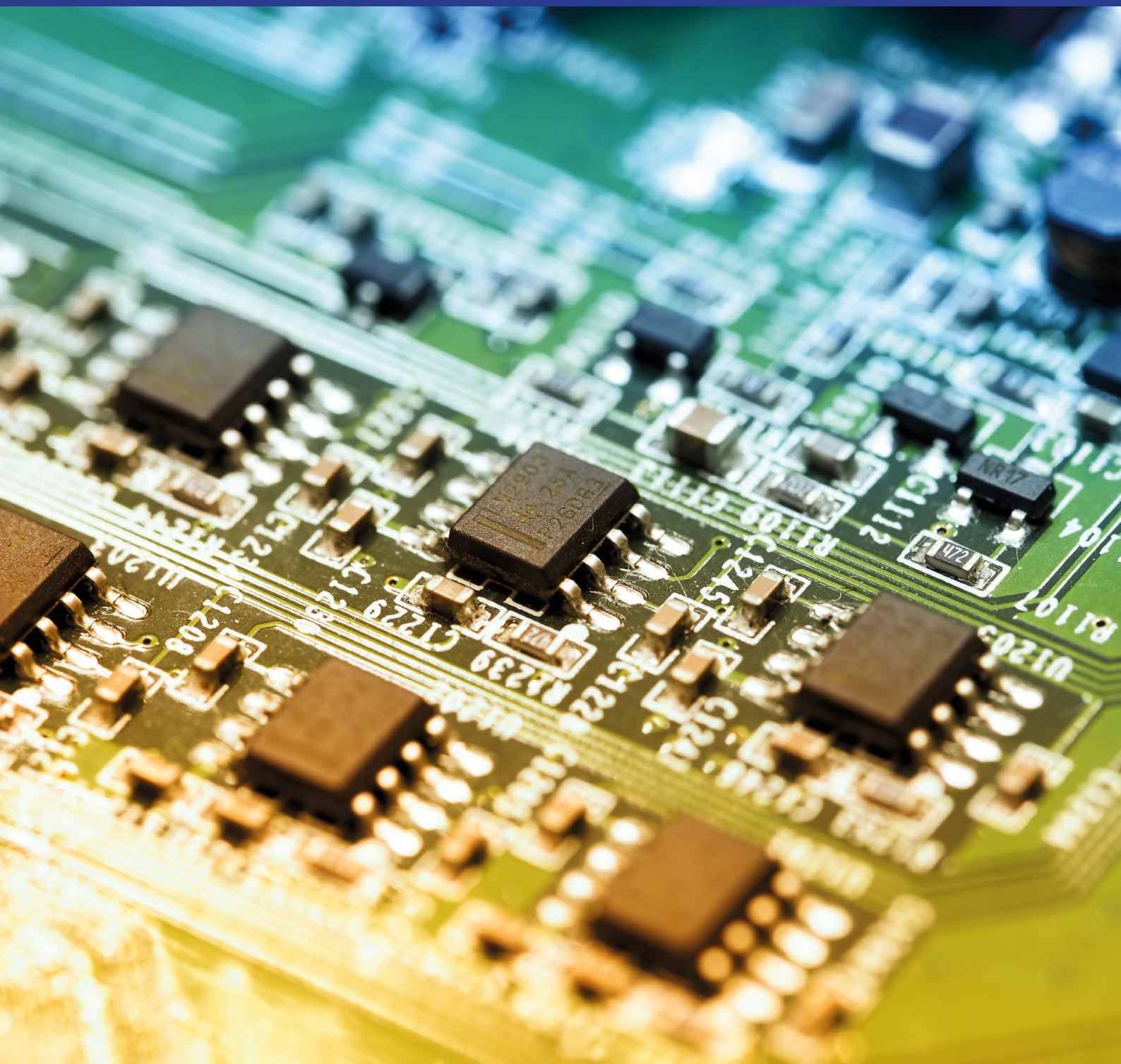
Johnson Matthey

PGM market report

May 2025



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Johnson Matthey defines 'light duty' as cars and light trucks with a gross vehicle weight (GVW) of up to 3.5 tonnes, except in the USA, Canada and Mexico, where vehicles are considered 'light' if they have a GVW of up to 6 tonnes. Automotive production data is taken from S&P Global Mobility, Powertrain Production Forecast, February 2025 (vehicles with a GVW of up to 6 tonnes) and KGP-GlobalData Commercial Vehicle Powertrain Forecast Q4 2024 (vehicles with a GVW over 6 tonnes).

The PGM market report is published annually, in May each year.

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Definitions

Europe	EU+ (includes UK and Turkey but excludes Russia)
Japan	Japan only
North America	USA and Canada (excludes Mexico)
China	China only
RoW	Rest of World: all countries not captured in the above
Primary supply	Supply figures represent sales of **primary PGM** by producers and are allocated to the region where mining took place, rather than the region of subsequent processing.
Secondary supply	Secondary supply is the quantity of metal recovered from open-loop recycling (i.e. where the original purchaser does not retain ownership of the PGM). Outside the automotive, jewellery and electronics markets, open-loop recycling is negligible. Automotive recycling represents the weight of metal recovered from end-of-life vehicles and aftermarket scrap. It does not include warranty or production scrap.
Demand	Demand figures for any given application represent the sum of industry demand for new metal in that application, net of any closed-loop recycling (i.e. where industry participants retain ownership of the metal). **Automotive demand** is allocated to the region where the vehicle is manufactured and is accounted for at the time of vehicle production. It includes emissions catalysts on vehicles, motorcycles and three-wheelers, as well as fuel cell vehicles. Non-road mobile machinery is counted as industrial demand, in the pollution control category. **Jewellery demand** is allocated to the region where the finished jewellery is manufactured, not sold.
Movements in stocks	This figure gives the overall market balance in any one year and reflects the extent of stocks that must be mobilised to balance the market in that year. It is thus a proxy for changes in stocks held by fabricators, dealers, banks and depositories, but excludes stocks held by primary and secondary refiners and final consumers. A positive figure (market surplus) thus reflects an increase in global market stocks. A negative value (market deficit) indicates a decrease in global market stocks.

PGM summary

Supply and demand in 2024

Platinum, palladium and rhodium remained in deficit, despite lower ICE vehicle production

Primary PGM supply was supported by the release of excess inventory

The auto scrap market remained depressed, as owners kept vehicles on the road for longer

Autocatalyst demand fell 3%, due to lower gasoline car production, and PGM thrifting in China

Industrial demand trends were broadly positive, except in the glass sector, hit by display glass plant closures

High gold prices helped support platinum jewellery fabrication

Investment demand was robust, with renewed ETF buying and strong demand for platinum bars in China

Ample market liquidity kept PGM price movements subdued during 2024

The platinum, palladium and rhodium markets recorded another deficit in 2024, with demand for all three metals relatively robust despite lower production of vehicles with internal combustion engine (ICE) powertrains. However, the markets remained liquid and price movements were generally subdued.

Supplies of the three 'autocatalyst PGM' were little changed: there was no material recovery in automotive recycling except in China, while primary PGM production remained under pressure from low prices (although South African shipments were supported by the release of excess inventory). Trends in industrial demand were broadly positive, except in the glass industry, which saw sales of PGM back to the market following recent plant closures and alloy composition changes. There was little change in platinum jewellery fabrication volumes, while both platinum and palladium investment demand remained in positive territory.

The ruthenium market was also in deficit, despite large producer stock sales, as demand in the hard disk industry rebounded, and consumption in chemical process catalysts set a new all-time high. However, market surpluses in recent years meant that there were adequate stocks of metal held by industrial consumers, fabricators and other market participants. Only the iridium market was broadly in balance: while demand continued its recovery from the 2022 low, supply was also up, with modest shipments from producer inventory.

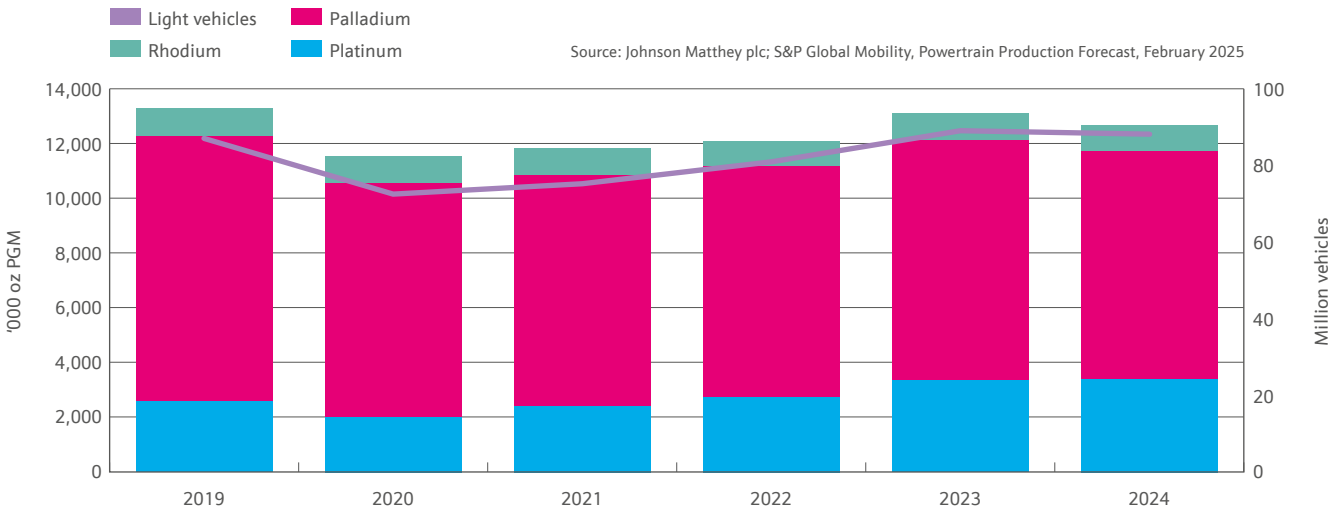

Figure 1 Automotive PGM demand and light vehicle output

PGM prices

As has often been the case in recent years, price movements remained largely divorced from fundamental market balance considerations during 2024. The **platinum** price traded between $900 and $1,000 for most of the year; brief excursions above $1,000 (notably in May, when it set the year's high of $1,070) were quickly followed by a retreat towards $900. While platinum continued to react to gold price movements on an intra-day basis, it derived little if any benefit from an exceptional rally in the gold price, which rose steadily from $2,070 in January to a then all-time high of $2,780 in late October. Prior to 2014, platinum generally traded at a premium to gold, but has since moved to a widening discount.

"Rhodium price volatility decreased significantly during 2024"

After trading at a large premium to platinum for much of the 2018 to 2023 period, the **palladium** price slid to parity with its sister metal in February 2024. Thereafter, it traded mainly in a $900 to $1,100 range, rallying briefly to above $1,200 in late October following talks between the USA and its allies on further restrictions on Russian exports, and an announcement by Sibanye-Stillwater that it planned to cut production at its palladium mine in Montana, USA. However, investor sentiment quickly turned negative again, reflecting ongoing concerns over the impact of vehicle electrification on future market balance, and palladium eased back to around $920 at the year end.

Heavy liquidation of surplus **rhodium** stocks by Chinese glass companies drove the rhodium price sharply lower during the first half of 2023, but the price stabilised during 2024, and volatility decreased significantly. Rhodium traded in a $4,400 to $4,800 range, supported by steady industrial demand and weak secondary supplies, but capped by producer and industrial selling.

It was the turn of **iridium** to see consistent downward price pressure during 2024, as optimism over near-term growth in hydrogen applications faded. The price ebbed from $5,000 in January to $4,400 at the year end. **Ruthenium** also descended steadily to record a three-and-a-half year low of $390 in August, but recovered to trade above $460 between September and December.

Mine supply

PGM supply in 2024 benefited from reductions in pipeline inventory in South Africa, and sales of some metals (particularly ruthenium) from producer stocks. There was nevertheless a small contraction in primary platinum supply, as Russian sales returned to more normal levels following heavy destocking in 2023. Mine supply of the other PGM rose modestly.

"Primary supply benefited from the release of excess WIP by Anglo American Platinum"

South African supplies of all the PGM were up versus 2023, with shipments benefiting from the refining and subsequent sale of excess work-in-progress inventory by Anglo American Platinum. Stocks of semi-processed PGM at Anglo's mining and processing facilities had been above normal levels since a converter outage in 2020, while a rebuild of the Polokwane furnace in 2022 and severe electricity shortages during 2022-2023 also impacted processing capacity. During 2024, with electricity supply improving, and smelter availability back to normal levels, most of the remaining backlog was refined and sold.

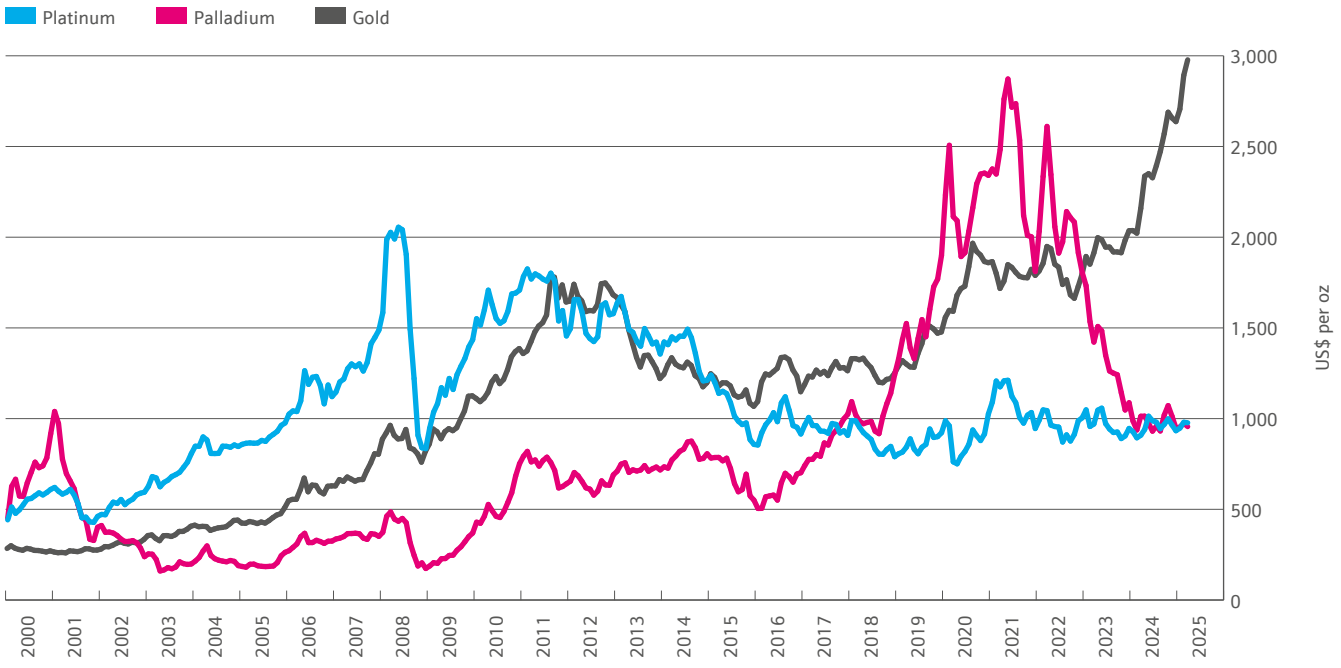

Figure 2 Monthly average platinum, palladium and gold prices, 2000 – 2025

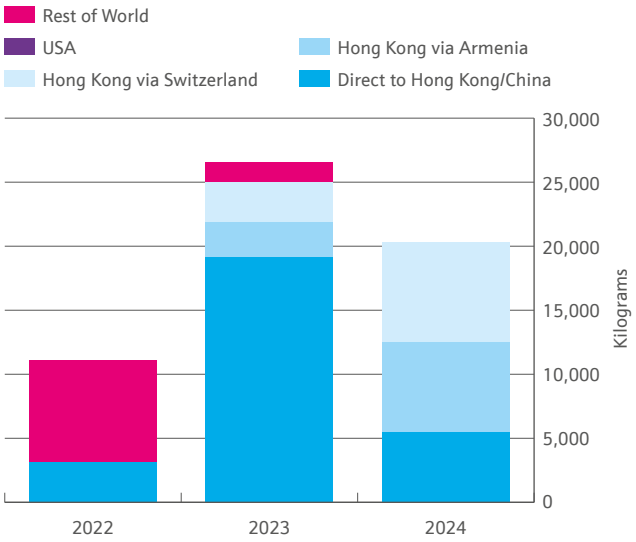

Figure 3 Russian platinum exports by destination

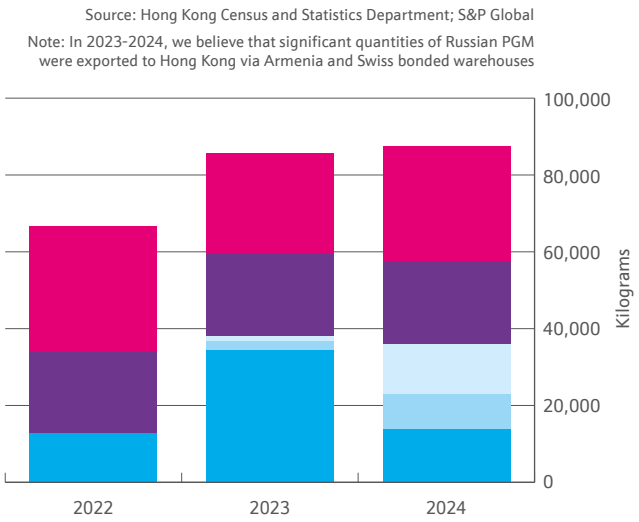

Figure 4 Russian palladium exports by destination

Other South African producers have also accumulated some excess work-in-progress (WIP), but did not reduce in-process stocks last year; we expect pipeline inventory to be reduced gradually over the next two-to-three years.

In addition to releases from work-in-progress, PGM supply from South Africa was also supported by sales from pre-existing refined inventories. This destocking was particularly evident for ruthenium, as producers took advantage of a strong chemicals and hard disk demand from Asia.

Although refined PGM output and sales improved in 2024, we estimate that underlying mine production in South Africa fell by around 2%. This contraction was largely a function of disruption due to safety stoppages, water supply outages, severe weather, and difficult geological conditions, combined with a gradual wind-down at some end-of-life shafts. All major South African PGM producers have initiated rationalisation programmes, but this had little direct impact on production in 2024. Restructuring to date has mainly involved cuts in headcount to 'right-size' the workforce at mines which have underperformed in recent years. Although a planned Merensky Reef expansion at Two Rivers was mothballed in late 2024, this did not affect PGM output last year.

PGM supplies from Zimbabwe fell slightly, despite some incremental gains in underlying mine output. The large Zimplats operation saw a build-up in stocks of semi-processed PGM ahead of the commissioning of its smelter expansion. Excess inventory will be processed this year and shipped to South Africa for final refining. (We count Zimbabwe PGM supplies at the point of shipment to South Africa, after adjusting reported concentrate and matte delivery volumes to account for typical refining recoveries).

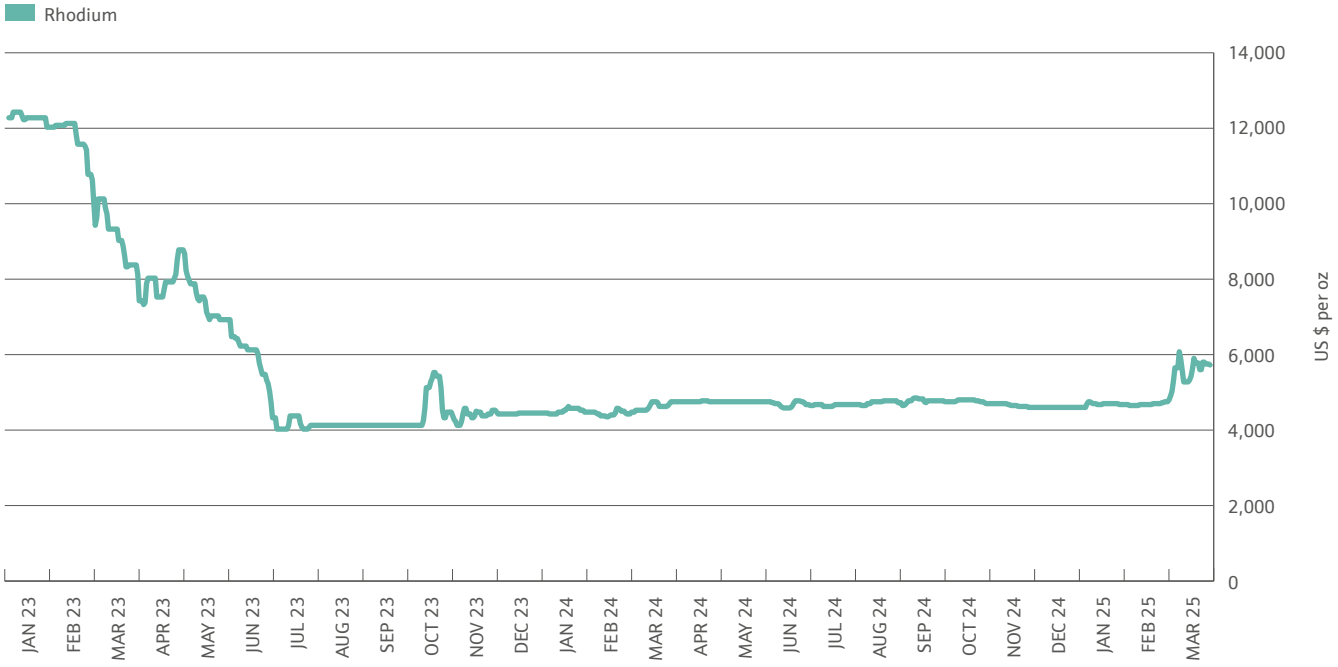

Figure 5 Rhodium price, January 2023 to March 2025

"Russian platinum sales fell by 24% in 2024, following heavy destocking the previous year"

Russian PGM production was little changed in 2024, at around 2.68 million oz of palladium and 670,000 oz of platinum. An anticipated fall in refined output at Norilsk Nickel did not materialise, with the company beating earlier guidance despite the rebuilding and upgrading of a furnace at its Nadezhda nickel smelter.

Russian supplies have in recent years sometimes varied significantly from production, due to a build-up in finished metal stocks following the Ukraine invasion, and a subsequent release of inventory. We estimate that Russian platinum sales fell by 24% to 650,000 oz in 2024, following significant destocking the previous year. Almost all Russian platinum is now exported to the Chinese market, mainly via Hong Kong. Although Hong Kong trade data shows a fall in direct exports of platinum from Moscow in mid-2024, we believe that significant quantities of Russian metal arrived in Hong Kong from Armenia and via Swiss bonded warehouses during the second half of last year.

Russian palladium shipments rose by 2% to an estimated 2.75 million oz in 2024, due to higher exports to the USA (where all forms of PGM except palladium sponge have been subject to prohibitive import tariffs since April 2023). We estimate that the USA accounted for nearly one-third of Russian palladium sales last year. In contrast, shipments to Hong Kong appear to have fallen slightly, although they still accounted for over 40% of total Russian palladium exports. As was the case for platinum, direct shipments of palladium from Moscow to Hong Kong dried up from July 2024 onwards. Instead, large quantities of Russian metal were imported by Armenia for onward export to Hong Kong, or were consigned via Swiss bonded warehouses.

North American platinum and palladium supplies fell in 2024, reflecting a drop in production at the Impala Canada mine, and a decline in by-product PGM output from Vale's Sudbury nickel operations. Although volumes of nickel-copper ore mined at Vale's Sudbury mines improved sharply during 2024, this was not reflected in refined PGM output, due to long processing timelines. At Impala Canada, remaining mine-life is now limited, while low palladium prices have resulted in a focus on high-margin ounces rather than overall volumes; PGM output fell by 14% last year.

There was almost no change in production volumes at Sibanye-Stillwater's palladium mine in Montana, USA, which produced 426,000 oz of PGM last year. However, weak metal prices have prompted a restructuring, announced in November 2024, that will see annual PGM output being cut by at least 35% in 2025.

Secondary supply

Secondary PGM supply benefited from a strong recovery in the relatively small but rapidly evolving autocatalyst recycling market in China, where scrap volumes were galvanised by government incentives aimed at encouraging consumers to trade-in older, more polluting vehicles for new, cleaner cars. However, outside China, the automotive scrap industry remained stubbornly depressed.

"Chinese scrap volumes were boosted by trade-in subsidies"

Chinese auto recoveries had been weak in 2023, with collection and processing activity hit by a combination of falling PGM prices, and a government clamp-down on informal collectors operating without hazardous waste permits. This caused a build-up in unprocessed scrap at small scrap collectors at the bottom of the recycling chain. We believe that some of this 'hoarding' was reversed in 2024, although it appears that untreated material is still being stockpiled in the hope of better prices in future.

The Chinese scrap market also benefited from the introduction of a government trade-in subsidy, initially launched in March

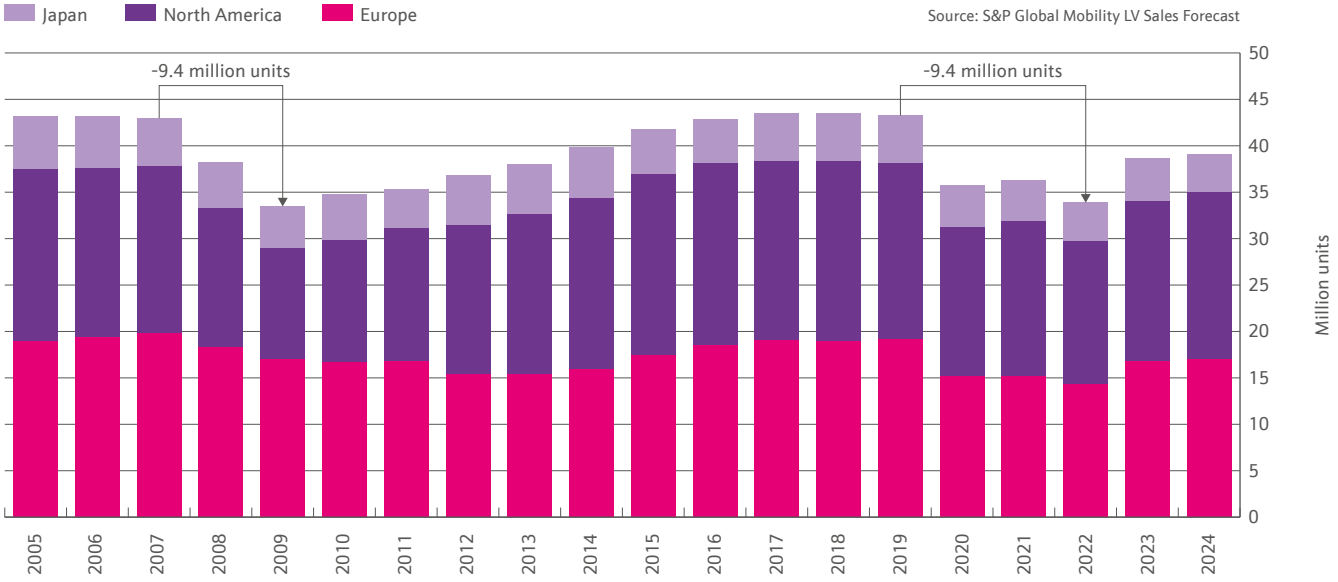

Figure 6 Light vehicle sales in mature auto markets, 2005 – 2024

2024, intended to incentivise owners to retire passenger vehicles built to China 3 standards, before June 2011 (gasoline vehicles) or June 2013 (other fuels). Initially, take-up was lacklustre, and in August 2024, the government doubled the subsidies on offer. The scheme's original target was to incentivise the destruction of 1.5 million old vehicles but by the year-end, this number had been significantly exceeded (and the scheme extended for another year – see page 16). This additional scrappage activity, combined with some 'dishoarding' at collectors, helped to boost Chinese automotive PGM recoveries by 21% in 2024.

In other regions, auto PGM recycling remained unusually depressed. Exceptionally weak auto sales during the 2020 to 2022 period have had a severe impact on the supply of second-hand vehicles, leading to a lasting downturn in the number of end-of-life vehicles reaching scrap yards.

Mature auto markets have seen two periods of pronounced weakness over the past two decades. Due to the Covid pandemic, and subsequent supply chain disruption, annual light vehicle sales in Europe, Japan and North America combined fell by 9.4 million units between 2019 and 2022, drastically reducing the flow of one-to-three-year-old vehicles onto the second-hand market. This impact was compounded by a shortage of older vehicles, following the collapse in sales and slow recovery in the wake of the Global Financial Crisis.

Although car sales recovered in 2023 – 2024, high vehicle prices and elevated borrowing costs kept new registrations well below 2019 levels. An ongoing shortage of younger models entering the second-hand market has continued to support used car prices across all vehicle age groups, restricting the flow of end-of-life vehicles to scrap yards last year.

Automotive PGM demand

After setting a post-Covid high in 2023, global light-duty (LD) vehicle production fell by 1% last year to 88 million units. Although Europe, North America and Japan all saw their auto industries contract, Chinese automakers enjoyed robust gains, with light duty output up 4%.

"Growth in BEV share slowed, and ICE car production held up better than previously anticipated"

Growth in battery electric vehicle (BEV) market share continued to slow in 2024, underperforming earlier expectations. Globally, the BEV share of world light-duty production rose by one percentage point, to 13%, but this was almost entirely due to further gains in China; in most other markets, BEV production share was flat or slightly down.

As a result, world gasoline car production held up better than most industry forecasters had anticipated, falling only 1% to 68 million vehicles. The Rest of World region registered a 3% gain in output, with continuing robust growth in the Indian domestic car market, and export production in Korea and Mexico benefiting from unexpected resilience in consumer demand for light duty gasoline vehicles in Europe and the USA. Meanwhile, Chinese output of gasoline cars was supported by a surge in popularity of plug-in electric/gasoline hybrids. These vehicles qualify for 'New Energy Vehicle' (NEV) status and hence for a range of Chinese government incentives (including exemption from purchase tax, and a higher trade-in subsidy versus that offered for the purchase of a conventional ICE model).

"Domestic Chinese automakers have thrifted PGM on their gasoline models"

Chinese production of plug-in hybrid (PHEV) and range-extended (REEV) electric vehicles rose by 80% to over 5 million units last year. These vehicles have gasoline engines as well as electric motors and hence require the use of PGM-containing catalytic exhaust aftertreatment. They are therefore included in our light-duty gasoline vehicle category. Gains in these segments were achieved despite relatively vigorous growth in Chinese output of 'pure' battery vehicles, which rose 16% to 7.6 million units in 2024.

In contrast, automakers in Europe and North America were unable to capitalise on weakness in the battery electric market: output of both gasoline and battery electric cars declined. However, even in these regions, LD gasoline production somewhat outperformed, falling 3-4% versus a 7% drop for BEVs. The cost of BEVs remains a significant barrier to their wider adoption in the European and North American markets, and the withdrawal or phase-out of subsidies in some countries has only exacerbated this. Consumer surveys also point to other deterrents such as 'range anxiety' and lack of public charging infrastructure.

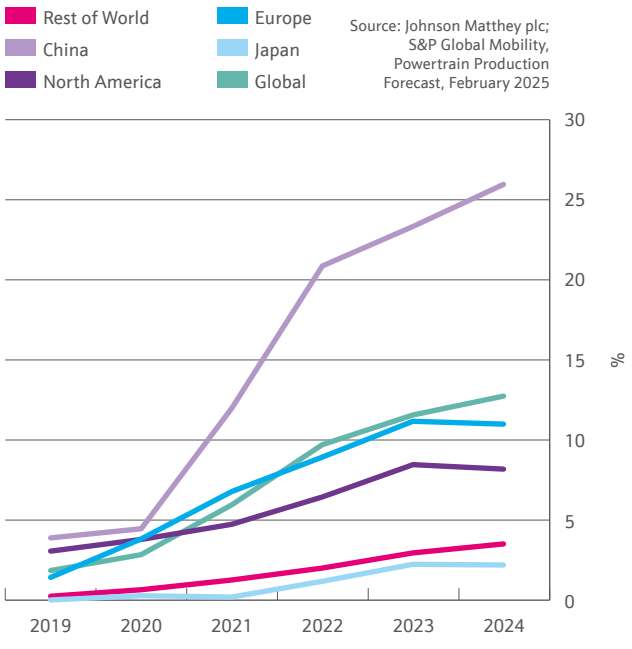

Figure 7 BEV share of light duty production, by region

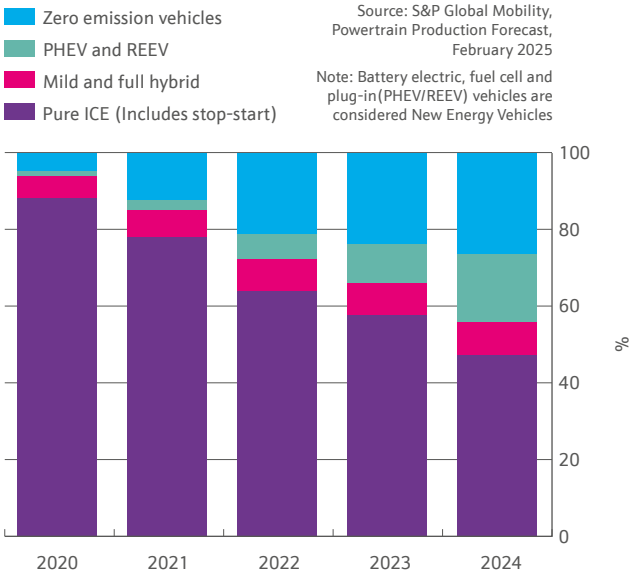

Figure 8 Chinese light duty market share by degree of electrification

Lower production of vehicles with internal combustion engines contributed to a 3% decline in global automotive PGM consumption to 12.7 million oz, but regional demand trends were also heavily influenced by changes in the PGM content of exhaust aftertreatment systems. Despite negative production trends in most vehicle categories, North American PGM use rose by 3%, as the phase-in of stricter Federal Tier 3 emission limits neared its conclusion, and more vehicles were required to meet the strictest 'SULEV' standards.

In contrast, Chinese PGM consumption slid by 12%, reflecting ongoing thrifting of PGM loadings on gasoline vehicles, as well as changes in market share. Domestic Chinese automakers dominate the rapidly expanding plug-in hybrid segment and have also gained share in conventional ICE vehicles. In recent years, these domestic OEMs have undertaken aggressive PGM thrifting programmes and now employ much lower-loaded catalysts compared to those used by international joint venture companies in China.

"Chinese gasoline car output was supported by a surge in popularity of plug-in hybrids"

Since 2020, there have been significant changes in the regional distribution of automotive PGM demand, with the Rest of World region overtaking Europe in 2021 and China in 2022. Rest of World PGM consumption rose by a further 4% last year and now accounts for 29% of the global total. While many smaller Rest of World vehicle markets have relatively lenient emissions legislation, a significant proportion of auto production meets legislation equivalent to Euro 6 or US Federal Tier 3, both for domestic sale (particularly in India and Korea) or for export (from countries such as Mexico, Korea, Morocco, South Africa and Thailand).

"China is by far the largest industrial PGM user, consuming nearly 2.2 million oz last year"

Industrial PGM demand

Industrial PGM demand fell by 2% in 2024, but remained above 5.5 million oz, not far off the all-time highs of around 5.7 million oz recorded during the 2021 to 2023 period. China remains by far the largest industrial user of PGM, with Chinese companies consuming nearly 2.2 million oz of PGM last year, unchanged versus 2023. Offsetting this, Japan and the Rest of World region saw demand fall, as recent expansions in display glass capacity in China triggered plant closures elsewhere.

These display glass facility closures were the main driver of an 11% decline in industrial **platinum** demand, to 2.56 million oz – the lowest since 2020. When PGM is released from glass facilities, either due to plant closures or following technology changes, companies sometimes choose to retain some or all of the metal to supply future requirements. However, on this occasion, we believe that significant quantities of platinum were sold back to the market, with the result that both Japan and the Rest of World region recorded negative glass demand in 2024. Worldwide, demand for platinum in glassmaking fell by over 40%, despite ongoing strong purchasing by the fibreglass sector. We note some retrospective changes to our glass demand numbers, primarily reflecting new capacity and PGM inventory information for the Chinese glass industry.

"Hard drive shipments recovered, prompting renewed PGM buying by disk manufacturers"

Other applications saw much smaller changes in demand. Consumption in the chemicals sector remained at historically high levels, but declined modestly versus 2023, as a wave of paraxylene capacity expansions in China (usually as part of integrated petrochemical complexes) came to an end. There was also a small decline in purchasing from the global petroleum and fuel processing industry, mainly due to lower capacity additions in the biofuels and synthetic fuels segment. However, electronics demand rose, as hard drive shipments recovered from a downturn in 2022 – 2023, prompting renewed PGM buying by disk manufacturers.

The use of **palladium** in industrial applications has been in decline since the 1990s, as periods of high price encouraged substitution, especially in the electronics and dental sectors. However, demand stabilised at just below 1.5 million oz in 2024, reflecting a recovery in palladium use in the electronics sector. The substitution of palladium with nickel in capacitors was largely completed many years ago, but palladium retains a niche position in high-value, high-reliability segments such as aviation, defence, automotive and medical devices, which saw growth last year. The use of palladium to plate

connectors and other components also increased, in line with the general recovery in the electronics industry.

Industrial consumption of **rhodium** rose by over 40% to 110,000 oz in 2024 but remained well below pre-Covid levels. The extremely high prices of 2020 – 2023 continue to exert an influence on demand: during this period, Chinese glassmakers significantly reduced the average rhodium content of the platinum alloys used in fibreglass manufacturing equipment and sold some of the recovered metal back to the market. These sales continued during 2024, as weak profitability in the Chinese fibreglass sector continued to incentivise the liquidation of rhodium inventory. Much of this rhodium was purchased prior to 2019, at prices significantly below current levels, enabling companies to report a profit on metal sales.

"Chinese fibreglass companies continued to sell rhodium back to the market"

In contrast, purchases of rhodium by the chemical industry were unusually strong last year. Lower prices have revived interest in the Monsanto acetic acid process, which uses a rhodium catalyst, while there has also been investment in new oxo-alcohol facilities. Most of these capacity additions were in China.

Ruthenium use is overwhelmingly in industrial applications, with only a small amount of investment and jewellery consumption (captured in our 'other' demand number). Demand surged by 13% in 2024, as a revival in data centre investment helped boost ruthenium purchasing by the hard disk industry, and consumption in chemical catalysts set a new all-time high.

The use of ruthenium process catalysts is dominated by China. Outside China, ruthenium sees comparatively limited use by the chemicals industry, mainly in catalysts for speciality chemicals, and alongside iridium in the Cativa acetic acid process (which competes with the rhodium-catalysed Monsanto process). But in China, ruthenium is used in some bulk chemical applications, in particular by the caprolactam sector, which produces feedstocks for the nylon industry. This application has seen substantial growth in recent years, driven by capacity additions for nylon 6 resins, used in a variety of applications including engineering plastics.

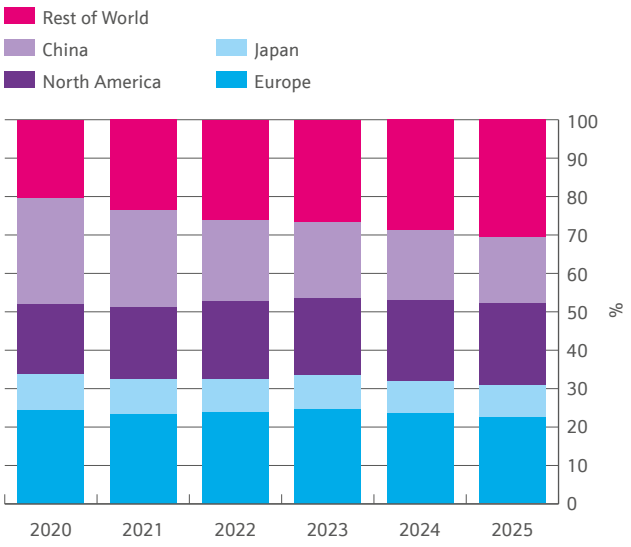

Figure 9 Regional share of automotive PGM demand

"Ruthenium is used to produce caprolactam, a feedstock for nylon 6 resins"

Industrial applications also dominate **iridium** consumption. Demand improved modestly in 2024, on the back of lower prices, robust purchasing by the chemicals industry, and steady gains in electrochemical applications. Green energy applications were the key growth driver in the latter sector, with rising EV production in China stimulating the use of iridium to produce copper foil for vehicle batteries, and demand in PEM (proton exchange membrane) electrolysis benefiting from the launch of some large green hydrogen projects in Europe. However, these gains were partly offset by a fall in iridium use in ballast water treatment on ocean-going ships, as a wave of retrofitting came to an end.

Jewellery demand

Global platinum jewellery demand was broadly flat in 2024, with a modest decline in fabrication volumes in North America offset by some limited growth elsewhere. US demand fell slightly, as the post-Covid boom in sales of both fashion and bridal jewellery began to ebb, but this was offset by higher fabrication rates in some other countries, in particular India (including in our Rest of World region), where there is growing export production in the Mumbai duty-free zone, as well as rising domestic demand for both men's and women's platinum jewellery.

In China, record gold prices were supportive of platinum fabrication demand, as retailers rotated a portion of their karat gold jewellery stock into cheaper, higher margin platinum pieces. This helped maintain platinum demand close to the 2023 level. However, it is as yet unclear whether stock-building by the distribution chain has translated into additional consumer purchases of platinum jewellery items.

"Record gold prices helped support Chinese platinum jewellery fabrication"

Investment

Last year saw a revival in investment in platinum and palladium exchange traded funds (ETFs). During the second quarter, platinum surged to the year's high of $1,070, triggering a wave of ETF buying which added nearly 0.5 million oz to total holdings. Although this was followed by some liquidation, as the price slumped back towards $900, a new rally during the third quarter spurred another bout of purchasing. This lifted

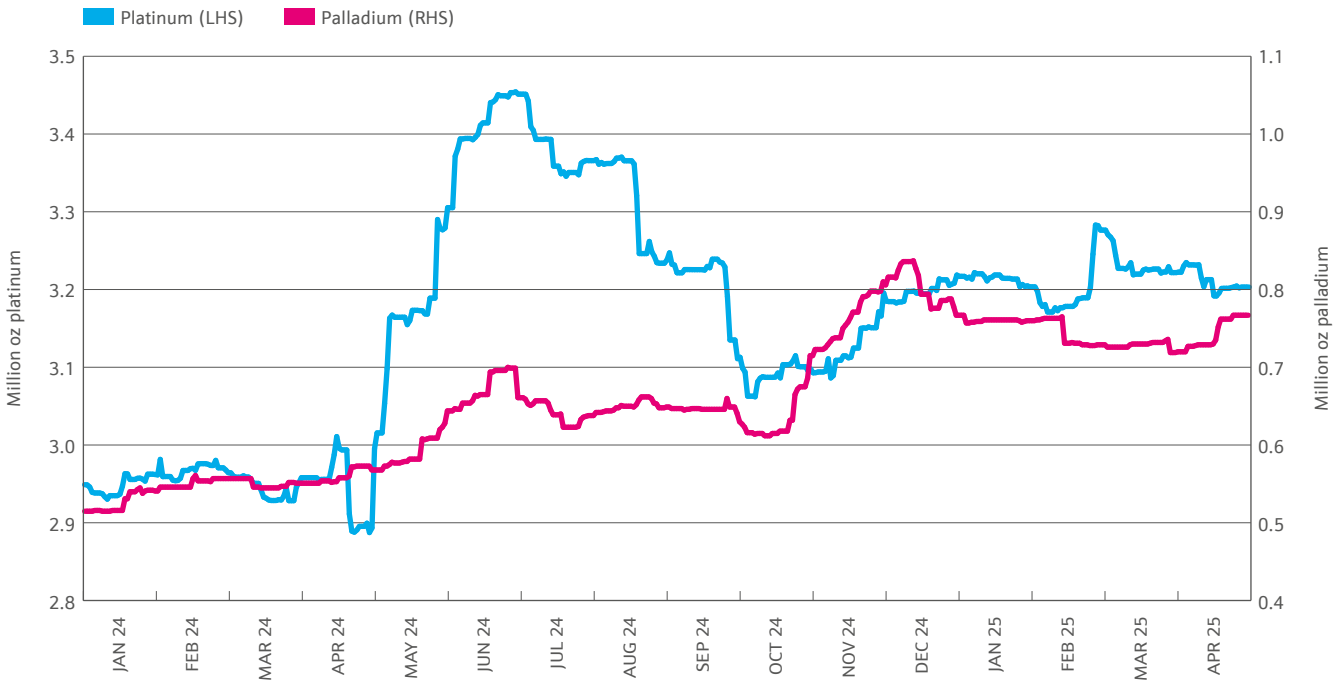

Figure 10 Platinum and palladium ETF holdings

total platinum ETF holdings to 3.2 million oz at the year-end, representing net annual purchasing of around 250,000 oz.

Palladium ETF holdings rose from just over 0.5 million oz to nearly 0.7 million oz during the first half of 2024, with renewed buying by 'value' investors as the price hovered around six-year lows. This was followed by another surge in investment during October and November, when market sentiment briefly improved following talks of further sanctions on Russian palladium, and the announcement of production cuts at the Stillwater palladium mine. Year-end palladium ETF holdings totalled just over 760,000 oz, up around 240,000 oz since the end of 2023.

"There is emerging interest in platinum among Chinese investors"

In Japan, retail investment demand for platinum bars was weak during 2024. In this market, investors are highly sensitive to short-term price volatility, especially when the price moves through key price points. Thus, a rise in the Japanese retail platinum price to a sixteen-year high of over ¥6,000 in May prompted significant liquidation. While there was a return to buying once the price pulled back, net investment was slightly negative for the full year.

Historically, Japan has been the only country to record significant over-the-counter sales of large bars to retail investors. However, over the past three years, interest in platinum has emerged among Chinese investors, and the fabrication and sale of large 500 gram and one kilo bars in China now makes a material contribution to our platinum investment demand number.

To date, investor behaviour in this region has been very different to that of Japanese buyers. Chinese investors have tended to buy into rising prices, so the strong price rally of April-May 2024 was particularly positive for investment demand. However, this is a very new market for platinum investment, so it is difficult to predict future investor behaviour.

There is also a market for small platinum investment products in China, including the China Mint's 'Panda' coins, and a range of collectible or commemorative platinum products produced by private companies in many different designs. There appears to have been some increase in consumer interest in these platinum collectibles, but they represent only a relatively small share of total investment demand.

PGM outlook

Supply and demand in 2025

Auto PGM demand will be hit by rising BEV share in China, and lacklustre car sales in other major markets

New tariffs on US car imports will intensify downward pressure on auto PGM consumption

Industrial demand remains strong, but faces downside risks from tariffs and weaker economic activity

Mine PGM supply will be constrained by rationalisation in response to weak prices

Outside China, there is little sign of any revival in auto PGM recycling

Scrap volumes could be further depressed by economic uncertainty and slower auto sales

"A liquidity shortage in the platinum ingot market provided some price support in early 2025"

The key near-term uncertainty for the PGM market is the impact of higher import tariffs on the global economy. Material downside risk exists for automotive production (and hence PGM demand), both for exporters of finished vehicles to the USA, and for US auto makers hit by increased duties on materials and components. In addition, demand from industrial consumers could be impacted by increased duties on some PGM fabricated products and chemicals. Trade conflict also has the potential to inflict wider economic damage, which could dent automotive and industrial PGM demand more broadly, both inside and outside the USA, and would also be a drag on consumer spending on luxury items such as jewellery.

However, moves by some large economies to increase defence spending could have positive implications for PGM demand, while an intensifying focus on domestic and regional security of mineral supply could prompt stock-building of critical minerals (including PGMs) by consumers, investors or even governments. This has the potential to soak up market liquidity and increase price volatility.

Our forecast incorporates an allowance for the deteriorating economic outlook, but we nevertheless show all five PGM recording balanced markets or deficits this year. However, the near-term risk on the demand side is clearly weighted to the downside. On the supply side, South African and North American mines remain under pressure from weak platinum and palladium prices, which could result in further shaft closures, while tariff-related falls in vehicle sales may further delay a recovery in automotive recycling.

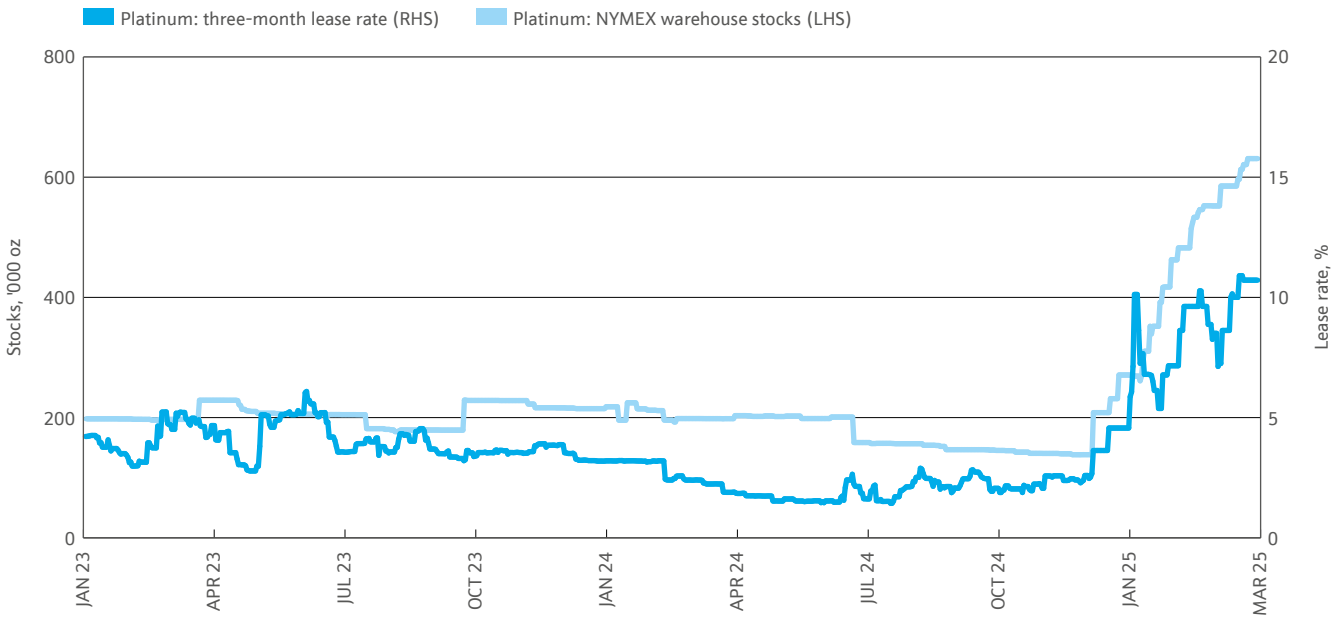

Figure 11 Platinum lease rates and NYMEX warehouse stocks

Supply '000 oz	2023	2024	2025
South Africa	4,003	4,112	3,900
Russia	850	650	670
Others	957	961	972
Total primary supply	**5,810**	**5,723**	**5,542**
Secondary supply*	1,348	1,372	1,385
Total combined supply	**7,158**	**7,095**	**6,927**
Demand '000 oz	**2023**	**2024**	**2025**
Automotive	3,353	3,410	3,227
Jewellery	1,372	1,375	1,391
Industrial	2,887	2,559	2,726
Investment	179	525	319
Total demand	**7,791**	**7,869**	**7,663**
Movements in stocks	-633	-774	-736

Table 1 Platinum supply and demand

Supply '000 oz	2023	2024	2025
South Africa	2,360	2,420	2,267
Russia	2,700	2,750	2,730
Others	1,537	1,484	1,375
Total primary supply	**6,597**	**6,654**	**6,372**
Secondary supply*	2,865	2,940	3,058
Total combined supply	**9,462**	**9,594**	**9,430**
Demand '000 oz	**2023**	**2024**	**2025**
Automotive	8,767	8,313	7,926
Jewellery	87	85	85
Industrial	1,455	1,468	1,473
Investment	61	229	-37
Total demand	**10,370**	**10,095**	**9,447**
Movements in stocks	-908	-501	-17

Table 2 Palladium supply and demand

*Secondary supply comprises open-loop recycling from the automotive, jewellery, electronics and pollution control industries

Prices

The **platinum** price rallied modestly through the first quarter of 2025, briefly touching highs of just over $1,000 in mid-February and mid-March, amid broader economic and geopolitical concerns. The gold price set a series of new all-time highs, breaching $3,200 in early April, as fears mounted that US trade policy could trigger a recession. While the platinum price no longer follows gold as closely as it did in the past, short-term price fluctuations are often influenced by gold price movements and gold's strength has probably been broadly supportive for platinum.

A liquidity shortage in the platinum ingot market also provided some price support during the first quarter. Fears that the US government could impose tariffs on precious metal imports led to a massive influx of platinum into NYMEX warehouses, draining liquidity from the European ingot market and provoking a spike in short-term lease rates to over 10%. However, higher lease rates primarily reflected mismatches in the location and form of metal availability, rather than any underlying lack of liquidity. Platinum sponge (the form of metal required by most industrial customers) remained readily available during early 2025.

The platinum price shed more than $50 over the first few days of April, falling back below $940, as the markets reacted to the announcement of new US import tariffs.

The **palladium** price closely tracked that of platinum during the first quarter, rising briefly above $1,000 in early February before retreating below $920 at the end of that month. The price regained the $990 level during March but dived to around $900 in early April following new tariff announcements. Although

"Tariff-related falls in car sales could impact PGM recycling as well as demand"

there has been some inflow of palladium to NYMEX warehouses, the impact has been much smaller than for platinum (due to much tighter regulatory controls on speculative palladium positions than on platinum). As a result, palladium borrowing rates have remained within historically normal ranges.

The **rhodium** price spiked above $6,000 in early March 2025, for the first time since mid-2023. This may reflect a temporary fluctuation in sales by South African producers: the first quarter is traditionally the weakest, as the post-Christmas restart of mining activities is often slow, and producers may schedule maintenance and stock-takes during this period. Although rhodium retreated during early April, it remained above the $5,000 level. It appears that much of the excess liquidity of the past two years has been absorbed; this could herald a return to more volatile trading conditions, after a period of price stability between late 2023 and early 2025.

Ruthenium moved decisively higher during the first quarter, setting a three-and-a-half year high of $630 in March, on strong consumer demand and talk of strategic buying in China. However, plentiful market liquidity intensified the downward pressure on **iridium**, which fell to a 28-month low of $4,250 in March.

Platinum market balance

In spite of gathering economic clouds, the balance of probability is nevertheless in favour of another year of deficit in the platinum market. South African supplies are expected to fall below 4 million oz, while there is little prospect of any material improvement in recycling outside China (where automotive recoveries are in any case skewed towards palladium and rhodium due to historic catalyst use patterns). On the demand side, platinum is less exposed to a downturn in the auto market than palladium or rhodium, and the near-term outlook for industrial demand remains relatively robust. Consumer demand for platinum jewellery in China is muted, but exceptionally high gold prices are motivating retailers to trim their gold jewellery stocks and increase platinum inventories.

Platinum investment will, as usual, be an important swing factor. Our forecast broadly reflects investment conditions during the first quarter and is neutral for the remainder of the year. The reignition of inflationary pressures (and any resulting tightening of monetary policy) would typically be negative for non-yielding assets such as platinum ETFs. However, platinum could benefit from some spillover of 'safe haven' investing from the gold market. Price movements will ultimately be a major factor determining investment demand. If geopolitical risks were to spur prices higher, this would probably be positive for investment in most regions. Conversely, should weaker demand weigh on prices, this might prompt some renewed large bar buying in Japan, but would probably be negative in other regions.

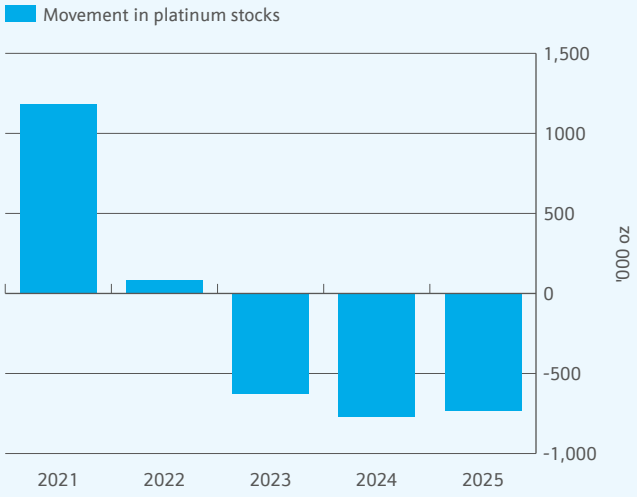

Figure 12 Platinum market balance

Palladium market balance

The palladium market is projected to be close to balance this year, but a move into material surplus cannot be ruled out, in view of higher tariffs imposed on US vehicle imports. We allow for palladium consumption on autocatalysts to decline by 5%, but our forecast was based on data available at the end of the first quarter and does not fully capture likely trade-war impacts.

Even without recent changes to US trade policy, palladium use in autocatalysts was set to decline this year. World light vehicle output is forecast to be flat at best, with gasoline cars continuing to lose share to BEVs, especially in China. Any disruption to auto production will accelerate the fall in palladium demand, especially if it primarily affects models destined for the US market, which on average have higher palladium loadings than vehicles sold elsewhere. (In this scenario, we would also expect automotive recoveries to fall, somewhat mitigating the impact on the market balance).

Industrial palladium demand should hold up better than the auto sector, but at only 15% of total consumption, any changes here will have a limited influence on the direction of market balance. However, investment demand could be an important swing factor. Much will depend on how ETF investors respond to price movements: weak prices could attract some additional purchasing by 'value' investors, but negative sentiment about the outlook for auto production could trigger a new bout of disinvestment.

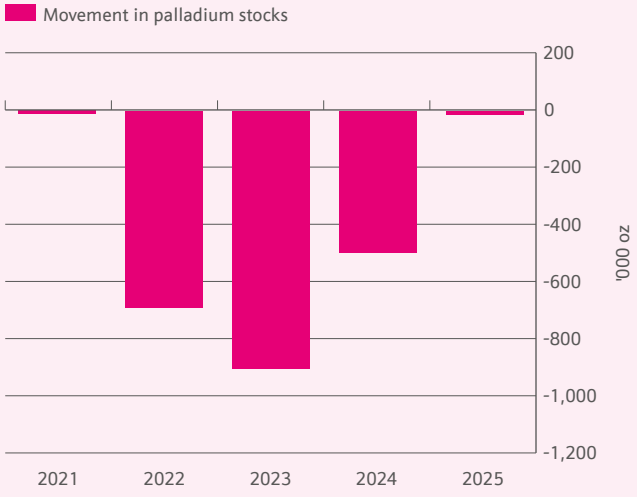

Figure 13 Palladium market balance

PGM supply

On the supply side, we forecast a mid-single-digit decline in South African PGM shipments in 2025. This reflects a lower contribution from the release of work-in-progress inventory, combined with a gradual ramp-down in production at some western Bushveld shafts that are approaching the end of their operating lives. There will also be a modest impact from heavy rains in February, which resulted in a temporary halt to mining operations at the Amandelbult mine, owned by Anglo American Platinum (due to be renamed Valterra Platinum in late May 2025, following a demerger from its parent company, Anglo American). Operations at some other shafts in the area were also affected.

There is a risk that deteriorating business conditions could prompt a new round of supply cuts. Supplies have already been affected by the decision by Impala Platinum and African Rainbow Minerals to cancel a planned Merensky Reef expansion at the Two Rivers joint venture, and to mothball the newly commissioned Merensky concentrator, which had been due to ramp up this year. In the first quarter of 2025, African Rainbow Minerals announced that it was reducing spending on expansion and cutting jobs at its Bokoni operation. This will not materially impact supplies this year, as Bokoni is a very small producer. However, it underlines the risk of further incremental cuts in PGM mining capacity, in the country which supplies around 70% of the world's primary platinum, and over 80% of its rhodium, ruthenium and iridium.

Elsewhere, we anticipate a fall in North American PGM supply, in line with rationalisation at Sibanye-Stillwater's Montana operations (where output is set to fall by around a third this year), and a ramp-down in production from Impala Canada's Lac des Iles mine as it approaches the end of its life.

PGM production at Norilsk Nickel in Russia is expected to be similar to last year. Our forecast assumes that Russian sales will equal refined output; however, Norilsk Nickel is thought to hold some palladium inventory, accumulated due to the imposition of market sanctions in 2022 following the Ukraine invasion. This metal could be sold if market conditions permit, but this may ultimately depend on demand in Russia's two key palladium markets, the USA and China.

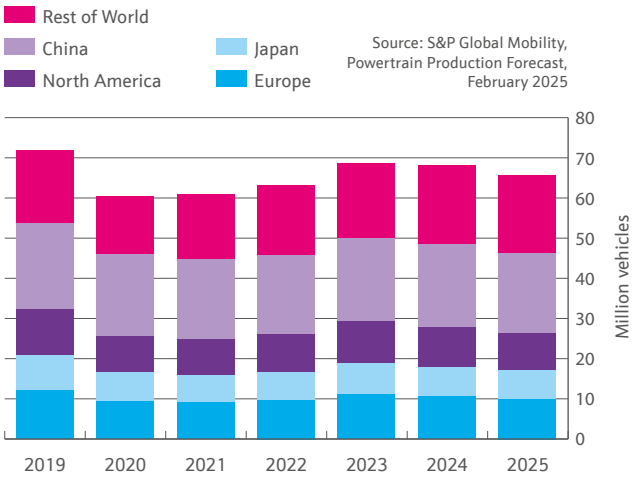

Figure 14 World light-duty gasoline car production

Supply '000 oz	2023	2024	2025
South Africa	555	586	561
Russia	75	57	60
Others	72	71	70
Total primary supply	**702**	**714**	**691**
Secondary supply*	289	293	303
Total combined supply	**991**	**1,007**	**994**

Demand '000 oz	2023	2024	2025
Automotive	977	931	888
Chemical	83	96	86
Glass	-22	-4	33
Electrical & Other	23	23	26
Total demand	**1,061**	**1,046**	**1,033**
Movements in stocks	-70	-39	-39

*Secondary supply comprises open-loop recycling from the automotive industry

Table 3 Rhodium supply and demand

Since Russian PGM no longer qualifies for 'good delivery' status, and cannot be delivered into market clearing locations, sales are heavily dependent on purchasing activity by PGM consumers in China and (for palladium) the USA. If current trade tensions cause a reduction in PGM consumption in key applications (particularly automotive), this could be negative for Russian sales. But trade tensions could also encourage defensive strategies, including the building of stocks by consumers, fabricators, investors, or other market participants.

"Deteriorating business conditions could prompt a new round of supply cuts in South Africa"

We expect only limited growth in the recovery of PGM from autocatalyst scrap this year, with gains almost exclusively in China. The Chinese government's trade-in incentive scheme, designed to encourage owners to replace older vehicles, has been extended for at least another year and widened to include vehicles registered before June 2012 meeting China 4 (or earlier) emission standards. This should boost the number of cars being scrapped, although low PGM prices continue to inhibit the flow of spent catalyst to refineries, with small-scale collectors still believed to be hoarding scrap converters in the hope of higher prices.

Outside China, there is little evidence of any improvement in the automotive scrap market; at best, volumes appear to be flat versus last year. This in turn implies that vehicle lifetimes continue to lengthen, and that significant numbers of very old vehicles, which would normally have

been scrapped by now, remain in use. At some point, these vehicles will be retired and will enter scrap collection networks, but the timing of any improvement in recycling volumes is very difficult to predict – especially in the current context of greatly increased economic uncertainty.

Indeed, the near-term risk is probably to the downside. Market participants report exceptionally difficult business conditions, and weak volumes and low prices may ultimately result in some rationalisation across the auto scrap industry. If auto sales are dented by US trade policies, we could see a further fall in the number of vehicles reaching scrapyards, which could in turn accelerate this consolidation.

PGM demand

Predicting PGM demand in 2025 is particularly challenging, in view of ongoing uncertainty over US import tariffs and potential retaliatory actions by trade partners. Our forecast is based on information available at the beginning of April 2025.

At the time of writing, in early April, the Trump administration had introduced new 25% tariffs on all steel and aluminium imports as well as on light vehicles (with some partial exemptions for vehicles with US content). An increased duty on imports of auto parts was due to be implemented in May 2025. In addition, tariffs exceeding 100% had been imposed on Chinese imports, although some technology products (including phones and computers) received a temporary reprieve.

Additional tariffs on imports of many other goods from most trade partners were announced on 2nd April but later delayed for 90 days, although a 10% duty was left in place. Imports of some key products such as pharmaceuticals, semiconductors, copper and certain critical minerals (including PGM in their pure form, and some PGM scrap) were excluded from this new round of duties. It is possible that some of these goods will be targeted by future tariffs, either by the USA itself, or as a result of trade partners' retaliatory measures.

"Weak volumes and low PGM prices could trigger rationalisation in the auto scrap sector"

US trade policy has serious implications for the broader global economy, but in the very near-term, the most obvious impact is to the auto sector. The outlook for automotive PGM demand is therefore subject to material downside risk.

Our PGM forecast is based on automotive industry projections issued in early March 2025, when the outlook for the global auto market was still broadly stable, with light vehicle output expected to be flat at around 88 million units this year. Light duty ICE vehicle share (including hybrids) is expected to contract again, with anticipated launches of new battery electric models helping to reinvigorate growth in the BEV segment. Heavy duty production is predicted to rise by 2%, but forecast

Rhodium market balance

The rhodium market is forecast to record another modest deficit this year, with a return to positive demand in the glass industry predicted to offset lower automotive consumption. Combined primary and secondary supplies are expected to fall slightly, due to lower shipments from South Africa. Although China should see an increase in auto recycling volumes, we do not expect any improvement in automotive recoveries elsewhere.

Rhodium is particularly exposed to US trade policy: light duty vehicles sold in this market have significantly higher rhodium loadings than those employed on cars sold in other regions. Imported cars are typically smaller than US-built vehicles, and therefore have somewhat lower rhodium loadings, but nevertheless we estimate they accounted for well over 100,000 oz of rhodium use last year. Even modestly lower production of vehicles for sale in the USA could push the market closer to balance.

There is also some downside risk to our forecast of glass demand. Our expectation of a return to buying is based on planned glass fibre capacity additions, and an assumption that sales of excess rhodium stock will be lower than in the last three years. However, weaker economic conditions could result in plants being idled and expansions being delayed.

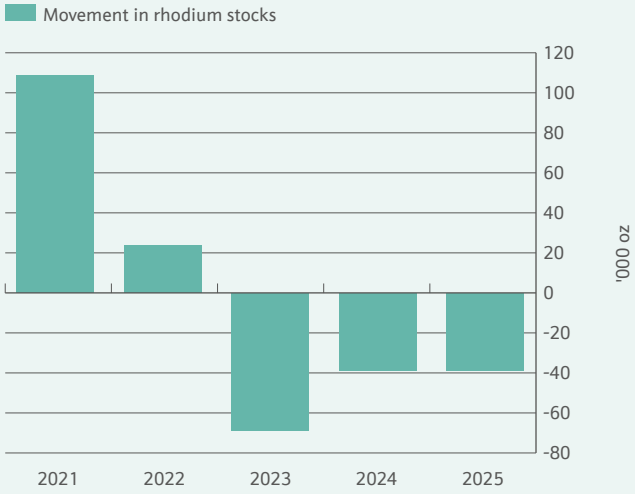

Figure 15 Rhodium market balance

Secondary rhodium supply is also highly exposed to the US auto market. In 2024, 43% of rhodium recovered from spent autocatalysts came from vehicles first sold in North America. If a fall in US car sales leads to owners keeping old vehicles on the road for longer, this could have a material impact on secondary supplies of rhodium.

Supply '000 oz	2023	2024	2025
Primary supply	**933**	**1,113**	**954**
Demand '000 oz	**2023**	**2024**	**2025**
Chemical	480	558	576
Electrical	293	349	362
Electrochemical	146	142	136
Other	145	148	150
Total demand	**1,064**	**1,197**	**1,224**
Movements in stocks	-131	-84	-270

Table 4 Ruthenium supply and demand

Supply '000 oz	2023	2024	2025
Primary supply	**219**	**223**	**242**
Demand '000 oz	**2023**	**2024**	**2025**
Chemical	33	39	33
Electrical	29	32	39
Electrochemical	104	107	106
Other	64	62	61
Total demand	**230**	**240**	**239**
Movements in stocks	-11	-17	3

Table 5 Iridium supply and demand

growth comes almost entirely from fully electrified vehicles; output of diesel trucks is projected to be little changed.

Based on this vehicle production outlook, we allow for automotive PGM demand to fall by 5%, or just over 600,000 oz, versus 2024. Shrinking light-duty ICE vehicle share in Europe and China accounts for most of this decline, but other major vehicle markets will also see lower consumption.

Chinese gasoline car output is expected to fall by over one million units this year (despite ongoing strong gains in the plug-in gasoline hybrid segment), with BEV production forecast to rise by over 20%. The impact on PGM demand will be compounded by a further slight decline in average PGM loadings on gasoline cars, driven primarily by an increase in domestic automaker share. As discussed on page 10, vehicles built by domestic Chinese car companies typically have lower PGM loadings than those produced by international joint ventures in China.

In Europe, production of ICE cars is expected to shrink by nearly 1.4 million units, as BEV output returns to growth after a weak 2024. PGM loadings in this region are forecast to be stable this year, as auto makers prepare for the implementation of Euro 7 limits (which will apply to new models from November 2026).

North America is forecast to see light duty gasoline output contract by around 6%, but this will be partly offset by a modest increase in PGM content per vehicle, as the phase-in of Federal Tier 3 emissions legislation concludes this year.

We reiterate that these projections are based on a 'business-as-usual' outlook for vehicle production, which we expect to be downgraded progressively as auto industry forecasters capture the impact of higher tariffs on US imports. This will primarily affect vehicle production (and hence PGM demand) in Europe, Japan and the Rest of World region (the latter includes Korea and Mexico, both major exporters of cars to the USA). However, it is likely that domestic US car output will be hit too.

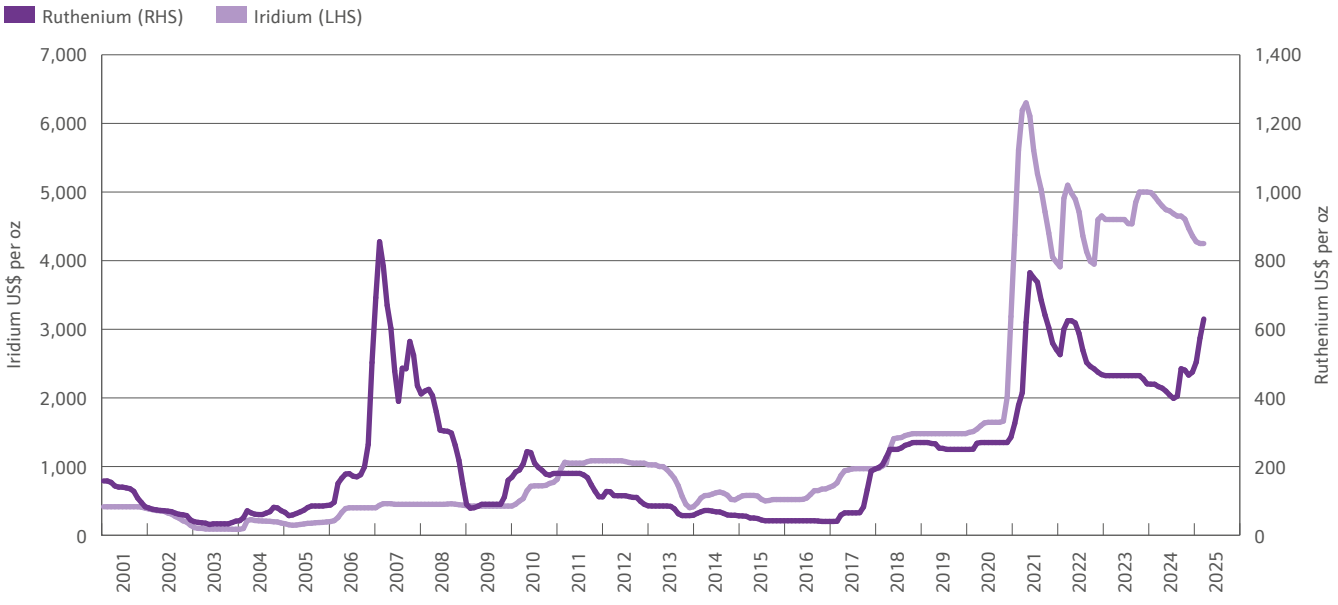

Figure 16 Monthly average ruthenium and iridium prices

Ruthenium and iridium market balance

The iridium market should remain close to balance in 2025, but ruthenium is likely to move into deeper deficit.

Demand for both metals is projected to be flat to slightly up this year, with robust demand for ruthenium from the Chinese caprolactam industry, and strong purchasing of both metals by the electronics sector. There is some downside risk to our projections. Compared to the three autocatalyst PGM, these metals have very limited exposure to the auto industry, but consumption of ruthenium and iridium in electronics applications, in particular, could be vulnerable to tariff impacts.

World iridium output has been broadly in line with demand in recent years, but mine production of ruthenium has fallen short of industrial consumption for most of the past decade. To date, producer stock sales have helped to keep the ruthenium market adequately supplied. Unless there is a further drawdown of producer inventory, we expect the ruthenium market to record a significant deficit this year.

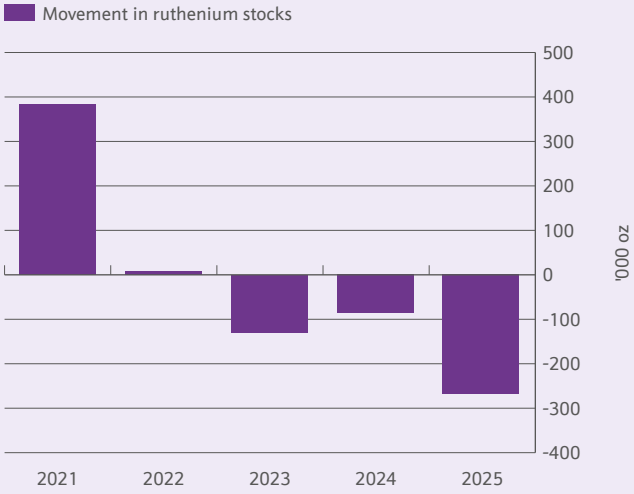

Figure 17 Ruthenium market balance

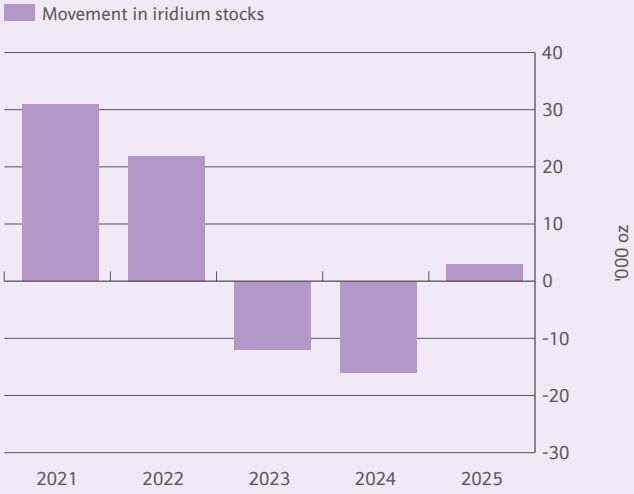

Figure 18 Iridium market balance

At the time of writing, the size of the impact on PGM demand is not yet clear. Around 8 million imported light vehicles were sold in the USA in 2024, estimated to contain over 1.3 million oz of PGM. Clearly some proportion of this demand is vulnerable. In addition, the knock-on effect of US trade policy on the global economy could harm vehicle sales not just in the USA but in other countries.

Initial estimates by industry forecasters suggest that, globally, around 1.3 million units of light vehicle production could be forgone this year (assuming no softening of US policy). The PGM impact will depend upon the regional location, powertrain and model mix of the lost output, but we estimate that some 200-250,000 oz of PGM demand (or around 2% of total auto consumption) could be at risk in 2025. In this scenario, we would also expect to see a hit to auto recycling, particularly in the USA, which accounts for over 40% of global PGM recoveries from spent autocatalyst. The size of the impact is hard to predict, but for indicative purposes, if scrap volumes outside China fell by 2-3%, this would remove around 100,000 oz of PGM supply.

"The launch of new electric vehicle models is forecast to reinvigorate BEV growth"

There are some other uncertainties which could influence PGM consumption on vehicles this year, and which could partly offset any tariff-related downgrade in demand. At the time of writing, industry forecasts continued to envisage a sharp rise in battery electric share in 2025, but this is by no means certain. In Europe, cuts to permitted fleet-average CO_2 emissions were due to be implemented this year, but automakers will now be allowed to average their CO_2 emissions over the 2025 – 2027 period, giving them longer to achieve compliance (and hence some additional leeway over the timing of the launch and ramp-up of new BEV models). In the USA, the political environment is increasingly unfavourable for electric vehicles, particularly imported models. We therefore expect further downgrades to the near-term BEV outlook this year, with some resulting upside for gasoline vehicle share.

There is also some uncertainty over PGM loadings in China. Proposed revisions to China 6 legislation, published in early 2025, are set to tighten the rules on type-approval and in-use emissions compliance (see page 22 for further details). These changes are expected to make in-use compliance more onerous, and could be positive for PGM loadings, especially on heavy vehicles and on plug-in hybrids.

Total industrial PGM consumption is forecast to rise by 4% this year, based on information on capacity additions and general market trends available at the end of the first quarter. Our

estimates do not yet allow for the potential demand impacts of tariffs on US imports of some PGM fabricated products and PGM chemicals, nor for the wider economic effects of trade conflict. In particular, US users of PGM-containing products subject to tariffs could postpone or cut their purchases, with supply chain disruption and higher costs potentially resulting in delays or cancellations to industrial projects. However, a prolonged trade standoff would affect demand in all regions.

Based on known expansion plans at the time of writing, PGM use in the **glass** industry is forecast to rebound this year, with rhodium demand in positive territory for the first time in five years. In response to high prices during 2020 – 2023, the Chinese fibreglass industry aggressively thrifted the rhodium content (and increased the platinum content) of alloys used in production equipment. Some of this excess metal was sold back to the market between 2021 and 2024. This year, fibreglass capacity expansions and reduced rhodium stock sales should lift rhodium demand in glassmaking back into positive territory. Meanwhile, we expect an improvement in platinum demand from display glass manufacturers (who sold platinum last year, following earlier plant closures). Fibreglass and display glass production is heavily concentrated in China, but a significant proportion of output is destined for export to the USA, so we could ultimately see some capacity being idled or permanently closed.

Based on current trends, demand for PGM from the **chemicals** industry is expected to be broadly stable this year, with continued investment in capacity by the Chinese industry, where demand remains close to all-time highs. We also allow for higher purchasing by the **petroleum and liquid fuels** industry, in line with investment in biofuels and synthetic fuels capacity. However, lower exports to the USA and weaker global economic activity could result in some projects being delayed.

In the **electronics** industry, demand has been recovering strongly from 2023's low point. We expect some growth in the use of palladium to plate connectors and other electronic parts, along with robust consumption of platinum and ruthenium in hard disks for near-line data storage. Significant new data centre capacity is planned or under construction both in North America and in other regions, to meet rising demand for artificial intelligence services. US data centres could face cost increases due to higher import tariffs, since hard disk drives are mainly manufactured in Asia. It is possible that some planned investment will be postponed.

Trade considerations aside, there may be some potential PGM demand upside arising from recent developments in US foreign policy. In particular, higher defence spending by Europe and other Western allies, combined with the reshoring of some weapons manufacturing capacity, could have positive implications for demand in certain PGM applications and in certain regions. PGM are contained in components used in aircraft and other defence hardware and are also used in defence-related manufacturing processes. Some examples are shown in the table below.

PGM applications in defence and aerospace

Avionics and other electronics	Palladium for military-spec capacitors and other components Rhodium and iridium for reed switches Ruthenium for chip resistors
High-performance alloys	Palladium for high-performance brazing alloys Platinum/iridium for fuel nozzles, ducts, gaskets/seals, missile nose cones Ruthenium-doped tungsten carbides for cutting tool inserts
Lasers and optical systems	Iridium crucibles for yttrium aluminium garnet (YAG) crystal growing Iridium complexes for organic light-emitting diodes (OLEDs) Platinum-rhodium alloys for production of technical glass
Aircraft engines	Platinum protective plating and pinning wire for jet engine blades Platinum/rhodium for temperature sensing Iridium for engine ignitors
Operational energy	Platinum/palladium catalysts for petroleum refining to fuels and lubricants Platinum in fuel cells for non-nuclear air-independent submarines Platinum in fuel cells for silent, long-duration field power and drones

Plus: nuclear applications, naval cathodic protection, ejector seat mechanisms, data storage, gas detection and others

Emissions legislation update

US federal (EPA)

The phase-in of US Federal Tier 3 emissions regulations will be complete this year. In March 2024, the Environmental Protection Agency (EPA) finalised new Tier 4 standards for light and medium duty vehicles, requiring further progressive reductions in emissions of toxic pollutants, over a five-year phase-in period starting with model-year 2027 vehicles. The new regulation also mandates cuts in greenhouse gas (GHG) emissions. A new 'Phase 3' GHG emission standard for heavy-duty vehicles was adopted in the same month. Both regulations would drive increases in the market share of electric vehicles (including zero emission vehicles - BEVs and FCEVs - and plug-in hybrids) in order for fleets to comply.

However, under the Trump administration, the EPA has announced plans to reconsider the GHG component of both these regulations. It is also commencing a formal reconsideration of the '2009 Endangerment Finding', which states that GHG emissions create a threat to public health and may therefore be regulated. If GHG regulations are rolled back, this will reduce growth prospects for ZEVs and plug-in hybrids in the US market. This would result in ICE and conventional hybrid vehicles retaining a higher market share for longer.

The EPA is also reevaluating tighter standards for toxic pollutant emissions from heavy-duty vehicles, adopted in 2022 as part of the 'Clean Trucks Plan' and due to be enforced from model-year 2027. It is possible that light-duty Tier 4 emissions limits will also be reviewed.

California (CARB)

Under the Clean Air Act, the California Air Resources Board has the right to set vehicle emissions standards that are stricter than Federal legislation, subject to an EPA waiver.

In December 2024, the EPA granted a waiver for the Advanced Clean Cars II (ACC II) regulation for light-duty vehicles. ACC II includes revisions to toxic pollutant limits and also specifies future ZEV share requirements: 35% of new vehicle sales in 2025, rising to 100% in 2035. Some plug-in hybrids with an all-electric range of at least 70 miles can be used to meet up to 20% of the annual ZEV mandate.

CARB has also received waivers for two regulations relating to heavy vehicles: the Advanced Clean Trucks (ACT) regulation, and the 'Omnibus' low-NOx regulation. These require, respectively, an increase in heavy-duty ZEV penetration to 40-75% by 2035 (depending on vehicle class), and a reduction in toxic pollutant emissions from heavy trucks starting in the 2024 model year.

In late 2023, CARB applied for a waiver for its Advanced Clean Fleet (ACF) plan, designed to accelerate the adoption of ZEVs in heavy-duty fleets suited to electrification. However, the waiver application was withdrawn in January 2025.

In February 2025, EPA announced that it would submit reports to Congress on Biden-era CARB waivers, seeking to overturn waivers granted for the ACT, ACC II and Omnibus regulations. Overturning the waivers is likely to be politically and legally complex, but if it were to happen, this could impact legislation not only in California, but in sixteen other states, and Washington DC, which have partly or fully adopted CARB standards.

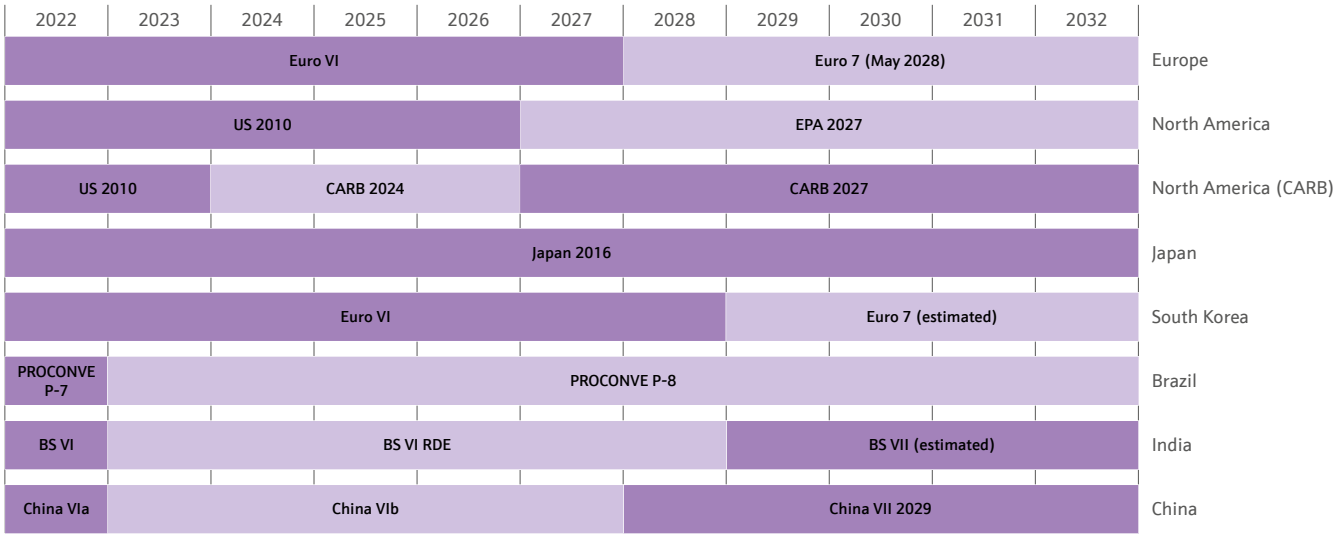

Figure 19 Emissions legislation for heavy duty vehicles

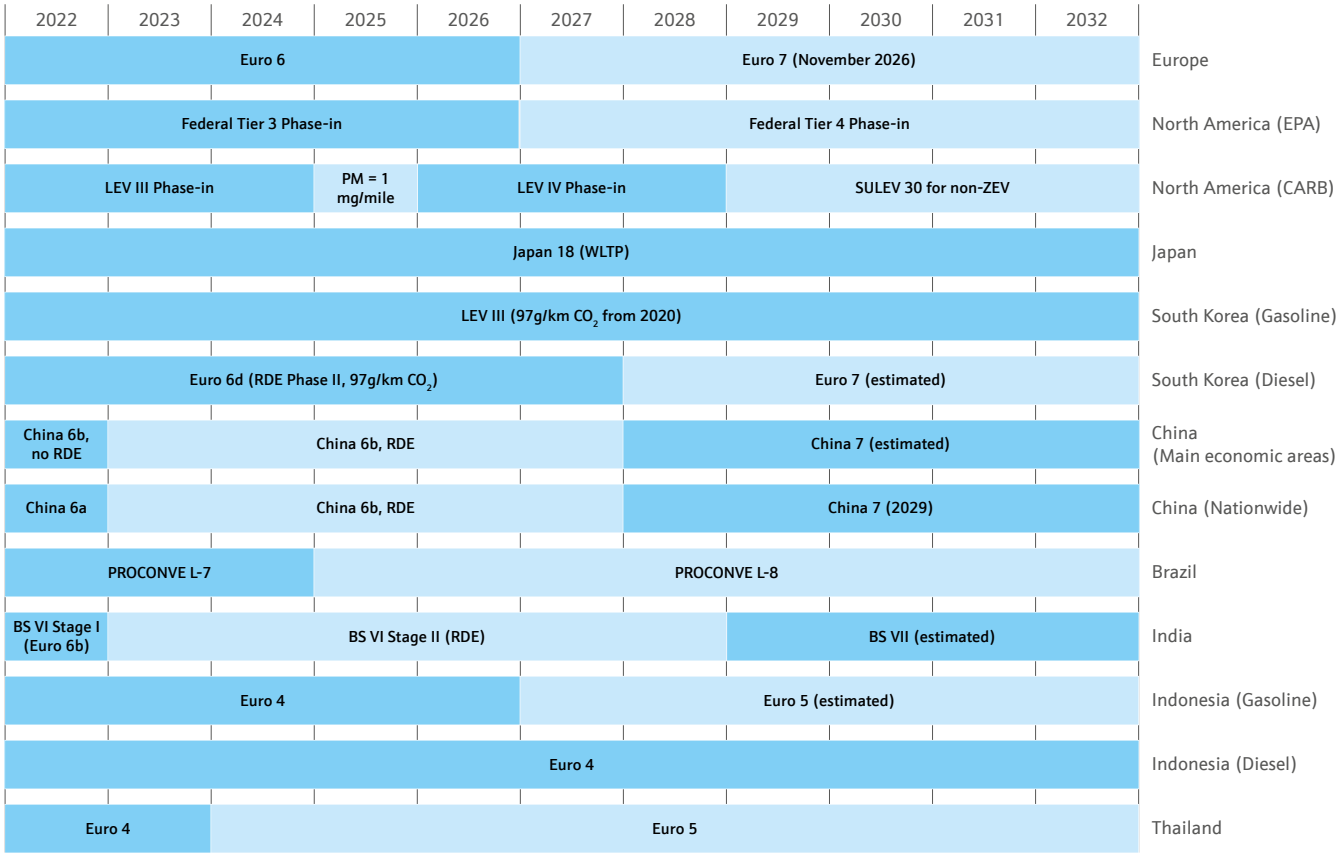

Figure 20 Emissions legislation for light duty vehicles

European Union

Euro 7 legislation entered into force in May 2024. For light-duty vehicles, Euro 7 standards will be implemented starting in November 2026 for new models (and one year later for all new vehicles); the new heavy-duty limits will apply to new truck models from May 2028 (and to all new HD registrations from May 2029). Further information on this legislation, and its implications for PGM demand, can be found in the feature on page 21 of our May 2024 PGM market report.

Current European regulations require CO_2 emissions from cars and vans to be reduced by 15% in 2025, relative to a 2021 baseline. However, in recognition of the challenges faced by car makers (especially in view of weak BEV sales in 2024), and to avoid companies incurring significant penalties, the European Commission has released a proposal for a 'targeted amendment' to the standards. Under this amendment, compliance will be assessed over the 2025 – 2027 period, with car companies allowed to offset excess CO_2 emissions in any one year by exceeding the CO_2 reduction target in other years.

China

A proposed amendment to China 6 regulations was published in early 2025, intended to tighten the rules around type approval and in-use compliance testing. The amendment provides for improved traceability in type-approval testing; greater information disclosure by car manufacturers, including monthly reporting of any emissions equipment failures; a revision to RDE test conditions, along with new requirements for PEMS (portable emissions measurement) instrument calibration; and stricter requirements for the type-approval of hybrid vehicles including PHEVs and REEVs.

Proposals for the next stage of Chinese emissions legislation, China 7, are expected to be to be published later this year. Nationwide implementation is now anticipated from 2029, although some major urban areas may introduce the new standards a year early.

Platinum supply and demand

Troy ounces

Primary supply '000 oz	2020	2021	2022	2023	2024	2025
South Africa	3,243	4,609	3,966	4,003	4,112	3,900
Russia	699	638	350	850	650	670
North America	334	279	280	288	267	257
Zimbabwe	482	465	488	515	507	529
Others	205	222	157	154	187	186
Total primary supply	**4,963**	**6,213**	**5,241**	**5,810**	**5,723**	**5,542**

Secondary supply '000 oz[1]	2020	2021	2022	2023	2024	2025
Automotive	1,154	1,230	1,201	1,074	1,084	1,088
Electrical & other	41	49	48	48	56	64
Jewellery	506	366	273	226	232	233
Total secondary supply	**1,701**	**1,645**	**1,522**	**1,348**	**1,372**	**1,385**

Combined primary and secondary supply	**6,664**	**7,858**	**6,763**	**7,158**	**7,095**	**6,927**

Demand '000 oz[2]	2020	2021	2022	2023	2024	2025
Automotive	2,024	2,410	2,743	3,353	3,410	3,227
Chemical	614	675	701	649	631	629
Dental & biomedical	214	220	249	266	273	277
Electrical & electronics	226	262	241	206	245	271
Glass	518	786	875	782	446	506
Investment	1,049	-1	-475	179	525	319
Jewellery	1,657	1,468	1,401	1,372	1,375	1,391
Petroleum	286	222	241	160	144	212
Pollution control	165	187	221	274	269	276
Other	417	444	483	550	551	555
Total demand	**7,170**	**6,673**	**6,680**	**7,791**	**7,869**	**7,663**
Movement in stocks	-506	1,185	83	-633	-774	-736

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive, pollution control, jewellery and electronics sectors.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Platinum supply and demand

Tonnes

Primary supply tonnes	2020	2021	2022	2023	2024	2025
South Africa	100.9	143.4	123.4	124.5	127.9	121.3
Russia	21.7	19.8	10.9	26.4	20.2	20.8
North America	10.4	8.7	8.7	9.0	8.3	8.0
Zimbabwe	15.0	14.5	15.2	16.0	15.8	16.5
Others	6.4	6.9	4.9	4.8	5.8	5.8
Total primary supply	**154.4**	**193.3**	**163.1**	**180.7**	**178.0**	**172.4**

Secondary supply tonnes[1]	2020	2021	2022	2023	2024	2025
Automotive	35.9	38.3	37.4	33.4	33.7	33.8
Electrical & other	1.3	1.5	1.5	1.5	1.7	2.0
Jewellery	15.7	11.4	8.5	7.0	7.2	7.2
Total secondary supply	**52.9**	**51.2**	**47.4**	**41.9**	**42.6**	**43.0**

Combined primary and secondary supply	**207.3**	**244.5**	**210.5**	**222.6**	**220.6**	**215.4**

Demand tonnes[2]	2020	2021	2022	2023	2024	2025
Automotive	63.0	74.9	85.4	104.3	106.0	100.4
Chemical	19.1	21.0	21.7	20.2	19.6	19.5
Dental & biomedical	6.7	6.9	7.8	8.3	8.5	8.6
Electrical & electronics	6.9	8.1	7.5	6.5	7.6	8.5
Glass	16.1	24.5	27.2	24.3	13.9	15.8
Investment	32.6	0.0	-14.7	5.5	16.4	9.8
Jewellery	51.5	45.7	43.6	42.6	42.8	43.3
Petroleum	8.9	6.9	7.5	4.9	4.5	6.6
Pollution control	5.2	5.8	6.8	8.6	8.3	8.6
Other	13.0	13.8	15.0	17.1	17.2	17.3
Total demand	**223.0**	**207.6**	**207.8**	**242.3**	**244.8**	**238.4**
Movement in stocks	-15.7	36.9	2.7	-19.7	-24.2	-23.0

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive, pollution control, jewellery and electronics sectors.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Palladium supply and demand

Troy ounces

Primary supply '000 oz	2020	2021	2022	2023	2024	2025
South Africa	1,975	2,645	2,288	2,360	2,420	2,267
Russia	2,636	2,689	2,200	2,700	2,750	2,730
North America	990	908	832	863	814	685
Zimbabwe	410	392	409	427	419	435
Others	185	212	235	247	251	255
Total primary supply	**6,196**	**6,846**	**5,964**	**6,597**	**6,654**	**6,372**

Secondary supply '000 oz[1]	2020	2021	2022	2023	2024	2025
Automotive	2,689	2,886	2,790	2,389	2,449	2,565
Electrical & other	430	444	457	466	481	483
Jewellery	9	9	10	10	10	10
Total secondary supply	**3,128**	**3,339**	**3,257**	**2,865**	**2,940**	**3,058**

Combined primary and secondary supply	**9,324**	**10,185**	**9,221**	**9,462**	**9,594**	**9,430**

Demand '000 oz[2]	2020	2021	2022	2023	2024	2025
Automotive	8,534	8,452	8,413	8,767	8,313	7,926
Chemical	498	593	602	539	546	534
Dental & biomedical	228	208	189	192	177	169
Electrical & electronics	636	649	547	516	535	542
Investment	-190	17	-109	61	229	-37
Jewellery	85	88	87	87	85	85
Pollution control	75	92	102	123	124	130
Other	93	96	82	85	86	98
Total demand	**9,959**	**10,195**	**9,913**	**10,370**	**10,095**	**9,447**
Movement in stocks	-635	-10	-692	-908	-501	-17

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive, pollution control, jewellery and electronics sectors.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Palladium supply and demand

Tonnes

Primary supply tonnes	2020	2021	2022	2023	2024	2025
South Africa	61.4	82.3	71.2	73.4	75.3	70.5
Russia	82.0	83.6	68.4	84.0	85.5	84.9
North America	30.8	28.2	25.9	26.8	25.3	21.3
Zimbabwe	12.8	12.2	12.7	13.3	13.0	13.5
Others	5.7	6.6	7.3	7.7	7.8	7.9
Total primary supply	**192.7**	**212.9**	**185.5**	**205.2**	**206.9**	**198.1**

Secondary supply tonnes[1]	2020	2021	2022	2023	2024	2025
Automotive	83.6	89.8	86.8	74.3	76.2	79.8
Electrical & other	13.4	13.8	14.2	14.5	15.0	15.0
Jewellery	0.3	0.3	0.3	0.3	0.3	0.3
Total secondary supply	**97.3**	**103.9**	**101.3**	**89.1**	**91.5**	**95.1**

Combined primary and secondary supply	**290.0**	**316.8**	**286.8**	**294.3**	**298.4**	**293.2**

Demand tonnes[2]	2020	2021	2022	2023	2024	2025
Automotive	265.4	262.9	261.7	272.7	258.6	246.5
Chemical	15.6	18.5	18.8	16.8	17.0	16.6
Dental & biomedical	7.1	6.5	5.9	6.0	5.5	5.3
Electrical & electronics	19.7	20.2	17.1	16.0	16.6	16.9
Investment	-5.9	0.6	-3.4	1.9	7.1	-1.1
Jewellery	2.7	2.7	2.6	2.7	2.6	2.6
Pollution control	2.3	2.7	3.1	3.8	3.9	4.0
Other	2.8	3.0	2.5	2.6	2.7	3.0
Total demand	**309.7**	**317.1**	**308.3**	**322.5**	**314.0**	**293.8**
Movement in stocks	-19.7	-0.3	-21.5	-28.2	-15.6	-0.6

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive, pollution control, jewellery and electronics sectors.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Rhodium supply and demand

Troy ounces

Primary supply '000 oz	2020	2021	2022	2023	2024	2025
South Africa	483	645	570	555	586	561
Russia	58	53	54	75	57	60
North America	22	17	20	19	19	19
Zimbabwe	43	42	43	46	45	44
Others	6	6	6	7	7	7
Total primary supply	**612**	**763**	**693**	**702**	**714**	**691**

Secondary supply '000 oz[1]	2020	2021	2022	2023	2024	2025
Automotive	338	361	339	289	293	303
Total secondary supply	**338**	**361**	**339**	**289**	**293**	**303**

Combined primary and secondary supply	**950**	**1,124**	**1,032**	**991**	**1,007**	**994**

Demand '000 oz[2]	2020	2021	2022	2023	2024	2025
Automotive	960	955	942	977	931	888
Chemical	56	58	66	83	96	86
Electrical & electronics	7	8	7	7	8	9
Glass	5	-16	-20	-22	-4	33
Other	4	10	13	16	15	17
Total demand	**1,032**	**1,015**	**1,008**	**1,061**	**1,046**	**1,033**
Movement in stocks	-82	109	24	-70	-39	-39

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive sector.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Rhodium supply and demand

Tonnes

Primary supply tonnes	2020	2021	2022	2023	2024	2025
South Africa	15.0	20.1	17.7	17.3	18.2	17.4
Russia	1.8	1.6	1.7	2.3	1.8	1.9
North America	0.7	0.5	0.6	0.6	0.6	0.6
Zimbabwe	1.3	1.3	1.3	1.4	1.4	1.4
Others	0.2	0.2	0.2	0.2	0.2	0.2
Total primary supply	**19.0**	**23.7**	**21.5**	**21.8**	**22.2**	**21.5**

Secondary supply tonnes[1]	2020	2021	2022	2023	2024	2025
Automotive	10.5	11.2	10.5	9.0	9.1	9.4
Total secondary supply	**10.5**	**11.2**	**10.5**	**9.0**	**9.1**	**9.4**

Combined primary and secondary supply	**29.5**	**34.9**	**32.0**	**30.8**	**31.3**	**30.9**

Demand tonnes[2]	2020	2021	2022	2023	2024	2025
Automotive	29.9	29.7	29.3	30.4	28.9	27.6
Chemical	1.7	1.8	2.0	2.6	3.0	2.7
Electrical & electronics	0.2	0.2	0.2	0.2	0.2	0.3
Glass	0.2	-0.5	-0.6	-0.7	-0.1	1.0
Other	0.1	0.3	0.4	0.5	0.5	0.5
Total demand	**32.1**	**31.5**	**31.3**	**33.0**	**32.5**	**32.1**
Movement in stocks	-2.6	3.4	0.7	-2.2	-1.2	-1.2

[1]**Secondary supply** comprises 'open-loop' recycling from the automotive sector.

[2]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Ruthenium supply and demand

Troy ounces

Primary supply '000 oz	2020	2021	2022	2023	2024	2025
Total primary supply	**930**	**1,417**	**971**	**933**	**1,113**	**954**

Demand '000 oz[1]	2020	2021	2022	2023	2024	2025
Chemical	356	350	326	480	558	576
Electrical & electronics	419	441	371	293	349	362
Electrochemical	138	129	131	146	142	136
Other	103	114	134	145	148	150
Total demand	**1,016**	**1,034**	**962**	**1,064**	**1,197**	**1,224**
Movement in stocks	-86	383	9	-131	-84	-270

Tonnes

Primary supply tonnes	2020	2021	2022	2023	2024	2025
Total primary supply	**28.9**	**44.1**	**30.2**	**29.0**	**34.6**	**29.7**

Demand tonnes[1]	2020	2021	2022	2023	2024	2025
Chemical	11.1	10.9	10.2	14.9	17.4	17.9
Electrical & electronics	13.0	13.7	11.5	9.1	10.9	11.2
Electrochemical	4.3	4.0	4.1	4.6	4.4	4.2
Other	3.2	3.5	4.2	4.5	4.6	4.7
Total demand	**31.6**	**32.1**	**30.0**	**33.1**	**37.3**	**38.0**
Movement in stocks	-2.7	12.0	0.2	-4.1	-2.7	-8.3

[1]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Iridium supply and demand

Troy ounces

Primary supply '000 oz	2020	2021	2022	2023	2024	2025
Total primary supply	**198**	**259**	**222**	**219**	**223**	**242**

Demand '000 oz[1]	2020	2021	2022	2023	2024	2025
Chemical	24	30	25	33	39	33
Electrical & electronics	59	52	28	29	32	39
Electrochemical	83	83	90	104	107	106
Other	64	64	57	64	62	61
Total demand	**230**	**229**	**200**	**230**	**240**	**239**
Movement in stocks	-32	30	22	-11	-17	3

Tonnes

Primary supply tonnes	2020	2021	2022	2023	2024	2025
Total primary supply	**6.2**	**8.1**	**6.9**	**6.8**	**6.9**	**7.5**

Demand tonnes[1]	2020	2021	2022	2023	2024	2025
Chemical	0.7	0.9	0.8	0.9	1.2	1.0
Electrical & electronics	1.8	1.6	0.9	0.9	1.0	1.2
Electrochemical	2.6	2.6	2.8	3.2	3.3	3.3
Other	2.0	2.0	1.8	2.0	1.9	1.9
Total demand	**7.1**	**7.1**	**6.3**	**7.0**	**7.4**	**7.4**
Movement in stocks	-0.9	1.0	0.6	-0.2	-0.5	0.1

[1]**Industrial demand** is net of 'closed-loop' recycling and sales of surplus metal back to the market, for example due to plant closures. It represents new metal requirements by industrial consumers in each year.

Glossary

ACC II	Advanced Clean Cars II, a CARB regulation
ACF	Advanced Clean Fleets, a proposed CARB regulation
ACT	Advanced Clean Trucks, a CARB regulation
BEV	Battery electric vehicle
CARB	California Air Resources Board
CF	Conformity factor
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
DOC	Diesel oxidation catalyst
DPF	Diesel particulate filter
EC	European Commission
ELV	End-of-life vehicle
EP	European Parliament
EPA	Environmental Protection Agency
ETF	Exchange traded fund
EUCO	European Council
FCEV	Fuel cell electric vehicle
GPF	Gasoline particulate filter
GVW	Gross vehicle weight
HD	Heavy duty
HDD	Heavy duty diesel
ICE	Internal combustion engine
LD	Light duty
LDD	Light duty diesel
LDG	Light duty gasoline
LEV	Low emission vehicle
LPPM	London Platinum and Palladium Market
LV	Light vehicle
NEV	New energy vehicle (BEV, PHEV or FCEV)
NO_x	Oxides of nitrogen
NYMEX	New York Mercantile Exchange
OLED	Organic light emitting diode
PEM	Proton exchange membrane
PEMS	Portable emissions measurement system
PGM	Platinum group metals
PHEV	Plug-in hybrid electric vehicle
PM	Particulate matter or soot
PN	Particle number
REEV	Range-extended electric vehicle
RDE	Real driving emissions
RoW	Rest of World region
SCR	Selective catalytic reduction
SGE	Shanghai Gold Exchange
SULEV	Super ultra-low emissions vehicle, a US classification for passenger vehicle emissions
YAG	Yttrium aluminium garnet
ZEV	Zero emission vehicle
4E grade	Combined content of four elements: platinum, palladium, rhodium and gold
6E grade	Combined content of six elements: platinum, palladium, rhodium, gold, ruthenium and iridium