THE PLATINUM STANDARD

May 2025

SFA Oxford

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The TPS Collection

The Platinum Standard was first launched in May 2014

One-half review, one-half preview, The Platinum Standard *comprises analytical commentary on those issues we believe will set the PGM agenda for the year ahead*

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FOREWORD

Foreword

Transforming risk into opportunities for PGMs

This year *The Platinum Standard* looks at the future of the PGM industry in a year in which it is having to navigate unusually volatile economic conditions.

In the first article, Beresford Clarke assesses the prospects for PGMs in the auto industry. In the near term, US tariffs mean that economic & automotive growth forecasts have been revised down with implications for automotive PGM demand this year. Although, with the delays and revisions to the tariffs and trade deals still to be done, the exact impact is still uncertain.

Tightening emissions standards for combustion engine vehicles have made the automotive industry the largest source of PGM demand. BEVs represent a transition that threatens that end-use. However, standing back and taking a longer-term view of automotive demand, the combustion engine is far from finished. The largest region for automotive PGM demand has shifted from Europe in the 2010s to China, and now to the Emerging Markets, countries with fewer opportunities for BEVs and potential for tighter emissions standards. Despite being a leader in BEV production, China itself still manufactures more than 20 million combustion engine cars.

Aggressive thrifting has reduced PGM loadings in China since the introduction of China 6 emissions legislation, but China 7 could mean significant upside. Underpinning automotive PGM demand is the US, where the growth in market share of BEVs has stalled and government support is likely to be removed, meaning the combustion engine is going to remain dominant in the second-largest country for auto sales.

Geopolitical risk has jumped up the priority list for the PGM industry with the renewed US trade war. In "**Beyond the geopolitical crisis: towards anti-fragile PGM producers in the phase transition**", Claude de Baissac of Eunomix looks at the implications for companies' risk management as the nature of globalisation is changing in a transition from integration and cooperation to fragmentation and confrontation. Risks arise not just from events but from new trends as structural changes can have profound effects. Businesses need to look beyond crisis management and focus on anticipating what is coming. Most geopolitical events are not completely unforeseeable but a traditional risk analysis approach can underestimate the magnitude of potential impacts during a phase transition.

The PGM industry has a narrow supply base and complex global value chains, making it highly exposed to structural shifts. Three structural changes are highlighted with suggestions for turning risk to advantage and creating resilience in a fragmented world.

TAILPIPES AND TARIFFS: RESHAPING PGM DEMAND

Tailpipes and tariffs: reshaping PGM demand

Beresford Clarke, Managing Director: Technical & Research, SFA (Oxford)

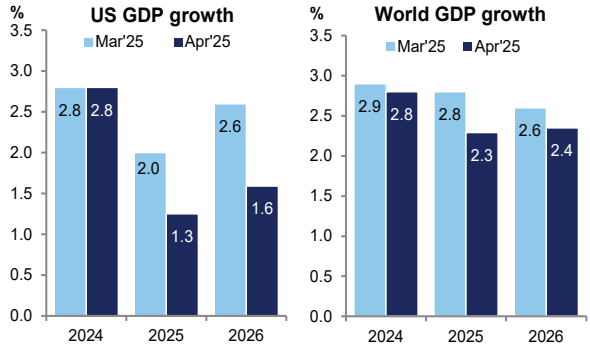
President Trump's trade tariffs have hit global trade and economic growth. The fluctuating nature of these tariffs, accompanied by frequent revisions and exemptions, has increased uncertainty and hindered companies' investment plans. According to Oxford Economics' base case, slower growth is anticipated, though not a recession; however, the risks remain skewed towards the downside.

US tariffs have brought costs and uncertainty

Oxford Economics has adjusted its US GDP growth projections to 1.3% in 2025 and 1.6% in 2026 owing to the effects of the tariffs. China's growth outlook has worsened as a result of significantly higher (and shifting) US tariffs on Chinese exports, with China's GDP now forecast to grow at 4.1% in 2025. The Eurozone's growth forecast has also been further revised downward due to the tariffs, and the Japanese economy is projected to experience a sharp slowdown as tariffs adversely affect auto exports to the US.

US and global growth forecasts are down

Economic growth outlook



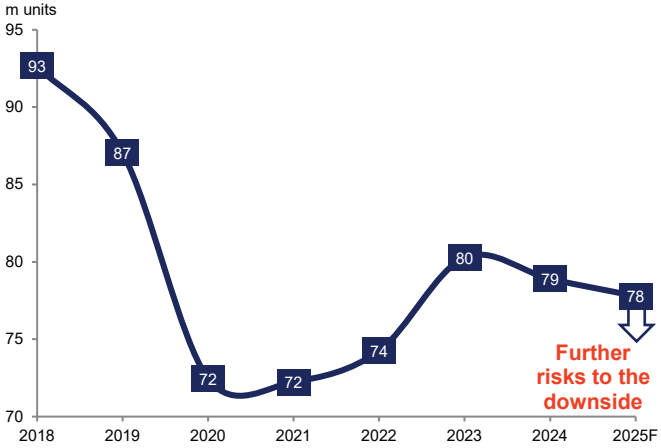
Source: Oxford Economics

After the surprisingly strong performance for combustion engine- and hybrid-powered vehicles in 2023 across most regions, production held up relatively well in 2024, which helped to keep the palladium and rhodium markets relatively balanced, while drawing on stocks of platinum.

Current forecasts indicate another slight slip in internal combustion engine (ICE) and hybrid vehicle production for 2025, but the reality is likely to be lower output once the full ramifications of Trump's tariffs are realised and lead to changes to OEM production plans for the year. Many companies are steering clear from announcing guidance and delaying announcements on production plans.

Downside risk to ICE production

Global light-vehicle production excl. BEVs

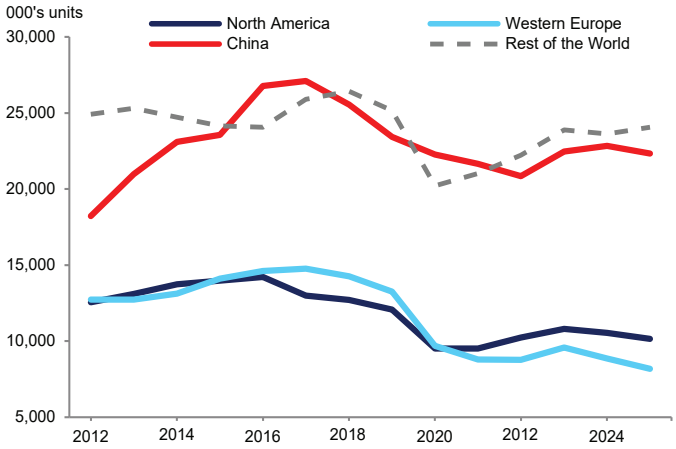


Source: GlobalData

The major emerging markets for ICE vehicles, including hybrids, have been consistently strong light-vehicle producers. China is still the single largest producer of ICE vehicles despite the explosion of BEV production and sales. One might have expected Chinese ICE and hybrid production to have declined much further over the last two years as BEVs took centre stage. However, the chart below shows Chinese ICE vehicle production has been surprisingly resilient, and thus it is still a powerhouse for automotive PGM demand.

China the biggest producer but EMs see largest chunk of demand

ICE and hybrid light-vehicle production



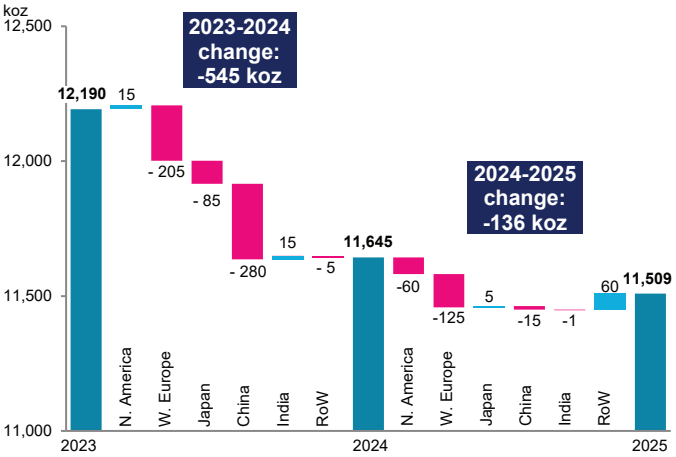
Source: SFA (Oxford), GlobalData

After strong growth in PGM demand in 2023 led by the ongoing recovery in ICE and hybrid vehicle production, last year saw a significant fall-off in PGM requirements across most regions, but in particular China and Western Europe.

A year ago, SFA (Oxford) was forecasting a drop-off in PGM demand of approximately 400 koz year-on-year in 2024 but, as shown in the chart below, global PGM autocatalyst demand actually contracted by 545 koz. The contraction was heavily weighted to China and Europe, while North America's requirements remained flat. Ongoing PGM thrifting in China, and vehicle production losses in Europe were the primary drivers for the changes. As indicated by the chart on the right, a further contraction is projected for 2025, albeit on a smaller scale. However, the current scale of the fall-off forecast in 2025 demand may be an underestimation, based on estimates for vehicle production for the full year and how the trade war plays out.

2024 autocatalyst demand was worse than predicted

PGM auto demand change: 2023-2025F

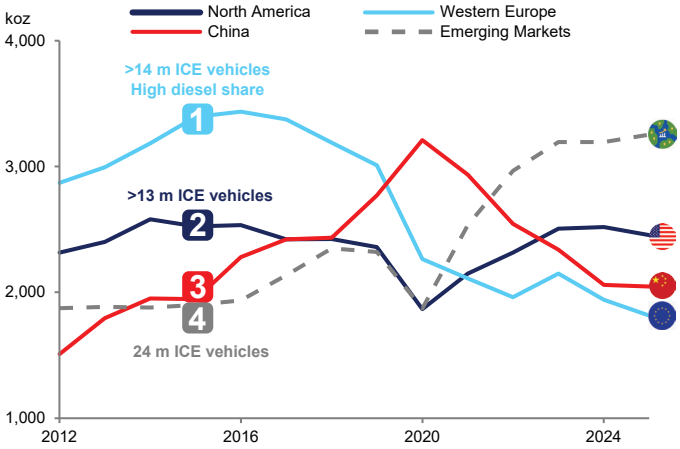


Source: SFA (Oxford)

On a longer timescale, there have been huge swings in regional demand. Looking back to 2015, Western Europe dominated auto demand for PGMs. A decade ago, the region was producing in excess of 14 million vehicles, average PGM loadings were higher, and there was a much more significant diesel market share, helping platinum demand alongside palladium. North America was in second place, with both a sizable ICE vehicle market of around 13 million units per annum and relatively high autocatalyst loadings.

Vehicle production and demand profiles have shifted dramatically

Evolution of major markets for automotive PGMs: 2015



Source: SFA (Oxford)

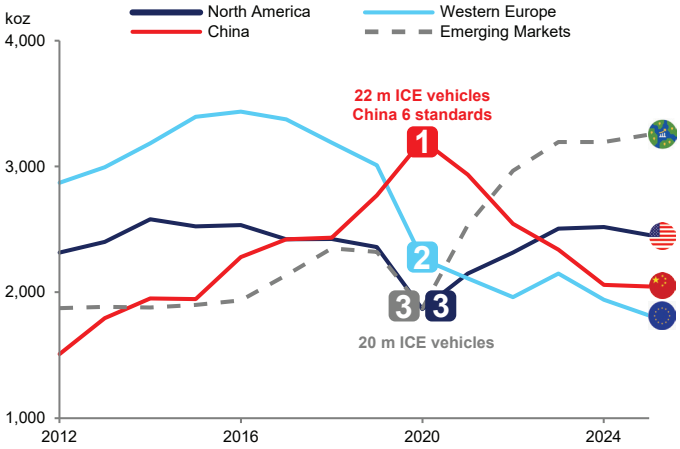
However, China and the emerging markets were lagging behind, despite both regions producing in excess of 20 million vehicles each year at that point. Tailpipe emissions standards were such that PGM loadings were well behind European and North American counterparts.

Emerging markets were once the laggards

During the pandemic, light-vehicle production in most countries was hit hard. European PGM autocatalyst demand came off heavily, as it did in North America and the emerging markets. In China, light-vehicle production numbers were impacted far less, and loadings saw (on paper) a boost as China 6 emissions legislation was rolled out nationwide.

China's share of PGM demand peaked during the pandemic

Evolution of major markets for automotive PGMs: 2020

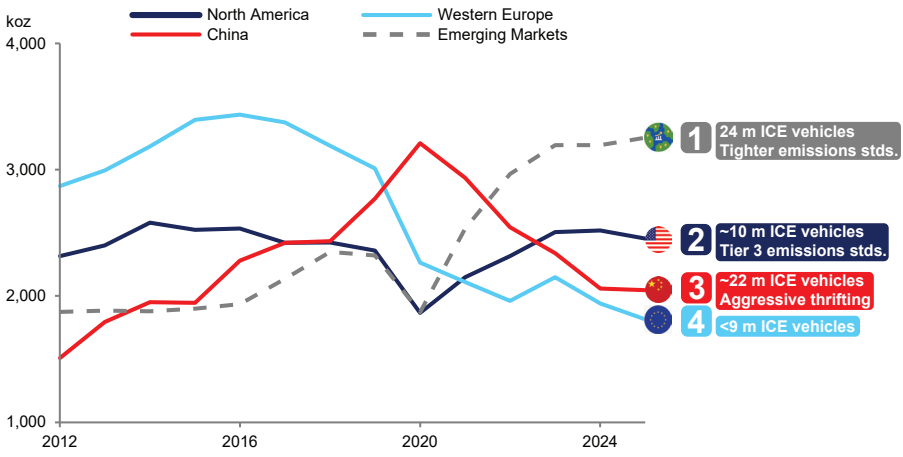


Source: SFA (Oxford)

Moving forward to today and North America remains a steady consumer of PGMs with consumption on par with the mid-2010s, even with tighter emissions standards linked to the phase-in of Tier 3 requirements from 2017 through to 2025 that require more PGMs per car (or in the case of the US, trucks). Based on the direction of travel in North America, with BEV market penetration stalling over the last 12 months and hybrids yielding record sales figures in March 2025, the combustion engine is not going away just yet and will continue to be a stable end-market for automotive PGM demand.

North American demand has remained stable

Evolution of major markets for automotive PGMs: 2025



Source: SFA (Oxford)

China's demand has come off considerably since 2020-21 as the prices of palladium and rhodium rallied, incentivising efforts to thrift PGMs from autocatalysts. Europe now sits in last place as a major consumer of automotive PGMs owing to some reduction in loadings, and a contraction in the volume of ICE vehicles produced.

China has rapidly fallen down the rankings...

What is perhaps most surprising for the PGM industry is the rise in emerging markets' requirements for PGMs. Both their growth as export markets sending vehicles to Europe and North America and the tightening of local emissions standards require more PGM consumption to provide cleaner air. These markets will be the major drivers for PGM demand for some time to come. Therefore, even as headlines from Europe and other regions worsen from a PGM point of view, emerging markets can pick up some of the slack in PGM demand.

...while EMs have raced ahead

Chinese loadings were lower than thought

Now looking closer at China, much of the discussion over the last year revolved around the suggestion that Chinese ICE vehicle catalysts were, in fact, hitting the tarmac with far lower loaded catalysts than the new China 6 emissions standards would imply on paper. China 6 standards are comparable to the latest European standards and are some of the toughest in the world.

Testing stringency...

However, there are levers that Chinese manufacturers can pull to thrift PGM loadings that are not available to European manufacturers. Firstly, China's Real-World Driving Emissions (RDE) tests tend to be more lenient, specifically RDE was not enforced with the promulgation of China 6a standards but rather monitored. They are now enforced with China 6b standards, which came into force at the end of 2023.

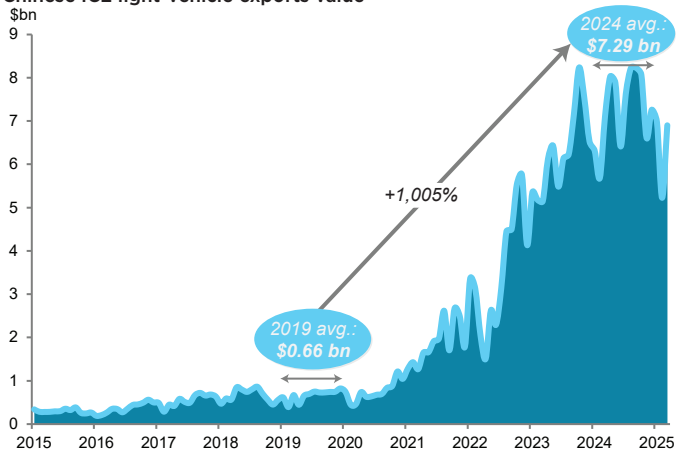
...legislative loopholes...

Secondly, cold start and idling emissions, the portion of a typical journey when a large proportion of emissions are emitted, were not legislated in China under 6a or 6b standards. In Europe, these loopholes have been closed up as Euro 6 standards have progressed: PGM loadings have to be higher and more complex, and expensive aftertreatment technology has been introduced in order to comply.

Thirdly, China has held its 'conformity factors' (CF) at 2.1 for NO_x (i.e. the allowable error margin for exceeding emissions limits was more than double the stated limit), whereas in Europe the NO_x CF started at 2.1 under Euro 6d-TEMP, was reduced to 1.43 under Euro 6d and further reduced to 1.10 under Euro 6e. A conformity factor of 1.0 will apply to both NO_x and for particulates under Euro 7, leaving essentially no room for emissions exceedances. In the US, there exists no formal conformity factor, though there is some margin of error accounted for in certification.

...high margin for error...

Chinese ICE light-vehicle exports value

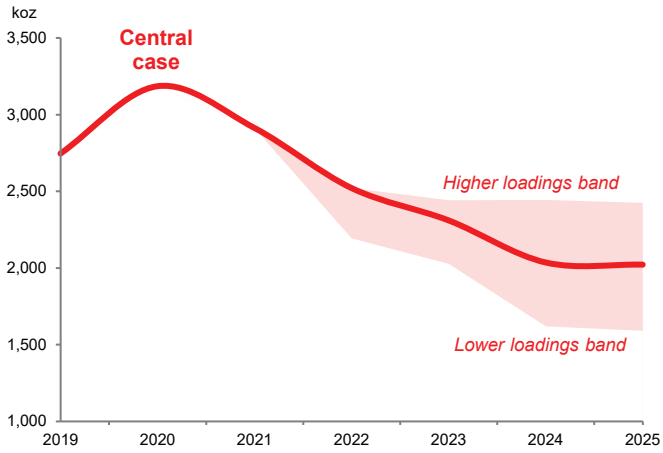


Source: SFA (Oxford)

Finally, the rapidly expanding export market for Chinese-manufactured vehicles to countries where emission standards are not as stringent as in Europe or China itself mean that average PGM loadings for light-vehicles manufactured for those countries are being pulled down.

...and growing exports all contributed

China automotive PGM demand



Source: SFA (Oxford)

These 'levers' provide us with an envelope of potential autocatalyst PGM demand in China. Local OEMs, foreign JVs and cars bound for the export market show a wide spectrum of PGM loadings. In the extreme, these provide a range of ~1 moz in total PGM autocatalyst demand.

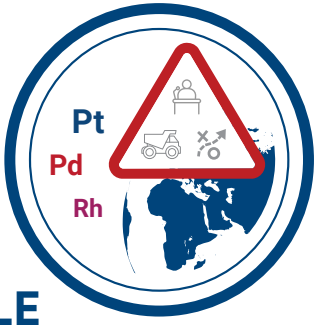
China 7 is coming

With China 7 emissions legislation due to come into force by the end of the decade, and loopholes left yet to close, autocatalyst loadings have scope to rise on a per-vehicle basis. However, net demand is at risk of declining owing to the already relatively well-advanced switch to BEVs in China. The expectation is for Europe to continue towards reducing the share of ICE vehicles added to the fleet each year in line with legislated targets, and for consumers in the US to gradually lean more towards electrification.

In summary, the outlook is not entirely bleak for PGM demand, however. With Donald Trump in office, top-down support for BEV production and sales in the US is at risk as the legislature takes aim at both EV 'mandates' and point-of-sale subsidies for would-be EV buyers. In Europe, the target of zero combustion powertrain sales by 2035 seems optimistic based on current total BEV market penetration of 15.2% year-to-date, and could result in a more drawn-out tail for PGM autocatalyst demand than the targets would suggest. Lastly, the emerging markets, which together are now the largest source of PGM autocatalyst demand, are forecast to see growth in production of ICE vehicles, and continue to open alternative avenues for demand beyond the traditional big-three markets of Europe, China and North America.

PGM demand could prove surprisingly resilient

BEYOND THE GEOPOLITICAL CRISIS: TOWARDS ANTI-FRAGILE PGM PRODUCERS IN THE PHASE TRANSITION



Beyond the geopolitical crisis: towards anti-fragile PGM producers in the phase transition

Claude de Baissac, Founder & CEO, Eunomix

Geopolitics has risen fast to the utmost concern of executives and shareholders. This shift away from economic and internal performance considerations to the upheavals in international relations has occurred relatively rapidly. Less than a decade ago concepts such as 'Chimerica' and the 'Expanding Middle' spoke of accelerating globalisation and tightly integrated value chains. No longer.

The world has shifted from integration and coopetition to fragmentation and confrontation. International cooperation and economic globalisation are reversing. The pace of this profound transformation is accelerating. Globalisation is not ending, having started long before its great acceleration of the 1990s. But it is fundamentally changing in nature. The world is in a phase transition.

The nature of globalisation is going through a transition

Business must do more than acknowledge reality and merely address the latest crisis. Because crises are the name of the game – appearing, interacting, shifting, escalating. Businesses need to urgently upscale and upskill their capacity to anticipate and adapt to the emerging future.

This is truer for mining than for many industries. The PGM sector is highly exposed to international relations, the flow of goods and services, the movements of capital, technological evolution and regulatory changes. It is deeply integrated across complex value chains that span countries now distancing from one another, and that have profound disparities in levels of development and prospects for long-term sustainability.

The significant threat of resource nationalism – of which Mali represents an extreme, uninhibited form – is joined by neo-mercantilism: government-to-government agreements that were the preserve of China. The agreements that the USA has signed with the DRC and Ukraine go further than China's minerals-for-infrastructure deals. These explicitly tie critical minerals and military assistance. This creates risks and dilemmas for the industry not seen since the worst of the Cold War.

Resource-rich nations are increasingly looking to leverage their mineral wealth

Geopolitical and country risk (GCR) is a clear and present emergency that requires more than concern, it needs decisive action. But there are challenges on the way to greater GCR resilience.

The risk normalisation paradox: how perception fails during phase transitions

Assumptions about the depth of change have to adjust rapidly. In parallel, risk analysis has to adapt fast.

On assumptions, standard assessment frameworks show a strong tendency to normalise events as temporary disruptions. The BlackRock Geopolitical Risk Indicator

(BGRI) and the Geopolitical Risk (GPR) index both show dramatic spikes during crises, followed by a return to the status quo ante. Both indexes, like many others, display a mean reversion bias[1].

Uncertainty metrics are often flawed...

BlackRock stated in a report that, "Our readings of perceptions around policy uncertainty are showing that the relatively high recent readings may have started to abate (...). Our confidence partly is backed up by the data trends: Sentiment metrics tend to be mean-reverting. In other words, they may spike, but they also historically have been shown to trend back to more "normal" levels. This could imply a more benign market environment ahead"[2]. That report was issued in October 2019, right before the Covid crisis.

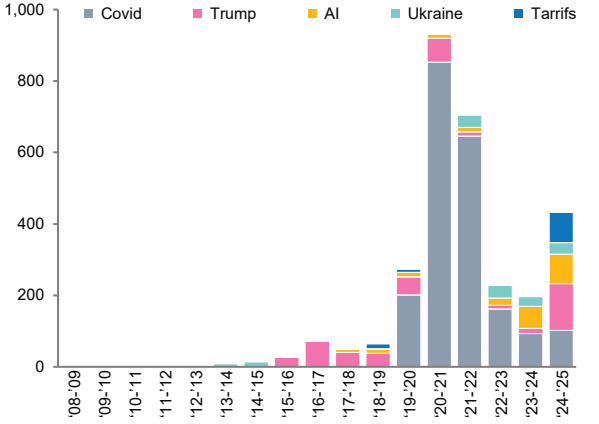
...and attention to risks is episodic

Online search terms confirm this "risk normalisation paradox". Chart 1 tracks Google searches in the business and industrials category for "Covid", "Trump", "AI", "Ukraine" and "Tariffs". It shows that attention on these is episodic, following rather than anticipating events in waves that rise suddenly and subside rapidly. And that attention is clearly biased. "Climate change", "global warming" and "natural disasters" do not register relative to the above five terms.

[1]The BGRI measures market attention to geopolitical risks through analysis of broker reports and financial news stories, while the GPR index quantifies geopolitical tensions through automated text analysis of ten major newspapers, counting articles related to adverse geopolitical events across eight categories.
[2]BlackRock, 2019, A positive twist on geopolitical risk? https://www.hvst.com/posts/a-positive-twist-on-geopolitical-risk-XzMTMjgv

These frameworks treat events as discrete occurrences rather than interconnected drivers of structural change. The Russian invasion of Ukraine was not merely a localised conflict – it triggered cascade effects across energy markets, food security, alliance structures, and nuclear deterrence paradigms that continue to reverberate globally. Yet the indices treated it as a spike that quickly returned to baseline.

Chart 1: Business and industrials category keyword searches on Google



Source: Google Trends, 2005, https://trends.google.com/trends/explore?cat=12&date=2008-05-01%202025-04-30&gprop=news&q=trump,AI,tariffs,ukraine,covid&hl=en-GB

eunomix™ advisors in resilience

Searches for 'Ukraine' quickly reverted to baseline

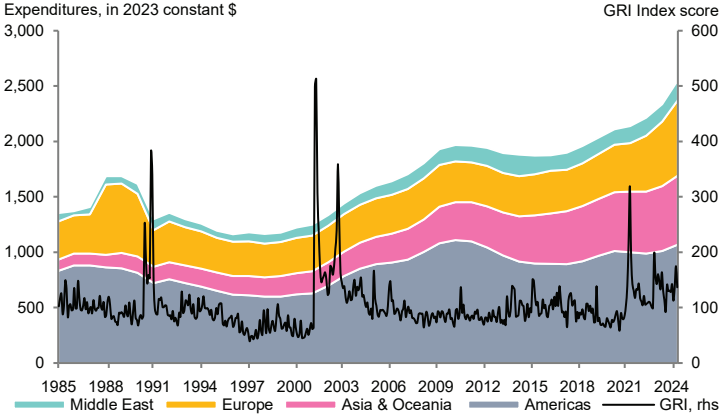
These patterns contrast sharply with how governments assess geopolitical risk and respond to it. Defence spending has increased for nine consecutive years, reaching $2.718 trillion in 2024 – a 9.4% annual increase that represents the steepest rise since the Cold War. As Chart 2 opposite shows, the fast-widening divergence between the GPR Index – showing massive spikes during events such as 9/11, the invasion of Iraq and the Russia-Ukraine conflict, then quickly returning to baseline levels – and SIPRI defence data is striking.

Defence spending shows governments see things differently

Munich Re's data shows that natural disasters caused by global warming resulted in $320 billion in losses in 2024 – considerably higher than inflation-adjusted averages of the past decades. Global temperatures, as objective a benchmark as one gets, are on track to reach the critical 1.5 °C above the 1850-1900 average. As a result, governments' expenditure on climate mitigation and disaster management reached nearly $3 trillion in 70 countries in 2024 – more than total global defence expenditures[3].

Climate mitigation spending has overtaken military

Chart 2: GRI index versus SIPRI military expenditures between 1985 and 2024



Sources: Caldara, Dario, and Matteo Iacoviello, Geopolitical Risk Index, 2025, https://www.matteoiacoviello.com/gpr.htm
SIPRI Military Expenditure Database, Stockholm International Peace Research Institute, 2025, https://www.sipri.org/databases/milex

On to risk analysis models...

In its 2019 article, BlackRock explained that the BGRI "quantif[ies] geopolitical risk in the aggregate". This is not what its index measures. It merely gauges consensus views on events, the subjective, biased perceptions of recent events and self-selected reality – Covid and the trade war, not climate change.

[3]*International Energy Agency, 2024, Government Energy Spending Tracker: Policy Database, https://www.iea.org/data-and-statistics/data-tools/government-energy-spending-tracker-policy-database*

Perception-based measurements thus neither gauge actual risk nor have predictive capacity.

Risk is not perception. Nor is it events. Nor is it in the past. Risk is the future probability of occurrences that are likely to impact values important for their owner, irrespective of whether or not the owner is aware of the risk.

Risk ≠ perception

Risk arises not only from visible events but also from trends – structural changes that have profound effects on the nature, scope and probability of risk. Structural changes are not perceptible in the way sudden events are. They therefore trick perception.

To confuse perception metrics with actual risk has serious consequences.

Rising residual risk in phase transitions: the risk analysis upscaling imperative

Eunomix has long focused attention on the growing gap between risk drivers and risk response through the concept of "geopolitical and country risk residual": the gap between objective risk and its management by its bearer.

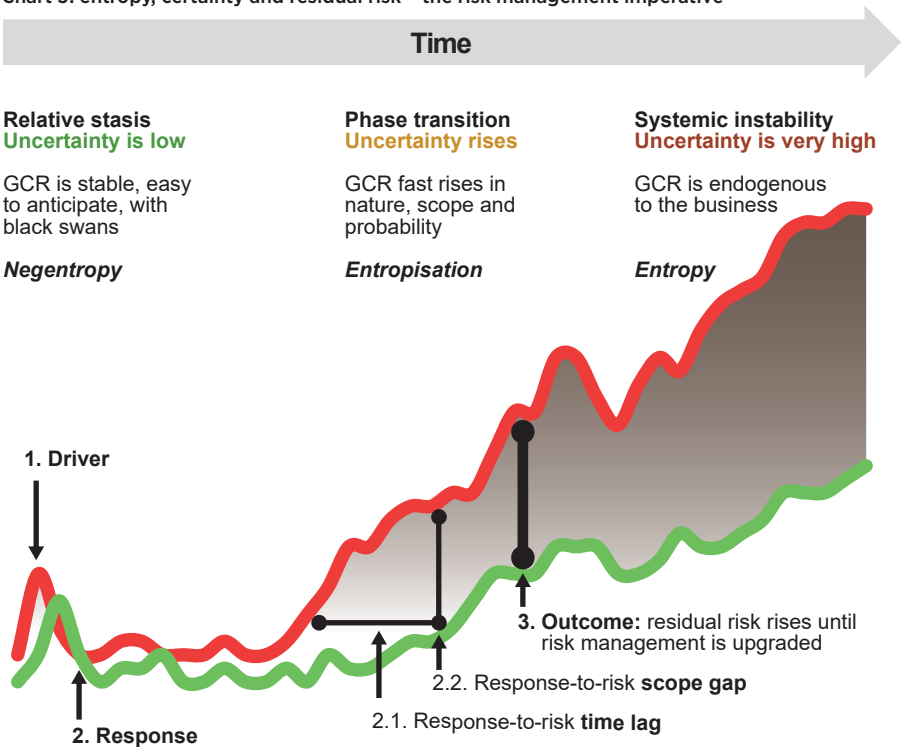
In periods of relative stasis, the residual remains low; the occurrence of 'black swans' not fundamentally altering the environment. In phase transitions, the residual rises rapidly because of the perceptual gap resulting from the disconnect between rising objective risk and expectations. Expectations lag. The fast-escalating succession of crises is misinterpreted as representing an unlikely convergence of black swan events. Reversion to the mean remains expected.

Black swans or lack of foresight?

This, in turn, acts as a brake on risk management, which is focused on crises management rather than anticipating what is coming, and on preparing for systemic disruption through strategic interventions throughout the business. A false sense of security takes roots. Survivorship bias takes hold.

Crisis control, not course correction

Chart 3: entropy, certainty and residual risk – the risk management imperative



Contrary to common belief, most geopolitical events are not true black swans. Nassim Nicholas Taleb has noted that events with roughly 50/50 probabilities cannot possibly be black swan events. True black swans must be genuinely outside the realm of regular expectations, carry extreme impact, and be retrospectively explainable in ways that make them appear predictable in hindsight.

Not all crises wear black feathers

To address these limitations, Eunomix has developed an impact-centric risk assessment framework that fundamentally reweights how we evaluate geopolitical events. Rather than the traditional risk equation (Risk = probability × impact), the impact-centric model applies a squared impact factor (Risk = probability × impact × impact). This approach operationalises our insight about the nature of risk in phase transition: that the magnitude of potential impacts matters more than their perceived likelihood.

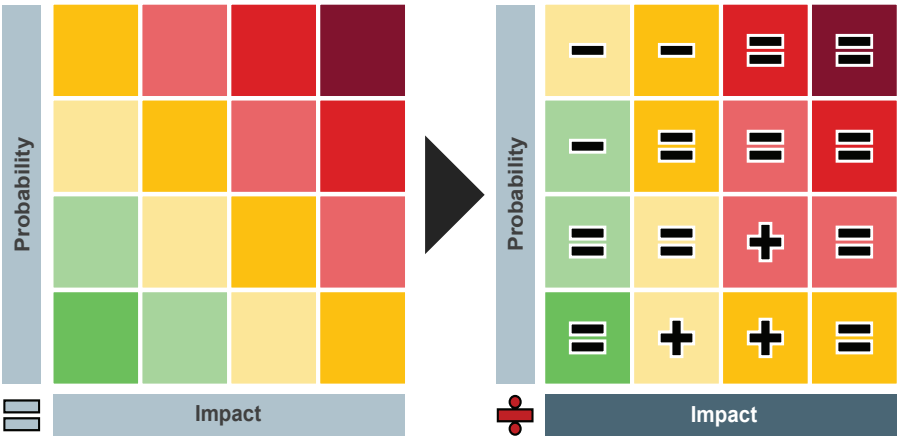
Unique methodologies can refine risk management

This methodology provides significant advantages. It properly weights high-impact events even when their probability appears low, aligns with how governments and military planners actually assess threats, and creates greater sensitivity to emerging systemic risks that may initially appear as isolated developments.

Similarly, many "geopolitical surprises" and "country shocks" can be anticipated with reasonable accuracy. The key is to operate the right analytical framework, starting with measuring objective phenomena rather than perception of reality. Eunomix has operated a global country risk index since 2016 that has proved to be accurate in forecasting the trajectory of countries within a 70-90% accuracy over the 5-10-year horizon – a very high accuracy in the field of country risk.

Surprise is just poor preparation

Chart 4: from risk scoring in stasis to risk scoring in phase transition



In early 2020, Eunomix identified precisely this risk trajectory for one of the world's leading PGM producers. The analysis warned of a company increasingly "astride major geopolitical and country risk faultlines" with production stretching "from legacy superpower to failing state", shareholders from "two competing superpowers", and markets similarly distributed across geopolitical divides. The report anticipated that maintaining this footprint would quickly become difficult, and likely impossible in the medium term. Covid, the war in Ukraine and the trade war have demonstrated this to be accurate.

We have been experimenting with a geopolitical risk index over the past year that seeks to match this.

The Eunomix Geopolitical Risk Index uses an events decay model that distinguishes between the immediate impact of events (which fades relatively quickly) and their lasting significance (which persists much longer). This distinction allows the model to capture how geopolitical events create resonant effects that persist and interact with new developments over time, with cumulative, systemic effects.

This is not to say that future events can be predicted, but rather that patterns of risk accumulation can be measured and anticipated. Through this, probability-based scenarios can be constructed, and the ability of the business to survive and strive prepared for risks improves.

Strategic implications for the PGM industry

The phase transition has existential implications for businesses everywhere in every sector. The PGM industry, with its narrow supply base and market applications, its high degree of integration through complex global value chains (GVCs), and its status as a provider of critical minerals, is highly exposed to rising objective risk and rising residual GCR. The PGM industry faces a fundamental restructuring, not a temporary disruption. Three structural shifts demand immediate strategic adaptation.

The PGM industry faces structural changes and the associated residual risks

First, supply chain bifurcation has already occurred. Russian palladium shipments to China increased by 35% in 2023 despite sanctions, creating parallel markets with divergent price points. This is no temporary arbitrage opportunity but the beginning of permanent market fragmentation that will intensify. Companies must now operate across disconnected spheres of influence rather than a unified global market.

Russia-Ukraine conflict bifurcated PGM supply

Second, price volatility will display asymmetric patterns that conventional models cannot capture. When investor sentiment finally aligns with fundamentals, we can expect price jumps of 200-300%. Traditional forecasting approaches built on mean reversion and cyclical behaviour will systematically underestimate both the magnitude and duration of these movements.

With fundamentals and investors aligned, this can feed price volatility

Third, structural supply constraints will persist regardless of price signals. With capital costs ranging between $2,000 and $3,000 per annual 4E production ounce, new projects face hurdles beyond what conventional supply-response models anticipate. Rising state fragility across key producing regions compounds this challenge, creating supply limitations that will reshape market dynamics for years.

Supply constraints will persist

Strategic opportunities: turning risk to advantage

The geopolitical phase transition creates strategic opportunities for companies prepared to fundamentally reorient their approach to risk:

Transitions can be capitalised on

1. The information advantage opportunity emerges from the perception-reality gap. Companies that implement robust frameworks for measuring cumulative risk gain strategic foresight that creates competitive advantage. This gap allows strategic positioning ahead of mainstream market recognition.

2. The supply chain opportunity stems directly from market fragmentation. Companies that develop dual capacity to operate across increasingly separate spheres of influence can serve markets that their competitors cannot reach, commanding premium pricing for supply security.

Fragmented markets reward flexible players

3. The positioning opportunity arises as industry reconfigures along emerging fault lines. Companies that anticipate these shifts can secure assets at favourable valuations before geopolitical realities are fully priced in.

Pathways to resilience in a fragmented world

Capitalising on these opportunities requires decisive reorganisation of risk governance. Three imperatives stand above all others:

Resilience begins with a reappraisal of risk

1. Adopt impact-centric risk frameworks that properly weigh high-impact events. Traditional matrices systematically undervalue precisely the kinds of transformative event that define phase transitions. Impact-squared methodologies (Risk = probability × impact × impact) create appropriate sensitivity to emerging systemic risks.

2. Integrate geopolitical risk governance into core business functions. Risk management must move beyond periodic assessments to become embedded in ongoing strategic planning. This integration turns geopolitical and country insight from defensive function to offensive capability.

Risk isn't static – governance shouldn't be either

3. Implement scenario planning designed for systemic change. The "base-case, upper-case, lower-case" approach fundamentally assumes continuity of the underlying system. Phase transitions require scenarios that anticipate discontinuous shifts between different states of order.

The platinum standard is not simply a measure of metal purity but of excellence in navigating complexity. In a world of accelerating geopolitical and country risk, competitive advantage will flow to companies that recognise the fundamental phase transition underway and position themselves at the leading edge of the emerging order – finding opportunity where others see only threat, and moving beyond crisis.

Quarterly PGM Market Report

Expert Price Risk Analysis

Amid rising geopolitical uncertainty, including evolving trade dynamics from US tariffs, and China's influence on PGM markets, our latest quarterly market report explores how these developments are influencing the platinum, palladium, and rhodium markets.

The report offers a forward-looking view of supply chain challenges and opportunities and the impact on price risk, while analysing market fundamentals, supply-demand trends, currency movements, and macroeconomic shifts driving volatility in these critical metals.

The price risk report includes:

- Macroeconomic outlook and the impact on PGM supply and demand
- Analysis of changing vehicle production forecasts and powertrain technologies on end-use demand
- Impact of lower PGM basket prices on producer margins and future investment
- Three-year price outlook
- 'What if' scenario analysis and price risk assessment out to 2028

Find out more

THE PGM MARKETS IN 2024/25

The PGM markets in 2024/25

Dr Ralph Grimble, Operations Director, SFA (Oxford)

The platinum market

The platinum market is in deficit

The platinum market in 2024 had a narrower deficit of 70 koz as primary supply was little changed and net demand fell owing to reduced automotive demand, with jewellery and industrial demand also slightly lower.

On the automotive side, platinum demand continued to benefit from substitution into gasoline autocatalysts. However, while BEVs gained further market share, BEV production underperformed initial expectations, but so did overall light-vehicle sales which fell slightly, resulting in a drop in combustion (ICE and hybrid) vehicle sales. Heavy-duty vehicle (HDV) production also declined, reducing overall automotive demand. Primary platinum supply from South Africa edged up owing to some stock being processed, helped by a more consistent power supply after load-shedding ended in late March, but remained below 4 moz for a third consecutive year. Subdued volumes of spent catalysts in Europe, the US and Japan continued to impact secondary supply in those regions but an upturn in recycled jewellery lifted overall secondary platinum supply.

Rising costs and subdued prices have caused some restructuring of supply

During 2024, both the platinum and palladium prices traded mostly in a range between $1,100/oz and $900/oz, and rhodium also mostly traded in a fairly narrow range, although it did at least end the year higher than it started it. This subdued price environment combined

with ongoing cost pressures meant that the highest-cost mining areas were loss-making. South African platinum producers responded by cutting costs, reducing stay-in-business capital expenditure and restructuring some operations, although there was minimal loss of production. The lower palladium price was particularly problematic for the palladium-rich North American mines, and a further restructuring was announced for the Stillwater operations in Montana which will result in a decline in output of 200 koz 2E (~45 koz Pt) in 2025. Additional production cuts are not currently expected but could become necessary if PGM prices continue to trend sideways to lower.

The platinum market deficit is predicted to expand in 2025, driven by a rebound in automotive demand and a drop in primary supply. However, there is perhaps more uncertainty around automotive demand than usual. The re-election of Trump as US President in November was initially thought to be beneficial for PGM demand owing to expectations of easier environmental rules for emissions, reducing the pressure to move to BEVs and supporting gasoline vehicle sales for longer.

While that may be the case in the longer term, in the near term the imposition of 25% import tariffs on cars and car parts could be very disruptive, raising costs for consumers and reducing sales. Given that negotiations are ongoing regarding the so-called reciprocal tariffs that the US also imposed and then suspended, it would seem plausible that the auto tariffs could also be negotiated down at the same time. However, as the final levels for the various tariffs are unknown, the implications for PGM demand are also uncertain but the risks are to the downside.

US tariffs could negatively impact PGM demand

Mine supply

Global platinum output fell by a modest 20 koz year-on-year to 5,500 koz in 2024. Although Eskom ended load-shedding at the end of the first quarter, only a small amount of work-in-progress stock was processed during the year, but this enabled South African output to rise marginally to 3,945 koz. Zimbabwe's production was impacted by power disruptions and dropped by 3% to 505 koz.

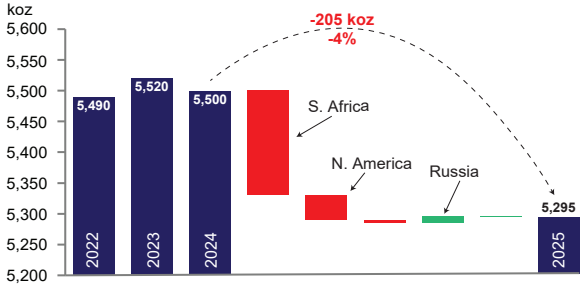
South African output held steady in 2024

Meanwhile, Russian platinum supply was flat at 670 koz despite smelter maintenance being carried out during the year. In North America, output was slightly lower as production at Impala Canada began to decline ahead of an earlier scheduled closure and Stillwater implemented restructuring.

This year, platinum supply is predicted to fall by 4% to 5,295 koz, mostly owing to lower yield in South Africa and North America. South African output is forecast to contract by 170 koz to 3,775 koz, despite the processing of additional partially processed stockpiled material. That is the lowest level in more than 20 years, outside strike-hit 2014 and Covid-impacted 2020. Lower output at the restructured Stillwater operation contributes to the 40 koz decline in North American platinum production.

Primary supply takes a step down in 2025

Platinum supply snapshot



Source: SFA (Oxford)

Recycling

In 2024, recycling of spent autocatalysts was lower in Europe, the US and Japan as cost-of-living pressures and the high prices of new vehicles meant that second-hand vehicles were sought after and kept on the road for longer. Additionally, there was an element of hoarding by scrapyards which reduced the flow of catalysts to recyclers as PGM prices remained subdued. The palladium price briefly exceeded $1,200/oz in October but this induced only a small amount of dishoarding. Jewellery recycling rebounded after a drop in the previous year and this was sufficient to lift overall secondary platinum supply by 3% to 1,410 koz.

For this year, a marginal improvement in recycling is predicted as the low point in autocatalyst recycling may have been reached. However, the risks are to the downside in the US, where the tariffs on US car imports will likely result in rising prices of new cars which could push more consumers to look at the second-hand car market and result in fewer old vehicles being scrapped.

Autocatalyst recycling may have reached its low point but there are downside risks

Demand

Global platinum demand (excluding investment) dipped under 7 moz to 6,980 koz in 2024, although that was higher than in 2020 to 2022. Lower automotive demand was the main cause, but jewellery and industrial demand were also both slightly weaker.

This year, gross platinum demand is projected to rebound to 7,205 koz as a result of greater automotive usage. The risk is that demand could be lower if tariffs impact economic growth too severely.

Automotive demand

Automotive platinum demand in 2024 was 3% lower at 3,330 koz, despite further use of some platinum in gasoline autocatalysts, owing to reduced ICE and hybrid light-vehicle production as total production volumes fell and BEVs gained market share. In addition, HDV production dropped by 6%, which also hit platinum consumption. The largest decline was in Western Europe, but there was also lower production in China, Japan and the RoW. The US was the only region to lift HDV production last year.

In 2025, automotive demand is forecast to rebound to 3,565 koz. Additional use of platinum in gasoline autocatalysts is predicted, although this year could be the peak if palladium continues to trade at a discount to platinum. Some growth is anticipated in HDV production which also contributes to higher demand this year.

Global platinum demand recovers in 2025 as automotive demand rebounds

Jewellery demand

Global platinum jewellery demand slipped marginally in 2024 to 1,350 koz. Sales in the Chinese market continued to edge lower which, combined with a dip in Japan, dragged down the overall total despite further gains in India.

This year, platinum jewellery demand is projected to ease to 1,325 koz. There are some signs of greater interest in platinum by jewellery fabricators in China as the discount to gold is so high that platinum is now cheaper than white gold. However, fabricator interest still needs to be translated into sales to customers. In India, further growth in platinum jewellery demand is anticipated but the risks in the US, Japan and Europe are to the downside given the uncertain economic situation as a consequence of the US tariffs, which could see consumers pull back from making major purchases.

Platinum jewellery has a chance with a record platinum price discount to gold

Industrial demand

Platinum requirements for industrial applications were slightly lower year-on-year at 2,230 koz in 2024. Most industrial sectors saw higher platinum use in 2024 with robust gains in chemical and electrical requirements driven by China. However, China was also responsible for the overall contraction in industrial usage as the glass industry slowed capacity additions after a period of very strong growth and this more than offset the gains elsewhere.

Diverse end uses mean that overall industrial demand is robust

In 2025, the outlook for industrial demand is similar to 2024, with a small overall decline again being driven by the glass industry in China further slowing capacity additions which more than offsets growth in other sectors. Hydrogen-related demand is predicted to rise in 2025, but the challenging economic situation could prove to be a headwind to further expansion in demand.

Investment and movement of above-ground stocks

Platinum ETF holdings gained 270 koz during 2024, lifting global holdings to almost 3.2 moz. Funds in the US and UK saw significant inflows (138 koz and 286 koz, respectively) whereas funds in other regions saw net outflows. Bar and coin sales were lower in 2024 partly owing to net sales of bars by investors in Japan where the sharp depreciation of the yen drove the domestic platinum price higher, resulting in some profit-taking.

Global investment demand was positive

The palladium market

In 2024, the palladium market had a small surplus (excluding investment). Primary and secondary supply were little changed but gross demand fell owing to lower automotive requirements for palladium. The market surplus

Palladium market is in surplus

is predicted to widen in 2025 to 245 koz but the risk is that the surplus is larger owing to weaker automotive demand related to lower light-vehicle sales, as prices rise in the US following the implementation of 25% tariffs on imported cars and car parts. While many of the roughly 4 million vehicles imported from Canada and Mexico that meet the USMCA requirements are exempt, some vehicles will still be subject to the tariff and those from Europe, Japan and Korea that represent a further ~3.5 million vehicles (~21% of US light-vehicle sales) will be hit.

Currently, it appears that the tariffs on cars and car parts are set, but it is possible that they could change. With the delay to the reciprocal tariffs enabling countries to negotiate trade deals with the US, car exporting countries could include cars in a wider deal, thereby reducing the level of the tariffs and the impact on auto sales and PGM demand.

Gross palladium demand was 8,965 koz in 2024, 4% lower than in 2023, as automotive demand declined, while jewellery and industrial uses were essentially flat.

Total automotive demand fell by 5% to 7,435 koz in 2024 owing to a combination of reduced light-vehicle sales and some further substitution by platinum in gasoline autocatalysts. A modest reduction in global light-vehicle sales was compounded by growth in the BEV market share, resulting in a drop in production of more than 1 million ICE and hybrid vehicles. In addition, more widespread use of tri-metal gasoline autocatalysts in which substitution of some platinum for some palladium had occurred also contributed to the contraction in demand.

Automotive demand is set to be lower in 2025 than 2024 as BEVs gain further market share...

... and US tariffs could cause an even larger decline in automotive demand

In 2025, automotive demand is projected to fall further to 7,080 koz, owing to greater use of tri-metal catalysts and a further decline in global ICE and hybrid vehicle production as BEV production ramps up to 14.1 million units, from 11.5 million in 2024, and more than offsets growth of 1.5 million units in the overall market. However, the risk is to the downside as tariffs raise the cost of many vehicles in the US and hence reduce sales.

Gross palladium demand is projected to slide by 4% to 8,625 koz this year, as the decline in automotive demand is partially offset by slight gains in both industrial and jewellery demand.

Primary supply was little changed year-on-year in 2024, at 6,470 koz. A drop in output from North America and Zimbabwe was more than offset by modestly higher production in South Africa and Russia, despite Nornickel rebuilding a smelter during the year.

This year, primary supply is forecast to decrease by 5% to 6,165 koz, owing to lower production in North America and South Africa. In North America, lower output from Impala Canada and restructuring at Stillwater in the US are set to sharply reduce production.

Primary palladium production dips in 2025

Secondary palladium supply dipped marginally in 2024. Autocatalyst recycling slipped in the US, Europe and Japan as new light-vehicle sales were subdued, meaning fewer second-hand cars were scrapped than would otherwise have been the case. However, in China a subsidy scheme for scrapping old cars when purchasing a new car resulted in a surge in the number of scrapped vehicles and a jump in the amount of palladium recovered from spent autocatalysts.

Growth expected in secondary palladium supply in 2025 but there are downside risks

While volumes of scrapped vehicles are expected to be little changed in Europe and the US this year, Japan is forecast to have higher new car sales which should support a greater number of scrapped vehicles. With the scrappage scheme in China being extended for 2025, further growth in recycling is anticipated there which, along with some growth from the RoW, is expected to lift global secondary palladium supply. However, if tariffs negatively impact light-vehicle sales in the US, then the risk is that fewer old vehicles are scrapped this year and recycling in the US contracts. A recession in the US and Europe could have an even greater impact on auto sales and the number of scrapped vehicles.

The rhodium market

The rhodium market is estimated to have had a deficit of 20 koz in 2024, which shrinks to 10 koz in 2025 as net demand falls slightly more than primary supply.

Rhodium market close to balance in 2025

Gross rhodium demand fell by 6% to 1,010 koz in 2024, owing to a decline in automotive usage, while industrial demand was essentially unchanged.

Automotive demand contracted by 6% to 880 koz last year, as thrifting continued in China and global catalysed light-vehicle production dropped by more than 1 million units owing to a combination of lower overall production and an increased BEV market share to 13% from 12% in 2023.

Automotive demand declined in 2024 owing to thrifting in China and lower ICE vehicle production

Primary supply of rhodium was slightly lower at 715 koz in 2024. South African production slipped marginally as some stock processing mostly made up for modest declines at rhodium-rich operations. Output in North America dipped as by-product production in Canada edged down. Secondary supply also contracted modestly as scrapped vehicle volumes in Europe and the US shrank again.

Industrial demand is forecast to slip by 5 koz to 125 koz in 2025. Glass demand was relatively subdued in 2024 and is set to be slightly lower year-on-year in 2025 with lower additions of new glass fibre capacity. The thrifting and stock sales in China have run their course and glass fibre bushings now have very low rhodium content.

Automotive demand is also expected to decline modestly in 2025 owing to a drop in ICE and hybrid vehicle production, as BEV production grows faster than the overall growth in total light-vehicle production. On the one hand it is possible that BEV gains are being overestimated, particularly in Europe where sales so far are falling short of targets, which could support PGM demand, but on the other hand sales in the US could be hit by tariff-related cost increases, which would cut PGM demand.

Automotive demand declines further in 2025 as BEVs take market share

This year, primary supply is forecast to fall by 3% to 695 koz, mostly as a result of shrinking output in South Africa following the restructuring of some operations combined with reserve depletion. Recycling is predicted to increase marginally in most regions, although the risk is that recycling could recede in the US if new light-vehicle sales are hit by tariff-related cost increases and fewer second-hand vehicles are scrapped.

Primary supply dips in 2025

Iridium and Ruthenium Quarterly Report

Expert Price Risk Analysis

This risk-focused iridium and ruthenium market report details on-the-horizon, price-impacting factors, offering analytical charts and scenarios, providing you with a competitive edge. The report contains SFA's hands-on, forward-looking commentary and analysis on the events and trends currently impacting supply, demand and pricing.

We assess the supply risks from falling PGM prices and the geopolitical issues, as well as analysing the influence of the worsening global macro situation and a slowdown in the growth of the hydrogen sector.

The price risk report includes:

- Impact of short-term liquidity issues on metal pricing
- Updates on the wider PGM dynamics and the impact on iridium and ruthenium
- Technology developments affecting future demand in main end-uses
- Outline of current macroeconomic risks and tariff-related uncertainty on industry sectors and value chains
- Supply, demand and price forecasts out to 2029

Find out more

The price outlook for the next six months

Platinum $945/oz

The platinum market is expected to be in a deficit for a third consecutive year in 2025, but this has not been reflected in the price. The availability of stock means that the price has traded broadly sideways for the last few years and plenty of stock remains available in 2025.

At the start of the year the outlook for the platinum price was cautiously optimistic, but the imposition of widespread tariffs by the US and the greater economic uncertainty that has resulted could negatively impact demand for PGMs and present a downside price risk.

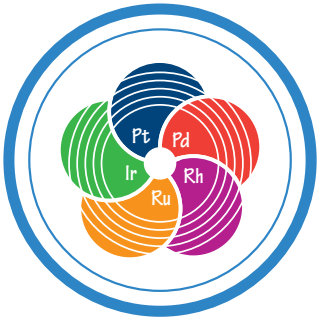
SFA forecasts a six-month platinum price average of $945/oz.

Palladium $935/oz

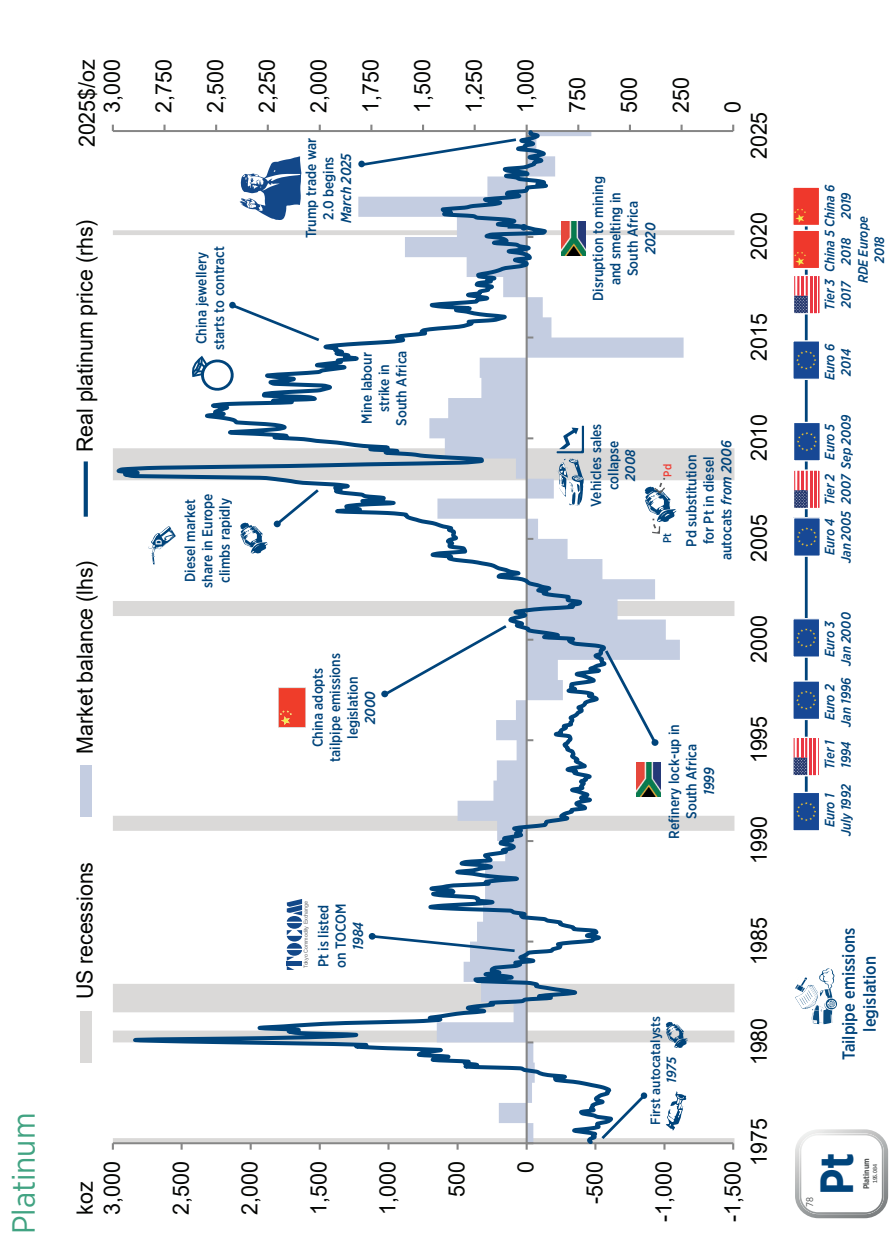
The advance of BEVs and the substitution of some platinum into gasoline autocatalysts reducing palladium demand have shifted the market into surplus. With the added uncertainty around US light-vehicle sales due to the US tariffs on imported cars, the risks to palladium automotive demand seem to be to the downside which means that the price risk is also to the downside. Although lower new light-vehicle sales will likely reduce the amount of recycling as fewer old vehicles are scrapped, the impact on automotive demand is larger. Palladium is much more exposed to developments in the automotive market than platinum and, as such, is expected to underperform. Consequently, SFA forecasts a palladium price average over the next six months of $935/oz.

Rhodium $5,150/oz

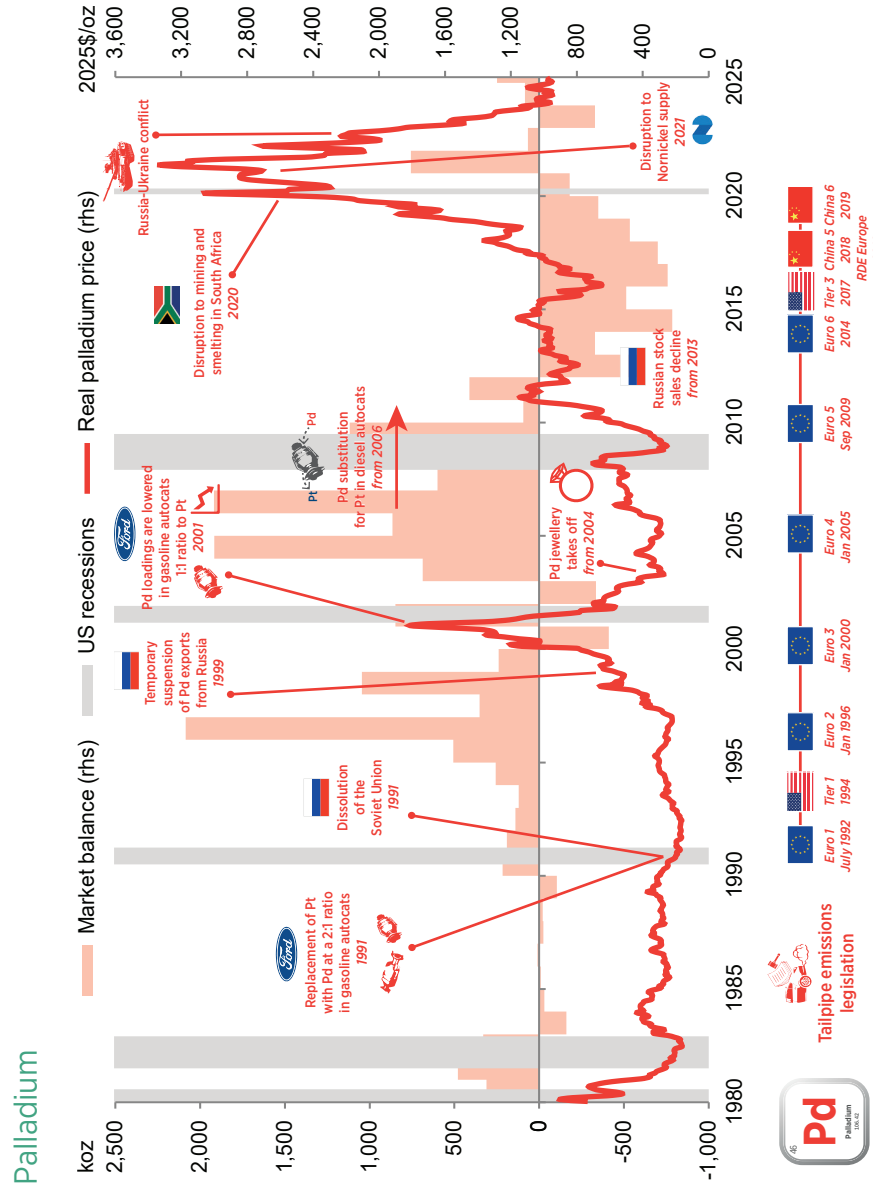
The rhodium market is close to balance, but shrinking, as both primary supply and demand decline – a situation that is not necessarily conducive to higher prices. However, temporary market tightness saw the rhodium price rally in the first quarter. Similarly to palladium, rhodium is exposed to turbulence in the automotive industry and US tariffs have the potential to crimp demand further than already assumed. The price has eased somewhat and is expected to continue to do so, averaging $5,150/oz over the next six months.



PGM PRICE HISTORY

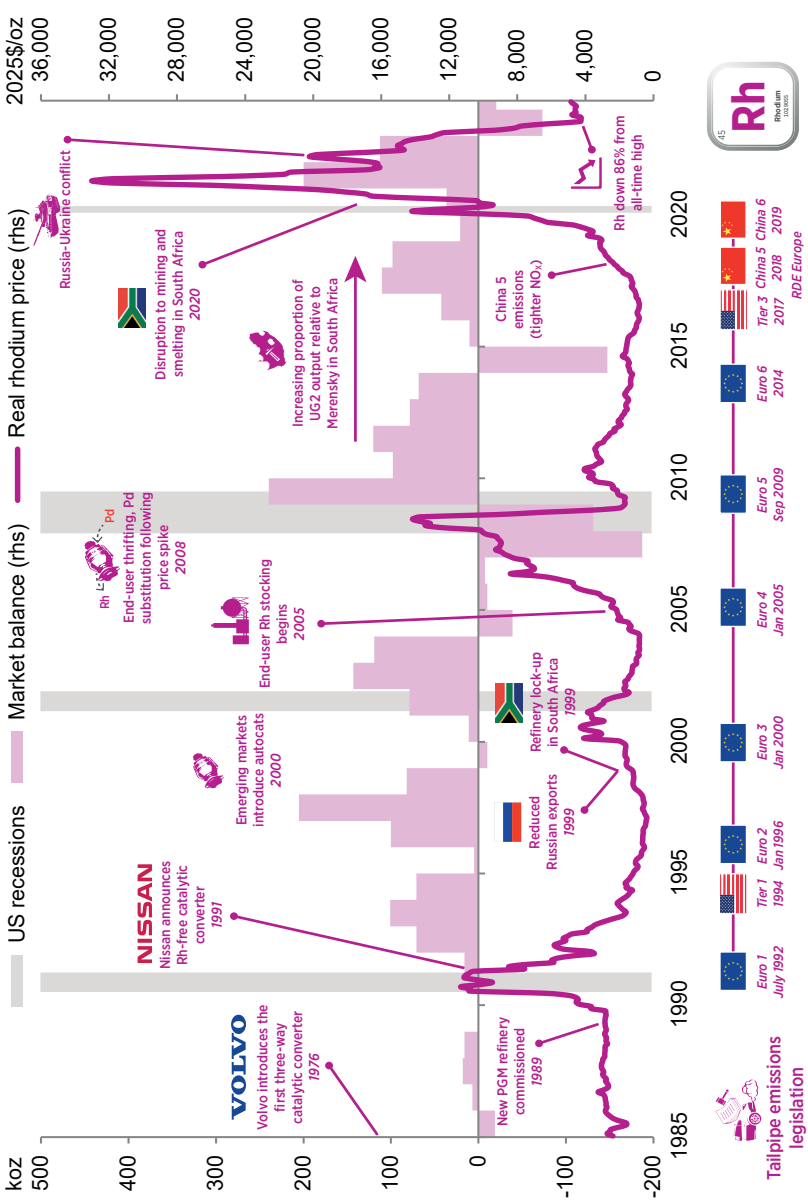


Source: SFA (Oxford)



Source: SFA (Oxford)

Rhodium



Source: SFA (Oxford)

APPENDIX

Platinum supply-demand balance

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Primary supply									
Regional									
South Africa	4,385	4,470	4,405	3,260	4,715	3,975	3,935	3,945	3,775
Russia	720	665	710	700	640	655	670	670	680
Zimbabwe	480	465	460	480	470	490	520	505	500
North America	360	345	350	330	265	250	265	260	220
Other	185	180	185	175	125	125	130	120	120
Total	**6,125**	**6,130**	**6,105**	**4,950**	**6,220**	**5,490**	**5,520**	**5,500**	**5,295**
Demand & recycling									
Autocatalyst									
Gross demand	3,300	3,120	2,870	2,440	2,805	2,995	3,435	3,330	3,565
Recycling	1,325	1,420	1,495	1,310	1,425	1,280	1,080	1,070	1,100
Net demand	1,975	1,700	1,370	1,130	1,385	1,715	2,355	2,255	2,465
Jewellery									
Gross demand	2,450	2,245	2,090	1,560	1,780	1,455	1,360	1,350	1,325
Recycling	560	505	500	410	400	250	245	290	295
Net demand	1,890	1,740	1,595	1,150	1,380	1,205	1,115	1,060	1,030
Industrial demand	**1,970**	**2,115**	**2,150**	**2,085**	**2,260**	**2,305**	**2,240**	**2,230**	**2,220**
Hydrogen	**50**	**70**	**40**	**15**	**20**	**20**	**60**	**70**	**95**
Other recycling	**30**	**30**	**30**	**30**	**45**	**40**	**40**	**45**	**40**
Gross demand	**7,775**	**7,550**	**7,150**	**6,095**	**6,865**	**6,780**	**7,095**	**6,980**	**7,205**
Recycling	**1,915**	**1,955**	**2,025**	**1,755**	**1,865**	**1,570**	**1,365**	**1,410**	**1,440**
Net demand	**5,855**	**5,595**	**5,125**	**4,345**	**4,995**	**5,205**	**5,730**	**5,570**	**5,765**
Market balance									
Balance (before ETFs)	270	535	980	605	1,220	285	-210	-70	-470
ETFs (stock allocation)	75	-240	990	495	-275	-565	-80	270	
Balance after ETFs	**195**	**775**	**-10**	**110**	**1,495**	**845**	**-130**	**-340**	**-470**

Source: SFA (Oxford)

Platinum demand and recycling summary

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Gross demand									
Autocatalyst									
North America	390	390	375	285	400	510	575	605	655
Western Europe	1,555	1,340	1,150	870	825	790	935	835	805
Japan	435	425	395	300	280	275	305	300	335
China	230	220	275	470	565	520	550	525	600
India	175	200	160	115	175	220	225	225	235
RoW	515	545	515	400	560	680	845	840	940
Total	**3,300**	**3,120**	**2,870**	**2,440**	**2,805**	**2,995**	**3,435**	**3,330**	**3,565**
Jewellery									
North America	280	280	275	210	255	265	250	255	255
Western Europe	250	255	260	175	190	205	195	195	195
Japan	340	345	330	245	260	270	255	250	245
China	1,340	1,095	945	755	875	510	435	410	375
India	175	195	210	120	135	160	165	175	185
RoW	75	75	75	55	60	50	60	65	70
Total	**2,450**	**2,245**	**2,090**	**1,560**	**1,780**	**1,455**	**1,360**	**1,350**	**1,325**
Industrial									
North America	455	395	340	335	345	375	390	400	400
Western Europe	330	340	310	325	45	305	310	320	295
Japan	80	110	110	150	145	105	100	85	100
China	685	720	810	835	1,055	945	840	875	820
RoW	425	555	580	440	670	570	595	555	605
Total	**1,970**	**2,115**	**2,150**	**2,085**	**2,260**	**2,305**	**2,240**	**2,230**	**2,220**
Hydrogen	**50**	**70**	**40**	**15**	**20**	**20**	**60**	**70**	**95**
Total gross demand									
North America	1,120	1,060	990	830	1,000	1,150	1,215	1,255	1,310
Western Europe	2,130	1,935	1,715	1,370	1,060	1,300	1,440	1,350	1,295
Japan	855	875	835	695	690	655	665	635	675
China	2,255	2,035	2,025	2,060	2,495	1,975	1,820	1,810	1,790
RoW	1,365	1,570	1,540	1,130	1,605	1,685	1,895	1,860	2,035
Total	**7,775**	**7,550**	**7,150**	**6,095**	**6,865**	**6,780**	**7,095**	**6,980**	**7,205**

Source: SFA (Oxford). Note: Regional totals exclude hydrogen demand.

Platinum demand and recycling summary (continued)

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Recycling									
Autocatalyst									
North America	585	640	640	560	570	475	370	365	355
Western Europe	440	465	515	445	520	465	385	375	380
Japan	100	110	110	105	115	105	110	110	110
China	40	35	40	30	35	40	30	35	40
RoW	160	170	190	170	185	190	185	190	210
Total	**1,325**	**1,420**	**1,495**	**1,310**	**1,425**	**1,280**	**1,080**	**1,070**	**1,100**
Jewellery									
North America	5	5	5	5	5	5	5	5	5
Western Europe	5	5	5	5	5	5	5	5	5
Japan	160	145	140	110	115	105	105	115	115
China	385	340	340	285	265	125	120	155	160
RoW	5	5	10	10	10	10	10	10	10
Total	**560**	**505**	**500**	**410**	**400**	**250**	**245**	**290**	**295**
WEEE	**30**	**30**	**30**	**30**	**45**	**40**	**40**	**45**	**40**
Total recycling									
North America	600	650	650	575	580	490	385	380	370
Western Europe	450	480	530	455	535	480	400	390	395
Japan	265	260	255	215	235	215	215	225	230
China	425	380	385	320	305	170	160	200	210
RoW	175	185	205	190	210	210	205	215	235
Total	**1,915**	**1,955**	**2,025**	**1,755**	**1,865**	**1,570**	**1,365**	**1,410**	**1,440**

Source: SFA (Oxford)

Palladium supply-demand balance

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Primary supply									
Regional									
South Africa	2,530	2,500	2,555	1,845	2,755	2,240	2,255	2,290	2,165
Russia	2,740	2,670	2,870	2,810	2,585	2,790	2,690	2,760	2,755
Zimbabwe	395	380	385	405	395	410	430	420	420
North America	985	1,035	975	950	950	740	785	740	560
Other	415	395	395	385	265	270	270	265	265
Total	**7,065**	**6,975**	**7,180**	**6,395**	**6,955**	**6,450**	**6,430**	**6,470**	**6,165**
Demand & recycling									
Autocatalyst									
Gross demand	8,125	8,455	8,590	7,545	7,820	7,810	7,820	7,435	7,080
Recycling	2,265	2,410	2,565	2,395	2,840	2,670	2,215	2,200	2,320
Net demand	5,860	6,050	6,025	5,145	4,985	5,140	5,605	5,235	4,760
Jewellery									
Gross demand	225	220	210	195	155	140	130	125	130
Recycling	70	60	55	50	40	35	30	40	40
Net demand	155	155	155	145	115	105	100	90	95
Industrial demand	**1,840**	**1,840**	**1,715**	**1,640**	**1,500**	**1,485**	**1,375**	**1,375**	**1,385**
Hydrogen	**0**	**0**	**0**	**10**	**20**	**20**	**25**	**30**	**30**
Other recycling	**380**	**370**	**365**	**335**	**415**	**365**	**350**	**345**	**350**
Gross demand	**10,190**	**10,515**	**10,520**	**9,385**	**9,495**	**9,455**	**9,355**	**8,965**	**8,625**
Recycling	**2,715**	**2,845**	**2,990**	**2,780**	**3,295**	**3,070**	**2,595**	**2,580**	**2,705**
Net demand	**7,475**	**7,670**	**7,530**	**6,610**	**6,200**	**6,385**	**6,760**	**6,385**	**5,920**
Market balance									
Balance (before ETFs)	-415	-695	-350	-210	755	65	-330	85	245
ETFs (stock allocation)	-375	-560	-90	-115	50	-90	80	245	
Balance after ETFs	**-40**	**-130**	**-265**	**-95**	**705**	**155**	**-405**	**-160**	**245**

Source: SFA (Oxford)

Palladium demand and recycling summary

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Gross demand									
Autocatalyst									
North America	1,850	1,860	1,815	1,460	1,620	1,660	1,780	1,770	1,660
Western Europe	1,705	1,720	1,675	1,280	1,200	1,090	1,115	1,035	955
Japan	805	840	870	760	715	715	735	665	635
China	2,040	2,060	2,290	2,465	2,135	1,830	1,630	1,395	1,310
India	240	320	285	235	335	410	410	425	410
RoW	1,490	1,655	1,650	1,345	1,815	2,100	2,150	2,150	2,110
Total	**8,125**	**8,455**	**8,590**	**7,545**	**7,820**	**7,810**	**7,820**	**7,435**	**7,080**
Jewellery									
North America	35	35	35	35	30	25	25	25	25
Western Europe	55	55	55	50	40	35	35	30	35
Japan	50	50	50	45	35	30	30	30	30
China	60	55	50	45	35	35	30	30	30
RoW	25	25	25	20	15	15	15	15	15
Total	**225**	**220**	**210**	**195**	**155**	**140**	**130**	**125**	**130**
Industrial									
North America	340	305	295	245	250	245	225	230	215
Western Europe	310	295	290	260	260	250	235	235	225
Japan	360	335	300	255	245	235	205	200	200
China	415	485	415	485	390	415	370	375	385
RoW	410	420	415	395	350	340	335	335	355
Total	**1,840**	**1,840**	**1,715**	**1,640**	**1,500**	**1,485**	**1,375**	**1,375**	**1,385**
Hydrogen	**0**	**0**	**0**	**10**	**20**	**20**	**25**	**30**	**30**
Total gross demand									
North America	2,225	2,200	2,150	1,740	1,900	1,930	2,035	2,025	1,900
Western Europe	2,070	2,070	2,015	1,590	1,500	1,375	1,385	1,305	1,215
Japan	1,215	1,225	1,220	1,055	995	980	965	890	865
China	2,515	2,600	2,760	2,995	2,560	2,275	2,030	1,800	1,730
RoW	2,170	2,420	2,375	1,995	2,520	2,870	2,915	2,920	2,890
Total	**10,190**	**10,515**	**10,520**	**9,385**	**9,495**	**9,455**	**9,355**	**8,965**	**8,625**

Source: SFA (Oxford). Note: Regional totals exclude hydrogen demand.

Palladium demand and recycling summary (continued)

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Recycling									
Autocatalyst									
North America	1,270	1,360	1,430	1,370	1,580	1,355	1,085	1,065	1,085
Western Europe	440	475	480	445	550	505	390	380	385
Japan	145	180	200	190	215	210	220	215	220
China	165	155	165	150	180	245	185	205	255
RoW	245	240	290	240	315	350	335	340	380
Total	**2,265**	**2,410**	**2,565**	**2,395**	**2,840**	**2,670**	**2,215**	**2,200**	**2,320**
Jewellery									
Japan	20	15	15	15	10	10	5	5	5
China	50	45	40	35	30	25	25	30	30
Total	**70**	**60**	**55**	**50**	**40**	**35**	**30**	**40**	**40**
WEEE									
North America	75	70	70	60	70	60	55	55	55
Western Europe	80	80	75	70	75	70	65	60	60
Japan	130	125	120	110	120	110	100	100	100
China	35	40	45	45	60	55	60	60	65
RoW	60	60	60	55	90	70	70	65	70
Total	**380**	**370**	**365**	**335**	**415**	**365**	**350**	**345**	**350**
Total recycling									
North America	1,345	1,430	1,495	1,435	1,645	1,420	1,145	1,120	1,140
Western Europe	520	550	555	510	625	575	455	440	445
Japan	295	320	340	310	350	330	330	320	325
China	250	240	250	230	270	325	265	295	350
RoW	305	295	345	295	405	425	400	405	445
Total	**2,715**	**2,845**	**2,990**	**2,780**	**3,295**	**3,070**	**2,595**	**2,580**	**2,705**

Source: SFA (Oxford)

Rhodium supply-demand balance

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Primary supply									
Regional									
South Africa	620	625	640	475	670	595	575	575	550
Russia	75	75	80	80	75	75	75	75	80
Zimbabwe	45	40	40	45	40	45	45	45	45
North America	25	20	20	20	20	15	20	15	15
Other	10	10	10	10	5	5	5	5	5
Total	**775**	**770**	**790**	**630**	**815**	**735**	**720**	**715**	**695**
Demand & recycling									
Autocatalyst									
Gross demand	865	915	1,020	935	925	925	935	880	865
Recycling	305	335	350	325	360	325	275	270	285
Net demand	565	580	670	610	565	600	660	610	585
Industrial demand	**100**	**95**	**100**	**-15**	**50**	**25**	**130**	**130**	**125**
Other recycling	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**
Gross demand	**970**	**1,010**	**1,125**	**920**	**975**	**950**	**1,070**	**1,010**	**990**
Recycling	**305**	**340**	**355**	**330**	**360**	**330**	**275**	**275**	**285**
Net demand	**665**	**675**	**770**	**590**	**615**	**620**	**790**	**735**	**705**
Market balance									
Balance (before ETFs)	110	100	20	35	200	110	-75	-20	-10
ETFs (stock allocation)	-20	-50	-15	-10	-5	0	0	0	
Balance after ETFs	**130**	**145**	**35**	**45**	**205**	**115**	**-75**	**-20**	**-10**

Source: SFA (Oxford)

GLOSSARY OF TERMS

Basket price
Collective revenue of metals divided by 4E oz.

BEV
Battery electric vehicle.

EMs
Emerging markets.

Eskom
South Africa's public energy producer and supplier.

ETF
Exchange-traded fund.

Gross demand
A measure of intensity of use.

ICE
Internal combustion engine.

koz
One thousand troy ounces.

moz
One million troy ounces.

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

Net supply
Proxy supply of metal surplus to requirements.

OTC
Over-the-counter trade. Trading via a broker-dealer network rather than a centralised exchange.

oz
Troy ounce.

PN
Particle number emissions refers to the total number of solid particles released from a vehicle's exhaust.

PGMs
Platinum-group metals.

Primary supply
Mine production.

Secondary supply
Recycling output.

Thrifting
Using less metal in order to reduce costs.

TOCOM
Tokyo Commodity Exchange.

WEEE
Waste electrical and electronic equipment.

4E
Platinum, palladium, rhodium and gold.

METHODOLOGY

Primary supply is calculated from actual mine production and excludes the sale of stock in order to provide pure production data. Stock sales are treated separately in SFA's database as movement of stocks. Therefore, state stock sales from Russia are excluded in tabulations.

Gross demand is a measure of intensity of use.

Net demand is a measure of the theoretical requirement for new metal, i.e. net of recycling.

Automotive demand is based on vehicle production data not sales.

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SFA (Oxford) Ltd
The Magdalen Centre
Robert Robinson Avenue
The Oxford Science Park
Oxford
OX4 4GA
United Kingdom

Tel: +44 1865 784366
info@sfa-oxford.com
www.sfa-oxford.com