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Palladium coatings provide effective exhaust gas cleaning in catalytic converters.

The Palladium Standard 2025

Setting the PGM agenda for the years ahead

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THE PALLADIUM STANDARD

September 2025

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FOREWORD

Foreword

A critical 12 months for PGMs

Many of the most dramatic changes that have occurred in the last 12 months have followed on from the election of Donald Trump to a second term as US President. With a combination of executive orders and tariffs the President has changed government policy in many areas, and the US's trade relationship with the rest of the world has been significantly altered. PGMs have been impacted by the 25% tariff imposed on automotive imports under Section 232 of the Trade Expansion Act, with higher car prices expected to result in reduced new vehicle sales, although PGMs avoided being subject to the reciprocal tariffs as they are considered critical minerals in the US. After agreeing a trade deal with the US, the EU did not put tariffs on PGM imports.

However, concerns over possible US tariffs caused platinum imports into the US to rise, with NYMEX inventories gaining over 500 koz of metal by early April. At the same time, the gold price continued to hit record highs, partly due to concerns about the tariffs, making platinum look ever more undervalued. The high gold price and low platinum price kept Chinese investors interested and encouraged jewellery fabricators to stock up on platinum, notably lifting trade flows into China and Hong Kong.

The established trend of BEVs gaining market share from combustion engine vehicles has continued which is cutting into automotive demand for PGMs. Although, for the US at least, the details have changed with the imminent end of tax credits for BEVs likely to be followed by changes to EPA emissions standards and possibly an end to California's ability to set its own emissions standards. This looks likely to slow BEV uptake in the US, thereby supporting palladium demand compared to previous forecasts.

A reordering of supply chains and trade relationships has put renewed emphasis on sourcing critical minerals. In the feature article the spotlight falls on two, ruthenium and iridium, critical metals in terms of both their supply concentration in South Africa and their technological uses. However, the limited impact of their prices on the economics of mining puts their future supply at the mercy of platinum, palladium and rhodium prices.

THE PGM MARKETS IN 2025

The PGM markets in 2025

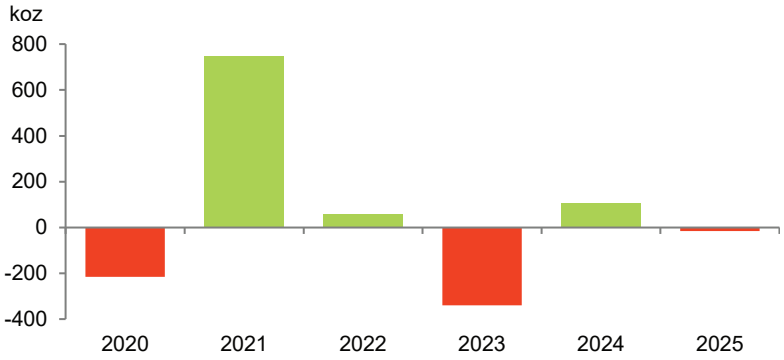
Dr. Ralph Grimble, SFA (Oxford)

The palladium market

The palladium market is forecast to be close to balance in 2025 (15 koz deficit), tightening from a moderate surplus last year, as primary supply falls faster than net demand. Production from South Africa was weaker than anticipated in the first half of the year and this compounded the decline from the restructuring of North American production. Secondary supply is growing again, helped by the vehicle trade-in scheme in China. However, palladium demand is set to decline by 2%, led by automotive demand as BEVs gain further market share.

The palladium market is close to balance

Palladium market balance



Source: SFA (Oxford)

This year's economic outlook has been shaped by President Trump who started his second term with a flurry of executive orders and tariffs impacting a whole range of industries, including automakers and the PGM markets. There have been two main opposing influences on US automotive demand as a result. The greater of the two, and a negative for palladium demand, is the introduction of 25% tariffs on cars imported into the US which will impact prices and reduce affordability for consumers. This has led to a downgrade to forecasts of light-vehicle sales this year in the US of around 1 million units. Supporting palladium demand is the ending of the tax credit for BEVs in September which will limit the uptake of BEVs, maintaining ICE vehicle sales at a higher level for longer.

Trump has impacted US trade with some fallout for palladium

Global light-vehicle production is forecast to climb to 90.8 million units in 2025, up from 90.2 million in 2024. However, BEV production is growing faster than the overall market and is predicted to exceed 14 million units this year, up from 11 million in 2024, resulting in a decline in ICE and hybrid vehicle production and palladium demand.

BEVs continue to take share from combustion vehicles

Mine supply

Primary palladium supply is contracting

Primary palladium production is forecast to fall by 6% to 6.09 moz this year owing to declining output in North America and South Africa.

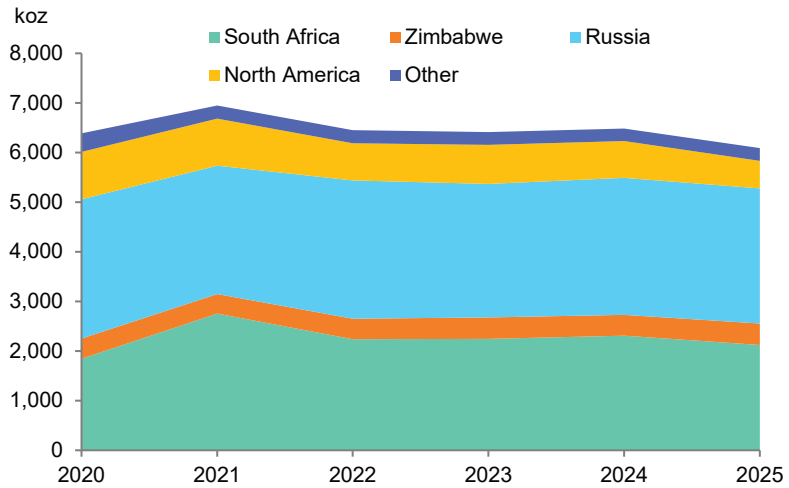
Disruptions cut South African production by 8%

In South Africa, heavy rains in the first quarter resulted in flooding which hindered surface operations and impacted an underground mine, resulting in lower than normal production. There was also smelter maintenance at various operations and Valterra carried out a stock count at the precious metals refinery which impacted refined output. Most of the backlog will be processed during 2025 but Impala increased the amount of work-in-progress stock it holds and intends to draw it down over the next few years. Adding modestly to output in the second half of 2025 are the restart of underground mining at Crocodile River and the planned start-up of the Platreef mine later this year. For the full year, output is now expected to be 8% lower than in 2024 at 2.12 moz.

North American output falls by 26% this year

In North America, palladium output is predicted to drop by 26% to 550 koz. Stillwater is finalising the restructuring of its operations, reducing production by around 40% this year. At the same time, Impala Canada's production is declining ahead of its closure which has been brought forward to 2026. In Russia, Norilsk's output is expected to be little changed at 2.73 moz, but in Zimbabwe a modest increase in supply is anticipated.

Primary palladium supply



Source: SFA (Oxford)

Recycling

Secondary palladium supply is projected to rise by 3% to 2.68 moz. Growth in autocatalyst recycling is expected in China, Japan and the Rest of World region. Chinese authorities extended the trade-in subsidy scheme for older vehicles that was introduced in 2024 to the end of 2025 and this has again helped boost sales of new cars and the number of older cars that are scrapped. In the US, if the tariffs on automotive imports result in further cost increases for new cars, this could push more consumers to look at the second-hand market and result in older cars being kept on the road for longer, impacting the number of scrapped vehicles. Thus far, light-vehicle sales have held up in the US and if that continues to be the case then secondary supply could be higher than currently anticipated.

Palladium secondary supply is rising

Demand

Global palladium demand is predicted to slip by 2% to 8.78 koz as automotive demand contracts, outweighing a slight gain in industrial demand. Light-vehicle production is forecast to increase modestly this year, but BEVs are still gaining market share and so catalysed vehicle production is shrinking. Some modest additional thrifting by Chinese automakers is also anticipated this year.

Palladium demand is shrinking

Automotive demand

Automotive demand for palladium is forecast to fall by 3% to 7.19 moz this year as BEV market share gains squeeze out ICE and hybrid production. Light-vehicle production is predicted to be 0.6 million units higher than last year at 90.8 million units. The growth in production is driven by China, helped by incentives and its growing car export momentum, as well as the Rest of World region and Japan, with North America, Western Europe and Korea experiencing lower production mostly related to US tariffs on auto imports. BEVs continue to gain market share, although not as fast as was anticipated in Europe or the US. With the removal of the tax credits for BEVs in the US, sales are expected to fall off in the fourth quarter. That said, global BEV production is forecast to climb to over 14 million units this year, around 3 million units higher than last year.

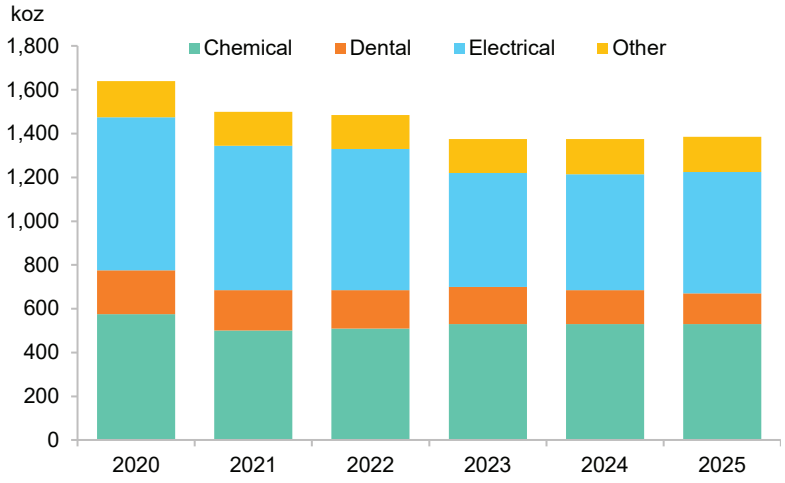
Automotive demand is contracting as BEV sales grow at the expense of ICE and hybrids

Industrial demand

Industrial palladium requirements are forecast to edge up to 1.39 moz in 2025. Record gold prices have shifted some demand to palladium for some plating applications, resulting in stronger electronic demand. Dental demand continues its long-term decline, somewhat offsetting the gain in electrical demand, with other demand areas holding steady.

Industrial usage forecast to expand slightly this year

Industrial palladium demand



Source: SFA (Oxford)

Investment

Palladium ETFs have seen volatile flows over the first eight months of 2025 with total holdings rising by 128 koz to 889 koz. Most of the gains were made from May to July (+172 koz) as the price rallied and were followed by some profit-taking in August. US investors were responsible for the majority of the increase (+76 koz), with UK investors adding 35 koz to their holdings. Even with the price rallying, the non-commercial net position on NYMEX remained net short. It was highest in April at just over 1 moz and shrank to less than 200 koz in July, before expanding again to over 400 koz at the end of August as the price retreated from its 18 July high of $1,336/oz.

Palladium ETF flows have been positive

The platinum market

The platinum market remains in deficit

The platinum market is forecast to see the deficit expand to 545 koz (excluding investment) in 2025 as primary supply contracts more than demand. Although jewellery demand is anticipated to be higher, automotive and industrial requirements are both predicted to drop this year, reducing net demand. Global production shrinks owing to production problems in South Africa in the first half of the year and declining output in North America.

Primary South African platinum supply is projected to fall to 3.6 moz in 2025...

Global primary supply is predicted to fall by 8% to 5.10 moz. Flooding impacted some South African mines in the first half of the year and annual production is expected to fall by 10% to 3.61 moz. North American production is declining, although not as significantly in volume terms for platinum as for palladium, amid Stillwater's restructuring and Impala Canada reducing output. Production in Zimbabwe edges up, while Russian output is little changed this year.

...while secondary supply rises modestly

Secondary platinum supply is predicted to rise to 1.42 moz in 2025, with slightly higher recoveries from spent autocatalysts as the recycling sector responds to higher prices, and an increase in jewellery recycling.

Automotive demand is forecast to drop to 3.03 moz this year. With platinum now used in tri-metal gasoline autocatalysts, the ongoing loss of market share to BEVs for gasoline vehicles compounds the further decline in diesel passenger car sales in reducing platinum requirements.

Interest in platinum jewellery by Chinese fabricators has increased

Global platinum jewellery demand is estimated to climb by 12% to 1.54 moz owing to strong fabricator demand in China. The number of Chinese fabricators producing platinum jewellery has jumped as the price discount to gold has made platinum jewellery more financially attractive. Platinum jewellery has become cheaper than white gold, even when higher fabrication costs are taken into account. However, fabricator demand still needs to translate into consumer sales.

Platinum requirements for industrial uses are predicted to drop by 7% to 2.22 moz this year. Several years of significant capacity build-out by the glass industry in China had led to overcapacity, which had resulted in increasing exports. However, tariffs have restricted the industry's ability to export excess production, so capacity expansions have been reined in sharply this year, reducing the need for platinum. This has outweighed modest gains in the other major industrial end-uses.

The rhodium market

The rhodium market is forecast to have a deficit of 30 koz in 2025. Automotive demand is edging lower as BEVs take further market share from ICE vehicles, whereas net industrial demand is predicted to expand owing to a return of glass demand. Primary supply is expected to decline owing to lower output in South Africa, whereas secondary supply is set to be up slightly year-on-year.

The rhodium market is in deficit in 2025

Automotive rhodium demand is estimated to slip by 3% to 860 koz. Automotive demand is trending lower as global ICE and hybrid-vehicle production is forecast to fall by 3% with BEVs gaining further market share.

Rising industrial demand offsets a contraction in automotive demand

Industrial rhodium requirements are projected to recover to 135 koz this year. Net industrial requirements are anticipated to expand owing to positive net glass demand now that stock sales by the fibreglass industry in China have ended. Most other industrial sectors are expected to have steady demand.

Primary rhodium supply is forecast to fall by 5% to 685 koz as a result of production interruptions in South Africa in the first half of the year. South African output is projected to drop by 7% to 540 koz after flooding impacted output in the first half of the year. Production in Russia, North America and Zimbabwe is expected to be essentially flat year-on-year. Secondary rhodium supply is predicted to be slightly higher this year owing to an increase in recycled autocatalysts.

Primary supply is shrinking

The price outlook for the next six months

Palladium: $1,110/oz

The palladium market is close to balance as primary supply has declined more than net demand. Production problems in South Africa in the first half of the year have combined with falling North American output to tighten the market. The palladium market has seen fewer signs of tightness than the platinum market with lease rates remaining relatively subdued and much more limited flows into US vaults. The palladium price followed platinum higher but is now consolidating those gains.

The fourth and first quarters of the year are typically the strongest for the palladium price. However, liquidity should improve going forward as South African production is returned to normal in the second half of the year. At the same time, automotive demand is falling as BEVs continue to take market share, squeezing out ICE and hybrid light-vehicle production. There is a downside price risk from deteriorating economic conditions as US tariffs feed through to economic activity.

The price is predicted to average $1,110/oz over the next six months.

Platinum: $1,330/oz

The platinum market is firmly in deficit, excluding investment demand. The price rallied sharply in the middle of the year amid underperforming primary supply in South Africa and unusual trade flows as concerns over US tariffs saw extra metal flowing into US vaults. China also imported more than usual owing to robust jewellery fabricator demand and continued investor interest.

The price exceeded $1,400/oz but has fallen back and is now consolidating those gains. Lease rates remain elevated indicating ongoing tightness, but the tightness could ease as production in South Africa should have returned to normal and ETF investors have been net sellers as they have taken profits.

Consequently, the price is expected to average $1,330/oz over the next six months.

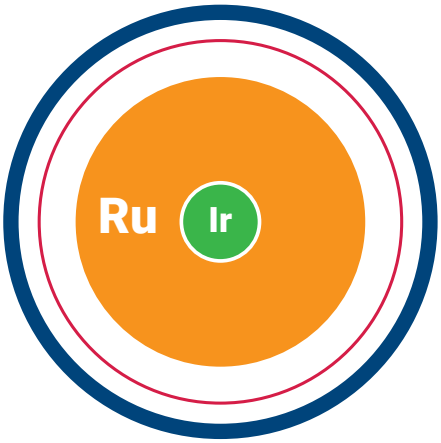
Rhodium: $6,850/oz

Rhodium demand is holding steady this year as improved industrial demand offsets declining automotive demand which is falling in line with lower ICE and hybrid automotive production. With primary supply underperforming expectations in the first half of the year, the market is predicted to be modestly in deficit this year.

Supply disruptions in South Africa in the first half of the year have been resolved, so supply should be higher in the second half of the year.

The rhodium price is forecast to average $6,850/oz over the next six months.

RUTHENIUM AND IRIDIUM: UNIQUE AND SCARCE METALS



Ruthenium and iridium: unique and scarce metals

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

A critical examination of market concentration, recycling potential, stocks and industry outlook

Ruthenium and iridium are integral members of the platinum-group metals (PGMs), which are sourced predominantly from South Africa's ancient ore bodies, with a small number of major mining companies responsible for a substantial proportion of supply. As demand for ruthenium and iridium grows across advanced technological applications, it is vital to understand the mechanisms of their extraction, the prevailing challenges, and future projections for their supply. It is also key to reflect on the in-use recovery of these valuable metals and consider available stocks to alleviate supply security concerns.

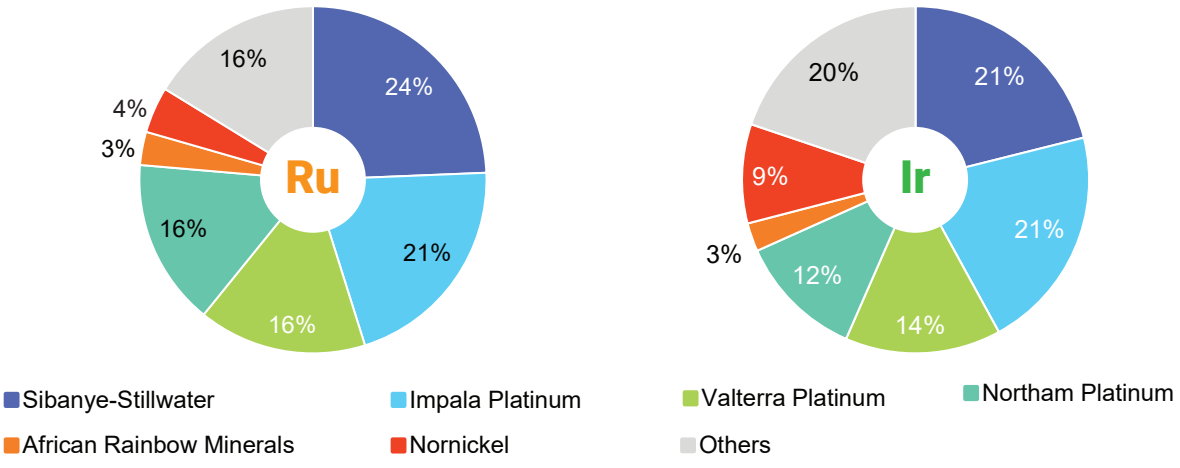
South Africa dominates ruthenium and iridium production, recycling ensures security

Dominance of South African mines

South Africa maintains a commanding position as the world's leading producer of ruthenium and iridium. Just five companies, Valterra Platinum, Sibanye-Stillwater, Northam Platinum, Impala Platinum and African Rainbow Minerals, collectively produce 80% of the world's ruthenium and 71% of its iridium. Including smaller producers, the nation supplies approximately 94% and 89% of primary ruthenium and iridium, respectively.

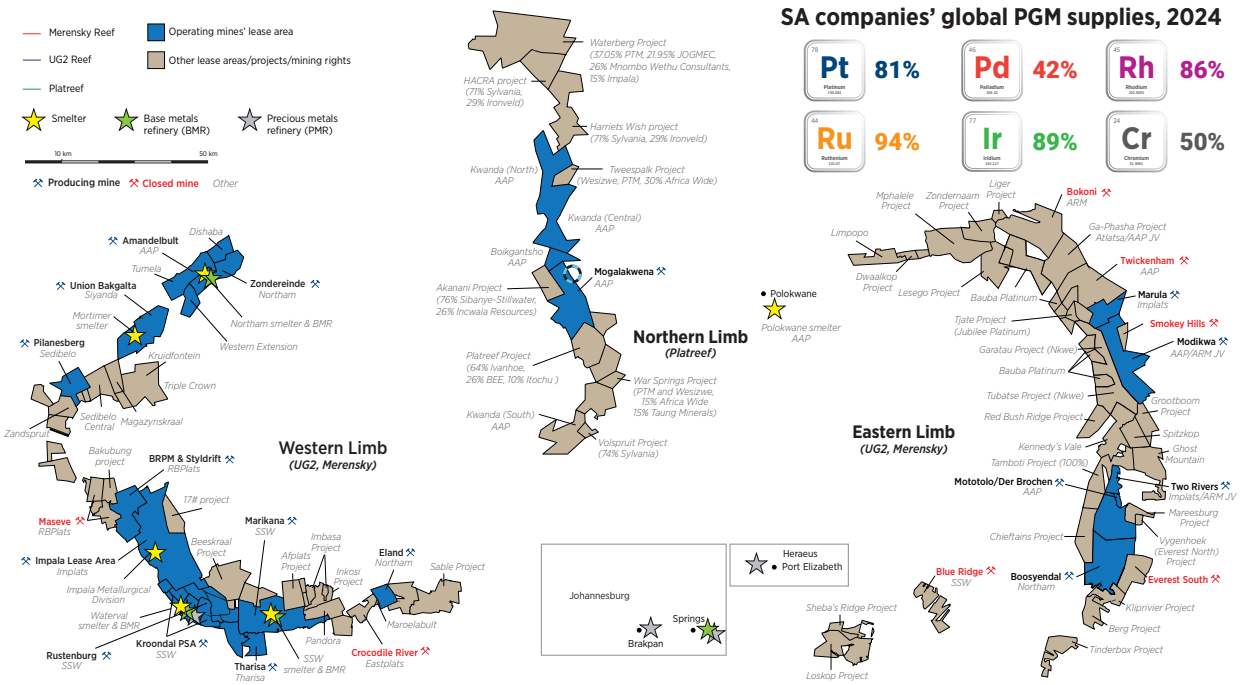
Five producers control an overwhelming share of production

Ruthenium and iridium supply by company, 2024



Source: SFA (Oxford), company results

Bushveld Igneous Complex (BIC) mines and PGMs



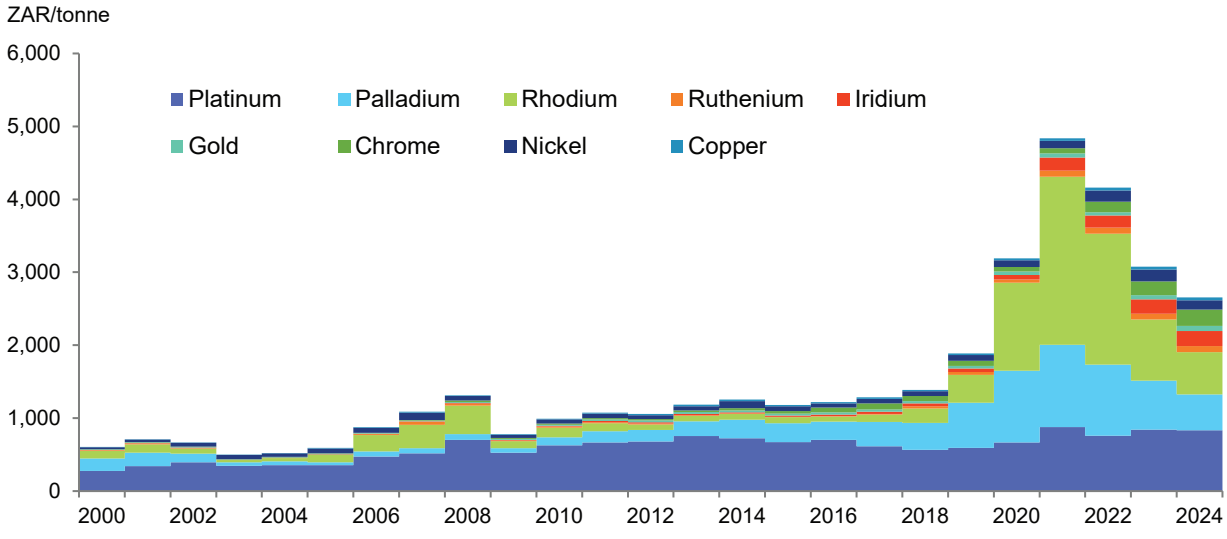
Source: SFA (Oxford)

Economic impact and mining challenges

Despite their industrial significance, ruthenium and iridium exert limited influence on the economics of mining in South Africa. As of 2024, ruthenium and iridium contribute only 3% and 8% of mine revenues, respectively. Even a dramatic 100% increase in the price of either metal would only marginally impact mine revenue — up 3.7% for ruthenium and just over 10% for iridium. The dominant revenue drivers remain platinum, palladium and rhodium.

Ruthenium and iridium contribute marginal mine revenues

South Africa PGM mine revenues per tonne 2000-2024



Source: SFA (Oxford)

Mine economics limit ruthenium and iridium supply

The availability of mine-derived ruthenium and iridium is likely to be impacted by a shift in the automotive sector from internal combustion engines to battery electric vehicles in the coming years, reducing demand for palladium and rhodium. Ruthenium and iridium, which cannot be selectively mined, are thus constrained within the broader context of mine economics.

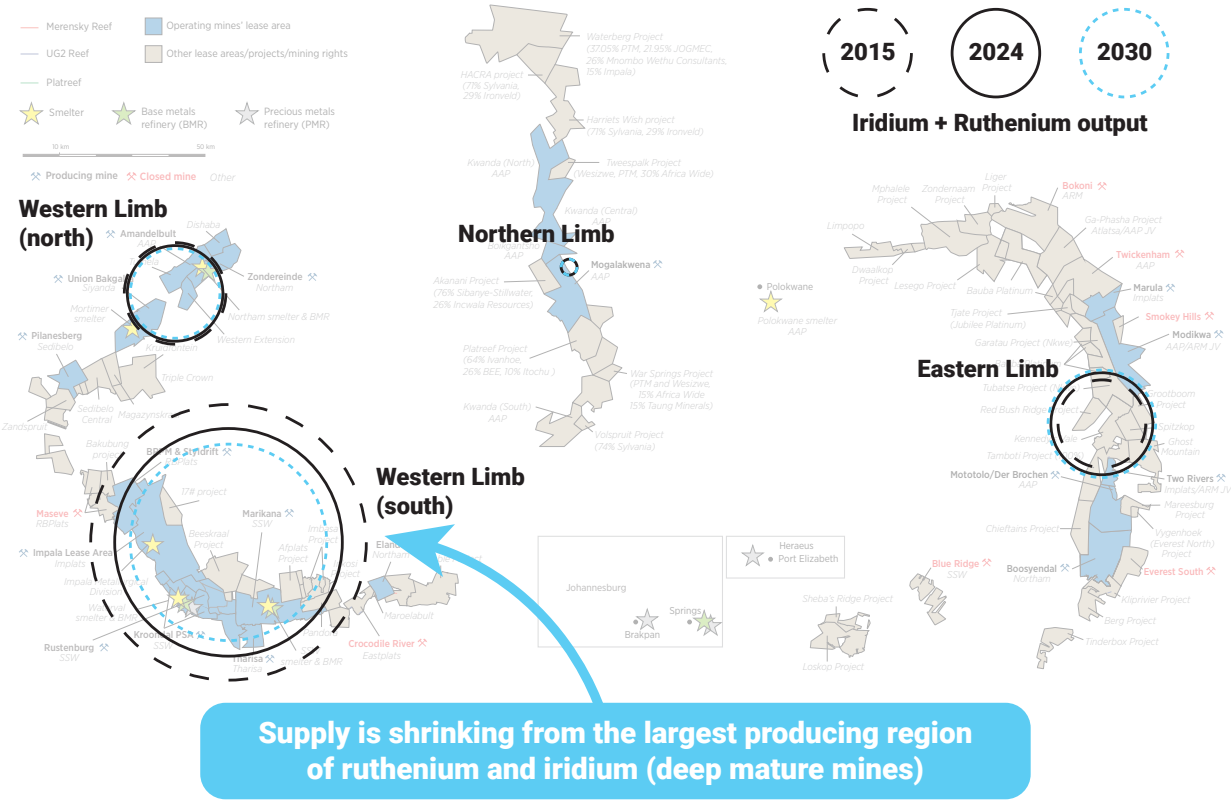
Deeper mining escalates costs, risks and complexity

Operational challenges are mounting as mining extends ever deeper due to the depletion of shallower reserves. The typical mining depth for ruthenium and iridium now approaches one kilometre, with virgin rock temperatures rising to 38-43°C. In the deepest operations, extraction occurs at depths of up to two kilometres, where temperatures can reach 65°C. Such conditions substantially increase upfront capital, operational complexity, risks, costs, and lower overall ore extraction ratios.

Western Limb production is in decline

The most mature and productive sections of the BIC are in decline, a trend expected to persist. The Eastern Limb is the exception, where relatively shallow mining continues to support growing production. Nevertheless, total primary supply of ruthenium and iridium has been declining steadily over the past decade.

Shrinking ruthenium and iridium output



Source: SFA (Oxford)

Applications and demand

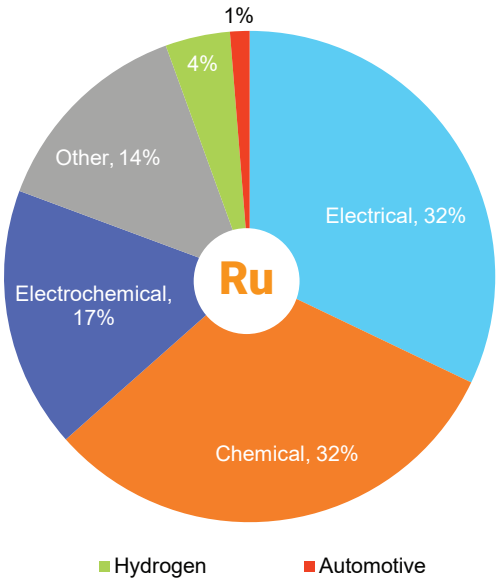
Ruthenium and iridium are indispensable to several advanced industrial sectors. Ruthenium is vital in plastics and textiles' manufacturing, data storage, and the synthesis of green hydrogen, with robust demand from the electrical and chemical industries. Modern, integrated petrochemical complexes are increasingly favouring ruthenium catalysts over other PGMs, particularly for caprolactam production in China. In data storage, ruthenium is seeing renewed momentum after a post-Covid downturn caused by excess inventories and weak consumer electronics sales. The rapid growth of AI and cloud computing is now driving demand for affordable data storage solutions, with ruthenium-based disk drives offering a clear cost advantage over alternative technologies.

Ruthenium demand surges with AI-driven storage

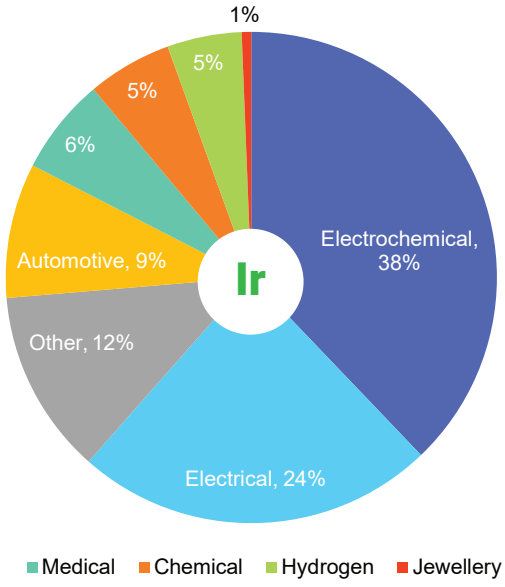
Iridium plays a vital role in chloralkali processes, green hydrogen production, satellite components, and high-temperature crucibles. With the continued expansion of the hydrogen and chemical industries, demand for the metal is expected to increase. The electrochemical sector remains a cornerstone of iridium demand, driven by environmental regulations that are phasing out mercury-based systems in favour of membrane technologies. These rely on iridium-ruthenium coated, dimensionally stable anodes to produce chlorine and caustic soda, bulk commodities whose growth is closely tied to rising populations and consumer demand in emerging markets.

Iridium demand strengthens on green tech expansion

Ruthenium demand, 2024



Iridium demand, 2024



Source: SFA (Oxford)

Recent optimism for green hydrogen has been tempered by the delays and cancellations of large-scale projects globally. In the US, policy headwinds driven by the Trump administration's broader opposition to renewables pose significant challenges for developers, even though hydrogen-related tax credits have faced a less severe rollback than expected. Rising uncertainty and escalating costs have pushed substantial growth expectations beyond 2030. Nonetheless, the strategic importance of ruthenium and iridium remains intact.

Project setbacks shift hydrogen growth beyond 2030

The role of recycling

Given the increasingly challenging conditions for primary extraction, recycling has emerged as a vital method for meeting future market requirements. The majority of this metal will have been sourced through closed-loop recycling, i.e. metal that stays within a loop from product, use and replacement with participation by a limited number of companies. Looking ahead, as primary sources of ruthenium and iridium continue to decline, so the need for greater sources of recycling will grow. This may come from unrecycled low-grade scrap, for which additional processing capability needs to be found to ensure recovery of these strategic PGMs. However, prices may need to rise further, or supply security may need to become a concern, before investment in such facilities and supply chains takes place. The open-loop collection of spark plug tips, for example, has started.

Open-loop recycling is limited for now

Conclusion

Ruthenium and iridium are rare metals with substantial industrial value, and South Africa's dominance in their production remains. However, ongoing technical and economic challenges such as deeper mining operations, declining ore grades and evolving market dynamics cast uncertainty over future primary supply trajectories. As global industries increasingly rely on these metals for technological advancement and sustainability, securing their supply will require both mining investment and greater recycling efforts to capture not only closed-loop recycled metal, but also low-grade open-loop material. Sustainably higher platinum, palladium and rhodium prices could help to unlock more ruthenium and iridium supplies from mining, while higher prices and increased price volatility may lead to concerted recycling efforts and substitution with other metals/materials.

Securing ruthenium and iridium demands investment, recycling, and resilient market strategies

SFA Oxford

Ruthenium and Iridium Market Report Q3 2025

This risk-focused ruthenium and iridium report examines the supply, demand and pricing trends for these critical metals over the next four years.

The price risk report includes:

- Data storage growth — how long will ruthenium remain relevant?
- China's chemical industry — growth prospects for ruthenium and iridium catalysts
- Trade tariffs and macroeconomic influences — global and regional metal trade effects
- Will rising PGM prices slow ruthenium and iridium supply depletion from South Africa?

Unrivalled insights and analysis

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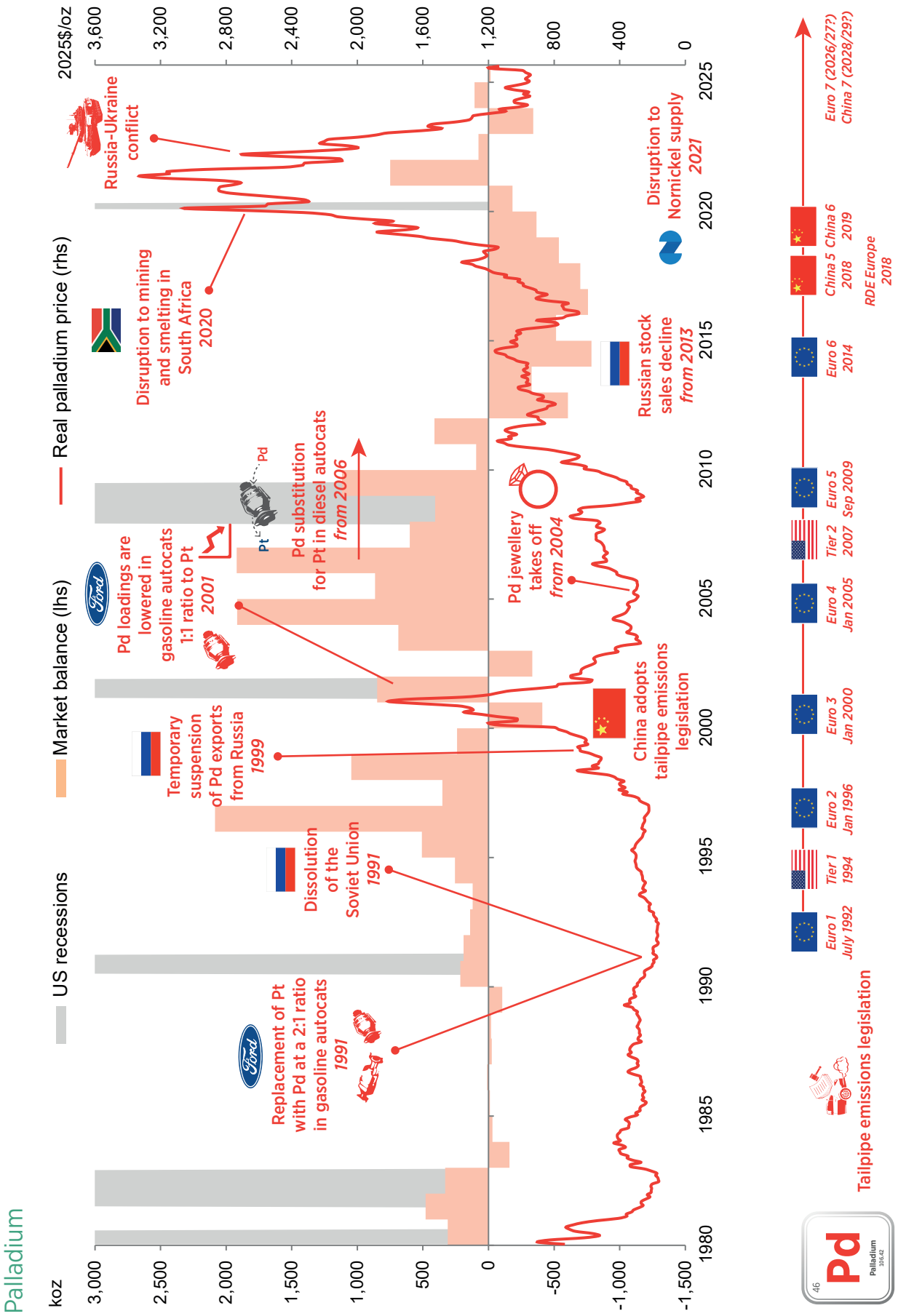
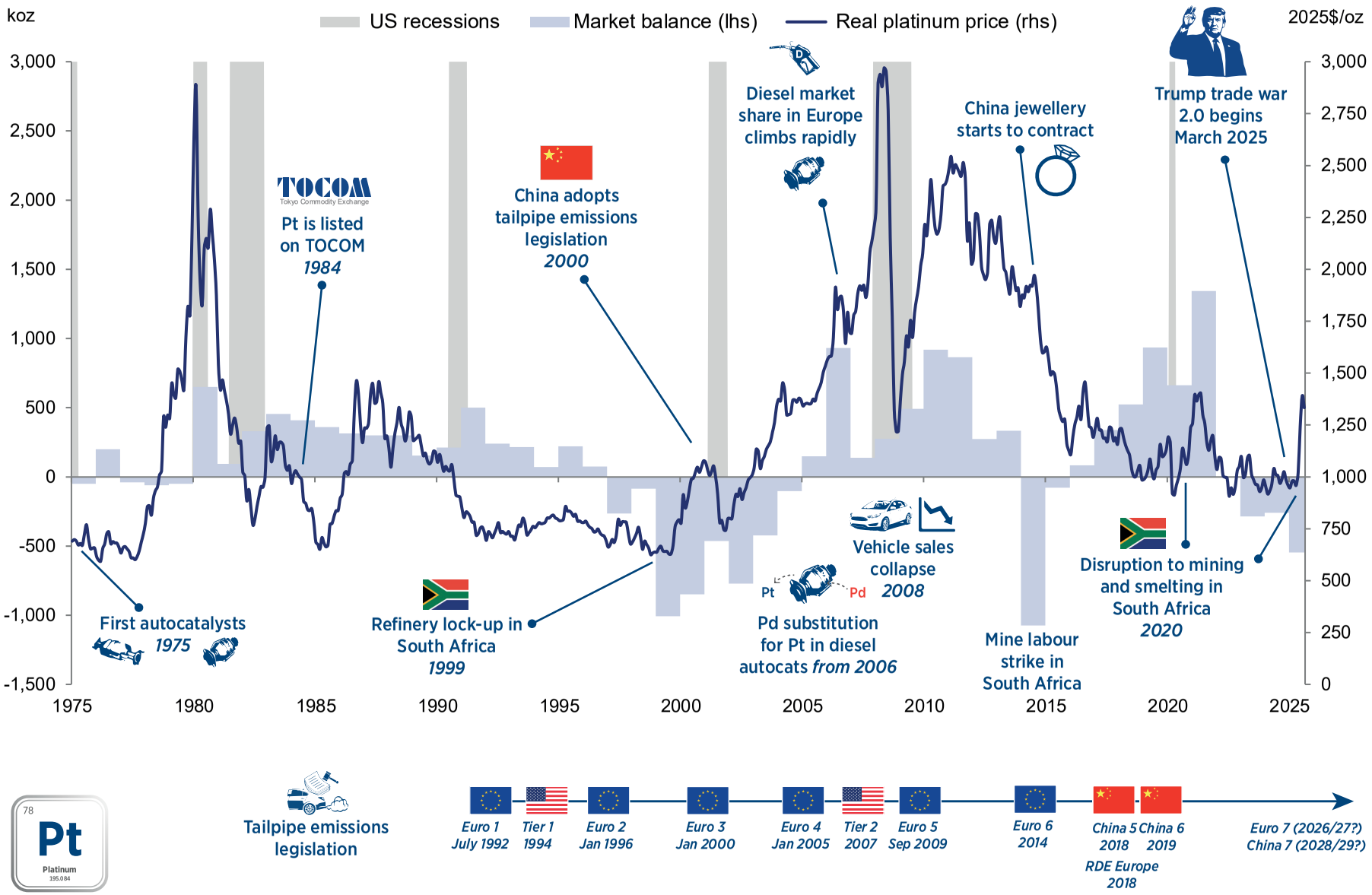
PGM PRICE HISTORY



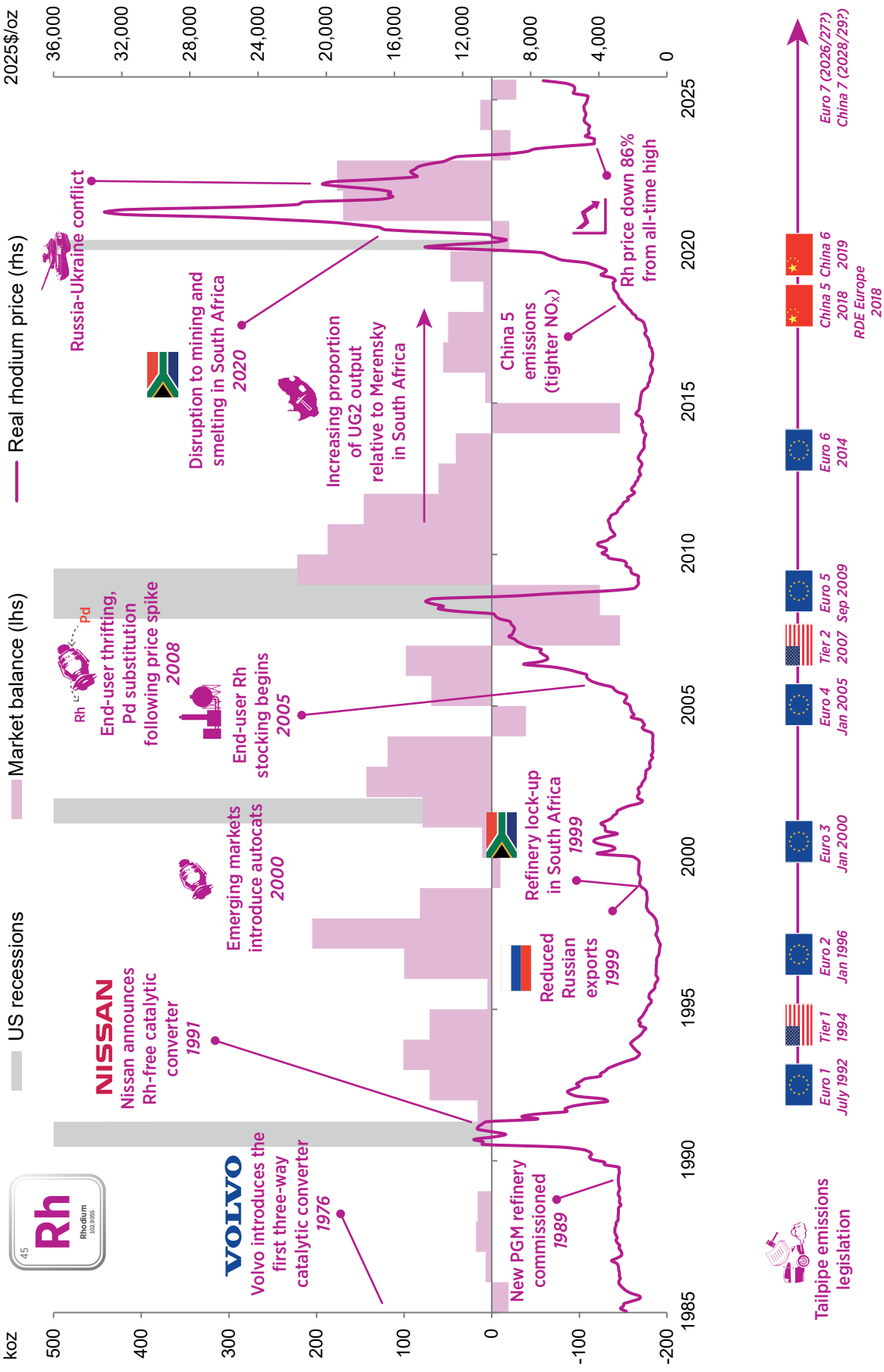
Source: SFA (Oxford), Bloomberg

Platinum



Source: SFA (Oxford), Bloomberg

Rhodium



Source: SFA (Oxford), Bloomberg

APPENDIX

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	2,245	2,310	2,120
Russia	2,740	2,670	2,870	2,810	2,585	2,790	2,690	2,760	2,730
Zimbabwe	395	380	385	405	395	410	430	420	430
North America	985	1,035	975	950	950	740	785	740	550
Other	415	390	375	375	265	265	260	255	260
Total	**7,060**	**6,975**	**7,160**	**6,385**	**6,955**	**6,450**	**6,415**	**6,485**	**6,085**
Demand & recycling									
Autocatalyst									
Gross demand	8,125	8,455	8,590	7,540	7,830	7,815	7,820	7,435	7,230
Recycling	2,265	2,410	2,565	2,395	2,840	2,670	2,215	2,215	2,295
Net demand	5,860	6,050	6,025	5,140	4,990	5,145	5,605	5,220	4,940
Jewellery									
Gross demand	225	220	210	195	155	140	130	125	130
Recycling	70	60	55	50	40	35	30	30	35
Net demand	155	155	155	145	115	105	100	95	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**	**9,380**	**9,500**	**9,460**	**9,355**	**8,970**	**8,780**
Recycling	**2,715**	**2,845**	**2,990**	**2,780**	**3,295**	**3,070**	**2,595**	**2,590**	**2,680**
Net demand	**7,475**	**7,670**	**7,530**	**6,605**	**6,205**	**6,390**	**6,760**	**6,380**	**6,105**
Market balance									
Balance (before ETFs)	-415	-695	-370	-215	750	60	-340	105	-15
ETFs (stock allocation)	-375	-560	-90	-115	35	-90	65	245	
Balance after ETFs	**-40**	**-135**	**-280**	**-100**	**715**	**150**	**-410**	**-140**	**-15**

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	1,785	1,770	1,680
Western Europe	1,705	1,720	1,675	1,275	1,195	1,090	1,115	1,020	990
Japan	805	840	870	760	715	715	735	665	670
China	2,040	2,060	2,290	2,465	2,140	1,830	1,630	1,400	1,380
India	240	320	285	235	335	415	415	425	440
RoW	1,490	1,655	1,650	1,345	1,820	2,105	2,145	2,155	2,065
Total	**8,125**	**8,455**	**8,590**	**7,540**	**7,830**	**7,815**	**7,820**	**7,435**	**7,230**
Jewellery									
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	**225**	**220**	**210**	**195**	**155**	**140**	**130**	**125**	**130**
Industrial									
North America	385	370	340	305	295	245	250	245	235
Western Europe	320	325	310	295	290	260	260	250	235
Japan	420	400	360	335	300	255	245	235	225
China	375	375	415	485	415	485	510	445	430
RoW	435	430	410	420	415	395	350	340	360
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	1,920
Western Europe	2,070	2,070	2,015	1,590	1,500	1,375	1,380	1,290	1,250
Japan	1,215	1,225	1,220	1,055	995	980	965	895	900
China	2,515	2,600	2,760	2,995	2,565	2,275	2,030	1,800	1,800
RoW	2,170	2,420	2,375	1,995	2,520	2,875	2,910	2,930	2,875
Total	**10,190**	**10,515**	**10,520**	**9,380**	**9,500**	**9,460**	**9,355**	**8,970**	**8,780**
Recycling									
Autocatalyst									
North America	1,270	1,360	1,430	1,370	1,580	1,355	1,085	1,065	1,045
Western Europe	440	475	480	445	550	505	390	380	380
Japan	145	180	200	190	215	210	220	215	220
China	165	155	165	150	180	245	185	220	275
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**	**2,215**	**2,295**
Jewellery									
Japan	20	15	15	15	10	10	5	5	10
China	50	45	40	35	30	25	25	25	25
Total	**70**	**60**	**55**	**50**	**40**	**35**	**30**	**30**	**35**
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	1,100
Western Europe	520	550	555	510	625	575	455	440	440
Japan	295	320	340	310	350	330	330	320	325
China	250	240	250	230	270	325	265	305	370
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**	**2,590**	**2,675**

Source: SFA (Oxford)

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	3,920	3,990	3,605
Russia	720	665	710	700	640	655	670	670	665
Zimbabwe	480	465	460	480	470	490	520	505	520
North America	360	345	350	330	265	250	270	245	195
Other	180	180	160	165	125	120	110	105	110
Total	**6,125**	**6,130**	**6,085**	**4,940**	**6,220**	**5,485**	**5,485**	**5,510**	**5,095**
Demand & recycling									
Autocatalyst									
Gross demand	3,300	3,120	2,870	2,440	2,815	2,995	3,430	3,330	3,205
Recycling	1,325	1,420	1,495	1,310	1,425	1,280	1,080	1,070	1,085
Net demand	1,975	1,700	1,370	1,130	1,390	1,715	2,350	2,260	2,120
Jewellery									
Gross demand	2,450	2,245	2,090	1,560	1,780	1,485	1,390	1,380	1,540
Recycling	560	505	500	410	400	250	245	250	285
Net demand	1,890	1,740	1,595	1,150	1,380	1,235	1,145	1,130	1,255
Industrial demand	**1,900**	**2,125**	**2,170**	**2,020**	**2,130**	**2,240**	**2,260**	**2,360**	**2,215**
Hydrogen	**50**	**70**	**40**	**15**	**20**	**20**	**60**	**70**	**95**
Other recycling	**30**	**30**	**30**	**30**	**45**	**40**	**40**	**45**	**40**
Gross demand	**7,700**	**7,560**	**7,170**	**6,030**	**6,740**	**6,745**	**7,140**	**7,140**	**7,050**
Recycling	**1,915**	**1,955**	**2,025**	**1,755**	**1,865**	**1,570**	**1,365**	**1,370**	**1,415**
Net demand	**5,785**	**5,605**	**5,150**	**4,275**	**4,875**	**5,175**	**5,775**	**5,770**	**5,640**
Market balance									
Balance (before ETFs)	340	525	935	665	1,345	310	-285	-260	-545
ETFs (stock allocation)	85	-240	995	505	-265	-560	-80	265	
Balance after ETFs	**255**	**765**	**-60**	**160**	**1,610**	**870**	**-205**	**-525**	**-545**

Source: SFA (Oxford)

Platinum demand and recycling summary

koz	2015	2016	2017	2018	2019	2020	2021	2022	2023f
Gross demand									
Autocatalyst									
North America	390	390	375	285	400	510	575	605	560
Western Europe	1,555	1,340	1,150	870	825	785	935	830	770
Japan	435	425	395	300	280	275	305	300	305
China	230	220	275	470	575	525	550	535	555
India	175	200	160	115	175	220	220	225	225
RoW	515	545	515	400	560	680	840	840	790
Total	**3,300**	**3,120**	**2,870**	**2,440**	**2,815**	**2,995**	**3,430**	**3,330**	**3,205**

Source: SFA (Oxford)

Platinum demand and recycling summary (continued)

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Gross demand									
Jewellery									
North America	280	280	275	210	255	265	250	260	270
Western Europe	250	255	260	175	190	225	220	230	245
Japan	340	345	330	245	260	270	255	255	255
China	1,340	1,095	945	755	875	510	435	390	505
India	175	195	210	120	135	160	165	175	195
RoW	75	75	75	55	60	60	65	65	65
Total	**2,450**	**2,245**	**2,090**	**1,560**	**1,780**	**1,485**	**1,390**	**1,380**	**1,540**
Industrial									
North America	410	415	365	300	360	365	380	385	385
Western Europe	325	335	305	320	35	300	305	315	290
Japan	80	110	110	145	145	105	100	85	105
China	665	720	815	815	920	910	890	1,030	835
RoW	420	550	580	440	660	565	590	550	600
Total	**1,900**	**2,125**	**2,170**	**2,020**	**2,130**	**2,240**	**2,260**	**2,360**	**2,215**
Hydrogen	**25**	**45**	**50**	**70**	**45**	**45**	**50**	**90**	**85**
Total gross demand									
North America	1,075	1,085	1,015	795	1,015	1,135	1,205	1,250	1,215
Western Europe	2,130	1,930	1,710	1,365	1,050	1,310	1,460	1,375	1,300
Japan	855	875	835	695	690	650	660	640	665
China	2,230	2,040	2,030	2,040	2,370	1,940	1,875	1,955	1,895
RoW	1,365	1,565	1,540	1,125	1,595	1,680	1,885	1,850	1,880
Total	**7,700**	**7,560**	**7,170**	**6,030**	**6,740**	**6,745**	**7,140**	**7,140**	**7,050**
Recycling									
Autocatalyst									
North America	585	640	640	560	570	475	370	365	345
Western Europe	440	465	515	445	520	465	385	375	375
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**	**1,085**
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	130
China	385	340	340	285	265	125	120	115	135
RoW	5	5	10	10	10	10	10	10	10
Total	**560**	**505**	**500**	**410**	**400**	**250**	**245**	**250**	**285**
WEEE	**30**	**30**	**30**	**30**	**45**	**40**	**40**	**45**	**40**
Total recycling									
North America	600	650	650	575	580	490	385	380	360
Western Europe	450	480	530	455	535	480	400	390	390
Japan	265	260	255	215	235	215	215	225	245
China	425	380	385	320	305	170	160	160	185
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**	**1,370**	**1,410**

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	570	580	540
Russia	75	75	80	80	75	75	75	75	75
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**	**715**	**720**	**685**
Demand & recycling									
Autocatalyst									
Gross demand	865	915	1,020	935	925	925	935	880	860
Recycling	305	335	350	325	360	325	275	270	275
Net demand	565	580	670	610	570	600	660	610	580
Industrial demand	**160**	**185**	**75**	**45**	**80**	**-35**	**80**	**105**	**135**
Other recycling	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**
Gross demand	**1,030**	**1,100**	**1,095**	**975**	**1,005**	**885**	**1,015**	**985**	**990**
Recycling	**305**	**340**	**355**	**330**	**360**	**330**	**275**	**275**	**280**
Net demand	**725**	**760**	**745**	**650**	**645**	**560**	**735**	**710**	**715**
Market balance									
Balance (before ETFs)	50	10	45	-20	170	175	-20	15	-30
ETFs (stock allocation)	-20	-50	-15	-10	-5	0	0	0	
Balance after ETFs	**70**	**60**	**60**	**-10**	**175**	**175**	**-20**	**15**	**-30**

Source: SFA (Oxford)

Rhodium demand and recycling summary

koz	2017	2018	2019	2020	2021	2022	2023	2024	2025f
Gross demand									
Autocatalyst									
North America	230	225	220	175	190	205	210	210	200
Western Europe	215	230	290	225	210	205	225	195	190
Japan	125	130	130	110	100	100	105	95	100
China	150	155	205	275	235	195	160	140	140
India	20	25	25	20	25	35	30	35	35
RoW	130	150	155	125	160	185	200	205	195
Total	**865**	**915**	**1,020**	**935**	**925**	**925**	**935**	**880**	**860**
Industrial									
North America	50	70	-25	-20	-10	-65	-30	-5	25
Western Europe	20	20	20	15	10	-55	15	15	15
Japan	15	15	10	-15	10	15	15	15	15
China	50	50	45	40	50	45	50	50	50
RoW	30	30	20	20	20	20	30	30	30
Total	**160**	**185**	**75**	**45**	**80**	**-35**	**80**	**105**	**135**
Total gross demand									
North America	275	295	195	155	180	140	185	205	225
Western Europe	235	250	310	240	225	150	240	210	205
Japan	140	145	140	95	110	115	120	110	110
China	195	205	255	320	285	240	210	190	195
RoW	180	205	200	170	210	240	260	265	260
Total	**1,030**	**1,100**	**1,095**	**975**	**1,005**	**885**	**1,015**	**985**	**990**
Recycling									
Autocatalyst									
North America	165	180	185	175	190	165	130	130	125
Western Europe	55	60	65	60	70	65	50	50	50
Japan	35	45	45	40	45	40	40	40	40
China	5	5	5	5	10	15	10	15	15
RoW	35	45	50	45	45	45	45	45	45
Total	**305**	**335**	**350**	**325**	**360**	**325**	**275**	**270**	**275**

Source: SFA (Oxford)

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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