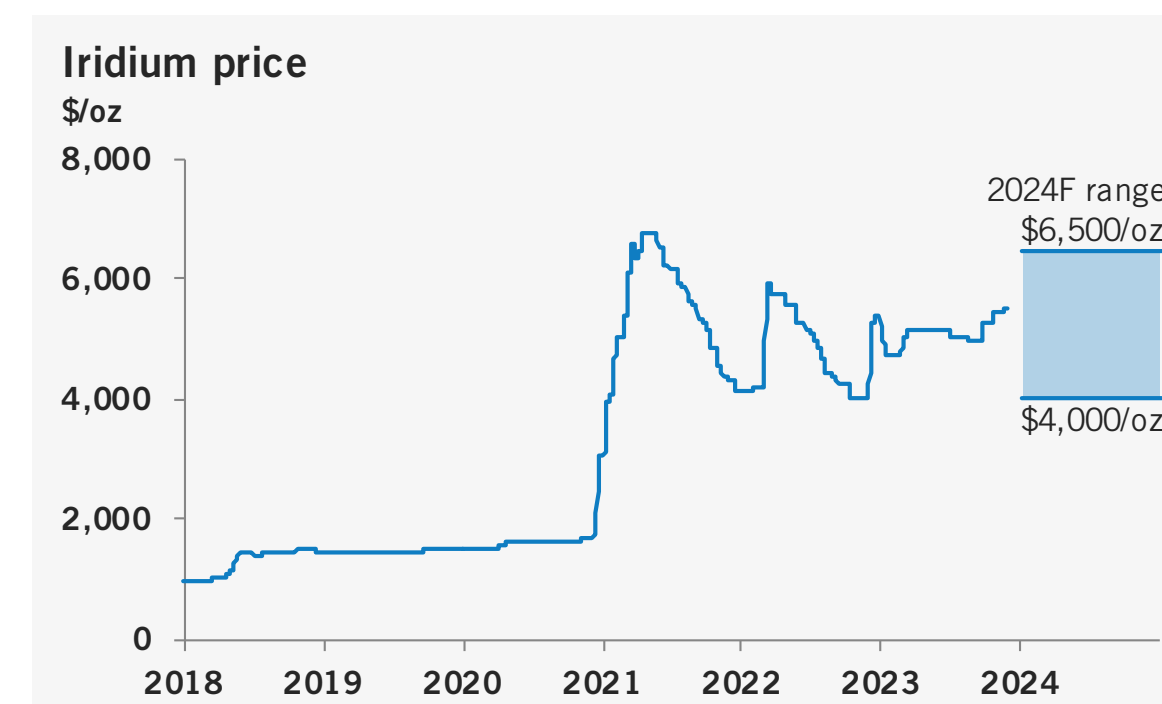
Load-shedding remains a risk to iridium supply. The risk of load-shedding is greater for iridium compared to other PGMs owing to the concentration of primary supply in South Africa. In 2024, 87% of newly mined iridium will come from South Africa, the highest proportion of any PGM. If significant grid disruption were to continue next year, refining of work-in-progress stocks could be delayed, potentially reducing primary supply for 2024.

Demand is forecast to be in line with 2023. Total demand is expected to be relatively unchanged in 2024. Small decreases in spark plug and electrical demand are offset by a rise in requirements from electrochemical applications. Economic weakness in the US and Europe could suppress demand, particularly from the electrical sector.

Smartphone sales are beginning to recover in Q4'23. However, a full recovery to pre-pandemic levels seems unlikely, as the trend towards longer device refresh cycles is likely to be more prevalent during periods of weaker economic growth and lower consumer confidence. This would be a drag on iridium crucible demand.

Green hydrogen production is increasingly important for iridium demand. In 2022, there was a surge in electrolyser production and a large jump in iridium demand from a very low base. That was followed by another increase in 2023 and further growth is expected in 2024. Over time the loading of iridium in electrolysers is being reduced and a new ruthenium containing catalyst developed by Heraeus for PEM electrolysis will help ease the pressure on a tight iridium market.

The iridium price has been more stable in 2023 as the markets have felt-out a fair price for the metal amid expectations of demand growth from the hydrogen economy. The fundamental outlook for iridium remains robust and there are risks that supply could be lower than predicted. However, there are also downside price risks if the economic outlook weakens as anticipated, as recessions could arrive in the US and Europe in 2024. **The iridium price is forecast to trade between \$4,000/oz and \$6,500/oz in 2024.**



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- 01 OUTLOOK 2024
- 02 FORECAST EUR/USD
- 03 GOLD
- 04 SILVER
- 05 PLATINUM
- 06 PALLADIUM
- 07 RHODIUM
- 08 RUTHENIUM
- 09 IRIDIUM
- 10 ABOUT HERAEUS

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The Heraeus Group is a broadly diversified and globally leading family-owned technology company, headquartered in Hanau, Germany. The company's roots go back to a family pharmacy started in 1660. Today, Heraeus bundles diverse activities in the Business Platforms Metals and Recycling, Healthcare, Semiconductor and Electronics as well as Industrials. Customers benefit from innovative technologies and solutions based on broad materials expertise and technological leadership.

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*All 2023 figures are to the end of November