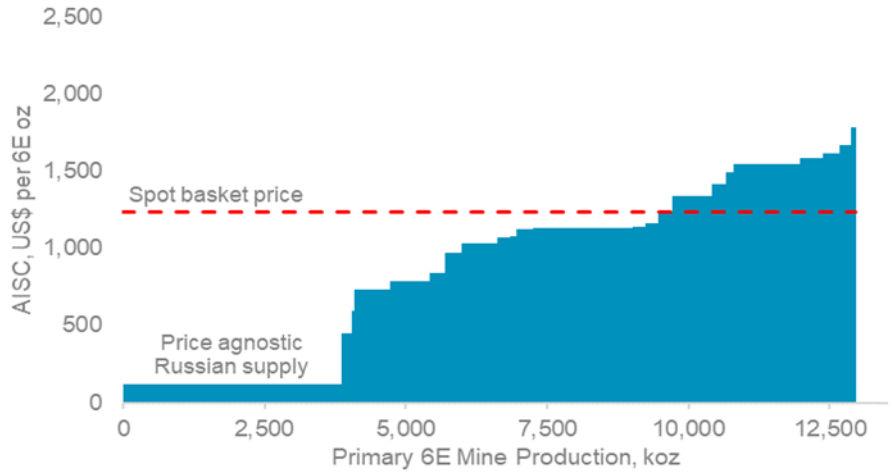
PLATINUM ESSENTIALS

Platinum's consecutive market deficits could deepen as lower PGM prices increase mine supply risks

The decline in the Platinum Group Metals (PGMs) basket price over the last twelve months has materially undermined the economic sustainability of significant portions of platinum mining supply. With several mines seemingly making significant cash losses, and despite several short-term actions some miners can take, a reduction in mined supply could occur. This report explores the potential platinum mine supply risks caused by the sudden and significant reduction in PGM prices, notably, palladium and rhodium, and the knock-on impact of deepening projected platinum market deficits.

The PGM basket price has declined by ~40% during 2023, leading to lower profitability across the PGM miners. The extent to which prices have fallen raises concerns about the long-term sustainability of several operations. Based on published FY '22 mining costs, WPIC estimates around 25% of PGM mine production is generating negative cash margins at the current spot basket price of around US$1,250 per 6E oz.

Figure 1. Large portions of PGM mining is loss making at spot prices



Source: Bloomberg, Company data, WPIC Research, 2022 cost curve, basket price at Nov'23

Miners have healthy balance sheets as a result of the significantly elevated PGM basket price between 2020 and 2022. Being largely debt free should provide some headroom to take one or several short-term actions to improve or tolerate current margins, with some restructuring efforts already being announced. However, we estimate that these types of actions are only likely to reduce loss-making ounces by 5-10%.

Should efforts to stem loss-making production result in production being suspended or closed, they will compound projected platinum market deficits, which are forecast to average 8% of demand between 2023f to 2027f, before capacity rationalisation. It is unlikely that above ground stocks will fill a prolonged supply deficit since we already expect a 70% reduction of above ground stocks to 1.4 Moz by 2027f. Meanwhile, palladium could remain in a deficit for longer than expected. Supply side shocks have also underpinned recent PGM prices volatility (particularly minor metals), typically to the upside. In conclusion, the combination of largely inelastic demand and risks to uneconomic supply being curtailed, have the potential to exacerbate deficits and tighten market conditions, enhancing the investment case for platinum.

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The PGM basket price has declined 40% YTD resulting in 25% of mining supply estimated to be generating negative cash margins.

A price led PGM supply response could raise supply side risks for critical metals required for today's emission control technologies and tomorrow's energy transition.

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Introduction

This report explores the potential platinum supply risks caused by the sudden and significant reduction in platinum group metals prices, notably, palladium and rhodium. PGMs are mined in polymetallic ore bodies, meaning miners cannot selectively extract specific metals which they may deem more attractive. Revenue is the aggregate of the entire PGM and base metals basket. Publicly available published production costs for FY'22 suggests that 25% of PGM mining supply is generating negative cash margins at current spot metal prices. Producers may be able to take short-term actions to reduce costs and/or fund losses, if they believe the current low basket price is temporary. However, should low metal prices cause more permanent restructuring, it risks destabilising metal supply. Whilst supply cuts would deepen projected platinum markets deficits, and support higher prices, we note that there is a risk that constrained critical mineral availability could slow down the ramp up of platinum use in some hydrogen applications.

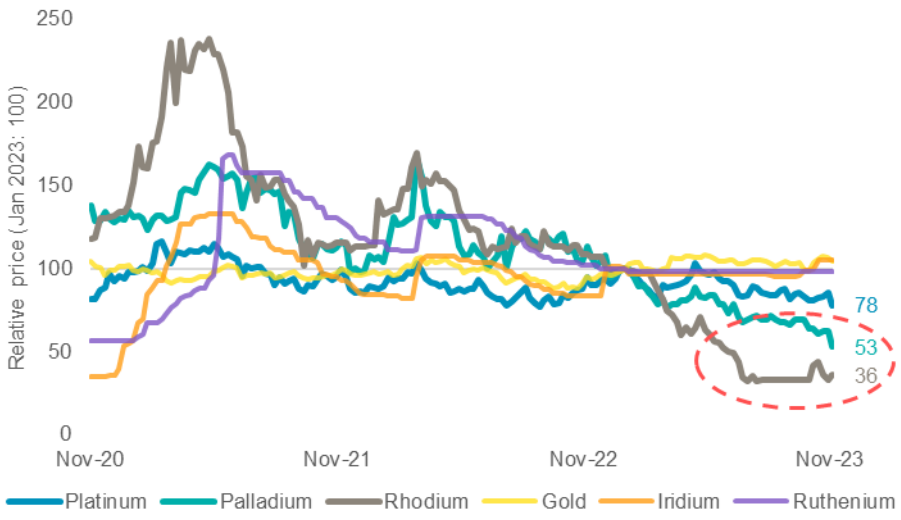
Palladium and rhodium price declines have underpinned a 42% year to date drop in PGM basket prices.

PGM demand is typically price inelastic, within reasonable bounds, as the metal use accounts for a small portion of the overall process or product costs and increasingly as PGM industrial applications reduce enterprise carbon emissions by reducing energy requirements and boosting process yields. However, recent record palladium and rhodium price peaks boosted mining profitability but also resulted in platinum replacing palladium and rhodium, severely disrupting short term prices and rapidly eroding mining margins.

Declining prices are pressurising revenues

Platinum Group Metals (PGM) prices have been under pressure through 2023. The majority of the six-element constituents (platinum, palladium, rhodium, gold, iridium, and ruthenium) are lower YTD. However, it is the rhodium and palladium price declines (Fig. 2) which have cumulatively led to the most downward pressure on the 6E PGM basket price.

Figure 2. Year to date, palladium and rhodium prices have underperformed amongst PGMs



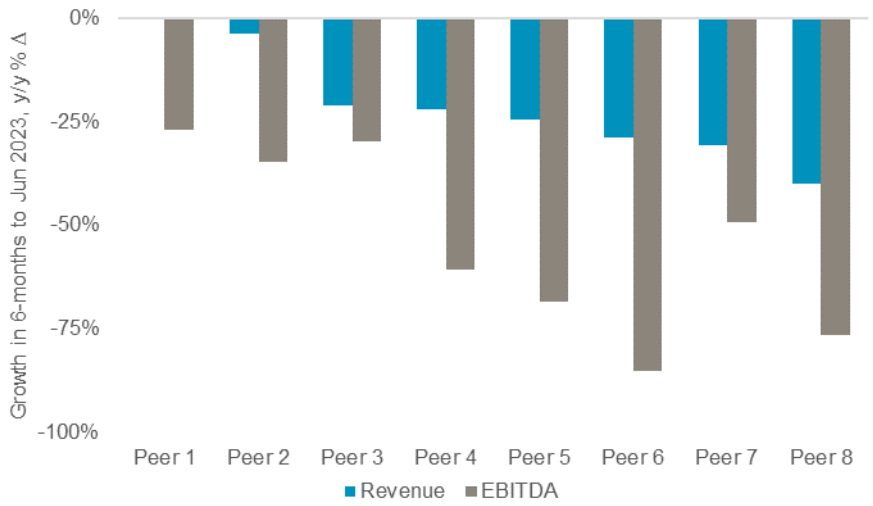
Source: Bloomberg, WPIC research

With rhodium having shed two thirds and palladium a third in price during 2023, the 6E PGM basket price of US$1,250 per oz is 42% lower YTD and 67% lower than its peak in April 2021. The impact of lower prices was evident in PGM miners' financial reporting to June 2023.

Miners' operating structures are highly leveraged to prices. Fixed costs account for around 25% of an open pit mine and 67% of a conventional underground mine. Accordingly, profitability reported as EBITDA has on average declined more (-54% YoY) than revenue (-21% YoY) across primary PGM miners over the six months to June 2023 (Fig. 3).

Figure 3. Profitably of primary PGM mining has deteriorated through the six months to June 2023 due to lower selling prices

Mining profitability is heavily geared to selling prices and volumes with producers having limited ability to flex the cost base.



Source: Published company data, WPIC research

The decline in revenue and profitability will only exacerbate in the second half of 2023 as prices have continued to decline since the end of Q2, with the impact not yet fully captured in all reported financial results (Fig. 4). Whilst South African and Russian producers would benefit from depreciating domestic currencies, these have been insufficient to offset both lower basket prices in US$ terms and production cost inflation. Therefore, it is likely that the profitability of primary PGM production has continued deteriorating.

Financial reporting to Jun'23 does not reflect the full extent of lower basket prices.

Figure 4. The annual rate of decline in PGM basket prices has sequentially accelerated through each quarter of 2023

Source: Bloomberg, WPIC research

PGM supply elasticity

Balance sheet headroom could buy miners time for turnaround strategies.

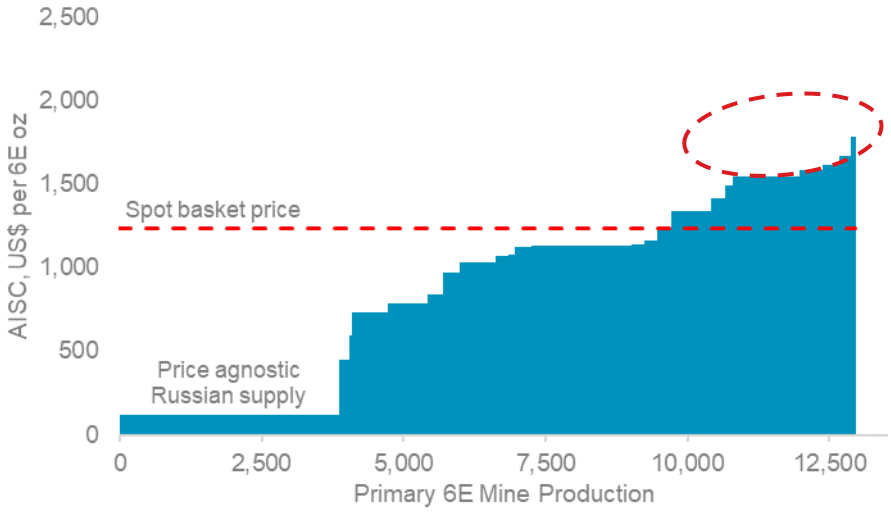
Using published production costs, the stark decline in PGM prices during 2023 has left an estimated 25% of primary PGM supply as loss making at current spot prices of US$1,250 per 6E oz (Fig. 5). The proportion of uneconomic supply increases to 35% if price neutral Russia is ignored (*Russian PGM supply is a by-product of nickel production from one of the world's lowest cost nickel mines*). **While spot metal prices often prove volatile, the lower PGM prices are factoring into primary producers' longer-term financial planning.**

Given the significant fixed capital base to operate a mine, a supply-side response is often a last resort to addressing loss-making assets. In the near-term, miners have the benefit of healthy balance sheets to persist with operations whilst they likely strive to:

1. Increase production volumes to reduce unit costs,
2. Process and sell excess pipeline inventory to enhance cash generation,
3. Reduce non-essential Capex,
4. Renegotiate supply agreements, and
5. Reduce or fully cut dividend payments.

The entire fourth quartile of the cost curve is loss making.

Figure 5. If inelastic first quartile Russian supply is ignored, 35% of PGM output is loss making based on 2022 costs and current spot prices



Source: Bloomberg, Company data, WPIC research

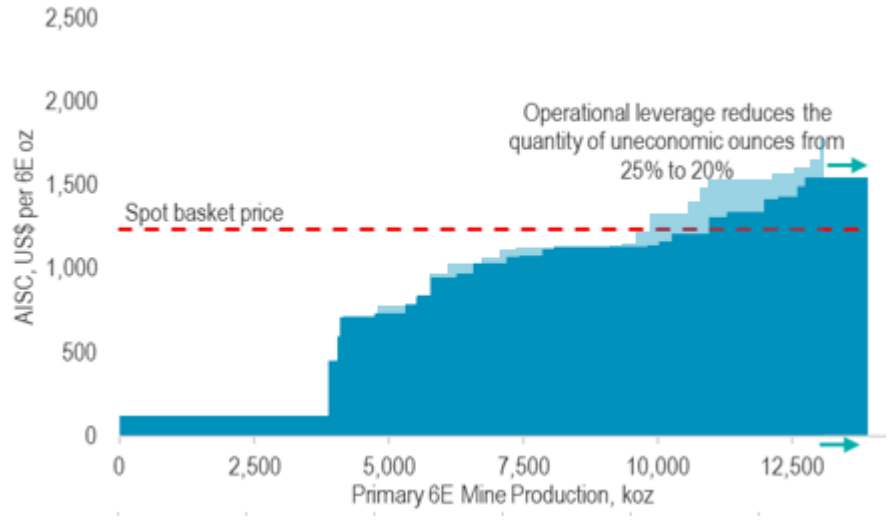
High prices during 2020 to 2022 emboldened some producers to undertake growth investments which could dilute fixed costs.

Increase output to reduce unit costs:

South African and North American PGM mining remained at depressed levels during 2023. In South Africa, electricity shortages have caused an estimated 200 koz of lost PGM output in the first three quarters of 2023. Additionally, South African operations are also negatively impacted by crime and community unrest. In North America, platinum production has averaged 268 koz over the past three years, substantially below the 346 koz average output between 2018 to 2020. As operational challenges unwind at the Stillwater complex, North American production should recover.

Despite the above headwinds, supply growth to reduce operating costs could be achieved through executing growth plans. WPIC estimates ~1.0 Moz of 6E production growth potential exists from the ramp up of projects at the following operations: Booysendal, Zondereinde, Two Rivers, Styldrift, Eland, Stillwater, K4, Zimplats and Mototolo. Assuming an operating model where 60% of on-mine costs are fixed (e.g. labour), these additional volumes could, over the longer term reduce the portion of loss-making operations 5%, to around 20% from around 25% (Fig. 6).

Figure 6. Ongoing growth and efficiency projects could allow some PGM mines to grow and improve their position on the cost curve

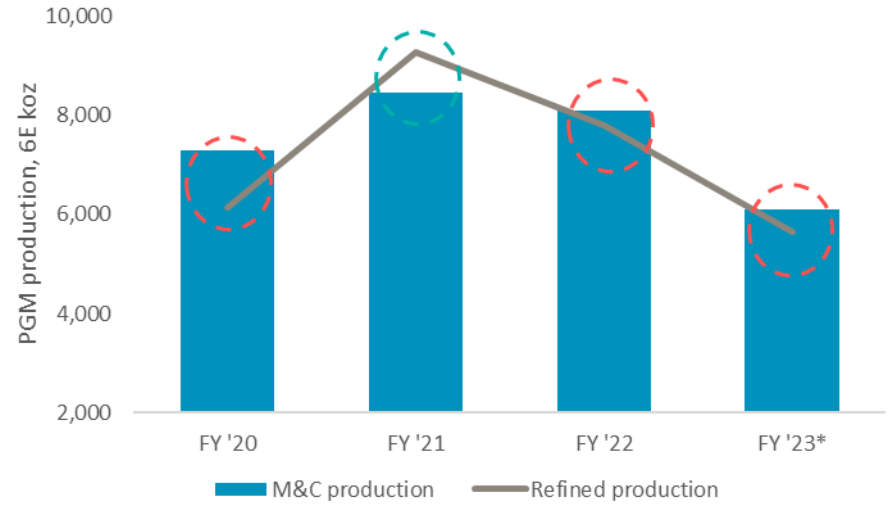


Source: Bloomberg, Company data, WPIC research

Restore processing stability:
Over the past 18-months several PGM producers have incurred planned and unplanned smelter downtime which has led to a build-up in pipeline inventories. This additional pipeline stock has compounded the increased inventories that accumulated through COVID in 2020, which were only partially worked through in 2021.

Load shedding, planned maintenance and unplanned downtime has disconnected mined and refined PGM production.

Figure 7. Refined PGM production has lagged matte and concentrate production output in SA over the past four years



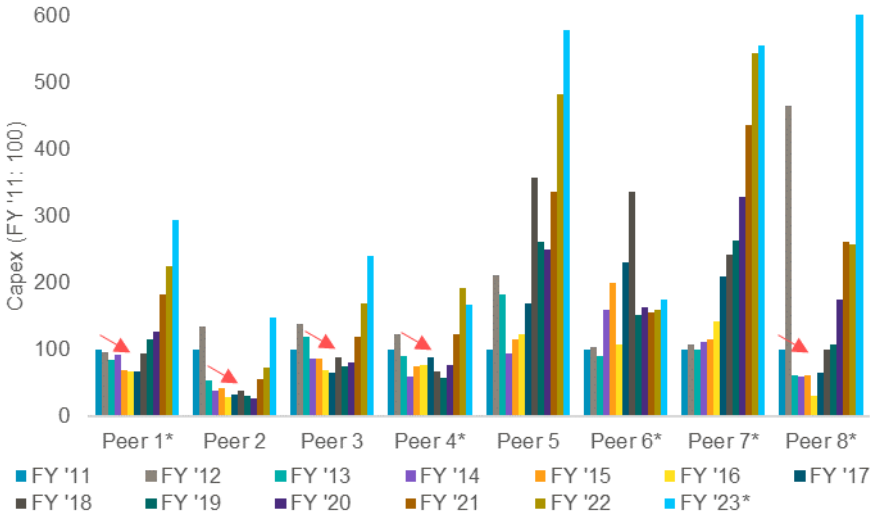
Source: Company data, WPIC research

Miners have raised capex to catch up on previous deferrals and improve operational stability.

WPIC estimates that around 1.2 to 1.4 Moz of 6E PGM pipeline inventory has accumulated since 2020 (Fig. 7). If miners can restore processing stability, the unwind of excess pipeline inventory is a low-cost short-term cash windfall able to ease some financial constraints. Notably, there could be signs of improving South African power availability. Kusile's Unit 1 has returned to service and Unit 5 is expected to return by year-end. These units have been down since Oct 2022, and their return adds a cumulative 1.6 GW of generation (roughly two stages of load shedding). Although the energy outlook appears better, latest company guidance from SA producers does not suggest a fast unwind of inventory with some also warning of possible further build-up in inventory in FY '24.

Reduce non-essential Capex:
PGM miners have increased capital expenditure by an average of 216% between FY'19 and FY'23. However, during the mid-2010s, several PGM miners were able to reduce Capex (Fig. 8). Annual capex reductions averaged 20% in response to a downturn in 6E PGM basket prices from US$ 1,357 to US$ 692 between Q1 '2011 to Q1 '2016.

Figure 8. PGM producers have previously reduced Capex in response to lower PGM prices, such as in the period from 2011 to 2018



*Source: Company data, WPIC research, *Capex guidance is used where FY'23 is incomplete*

The recent increase in Capex from PGM miners has an inevitable element of "catch-up" spending from previous deferrals, notably at processing infrastructure. Accordingly, miners will probably have scope to lower capex given current price pressures.

We estimate that the weighted average unit capex (SIB plus development) across non-Russian operations is around US$190 per 6E oz. Replicating the 20% average reduction in capex across the peer group between 2011 to 2016, would imply scope to cut capex by around US$40 per oz (all else being equal). However, this would only shift 2% of the cost curve from negative to positive margins per our estimates.

Balance sheet headroom could temporarily insulate miners from low prices.

Elsewhere, miners could scrutinize capital intended for early phase expansion projects. Early phase expansion projects may have as yet negligible sunk costs and upon revaluation of project economics, could be considered non-essential thereby ranking low on a firm's capital allocation hierarchy. Recent updates indicate miners have already begun announcing project deferrals in response to depressed prices.

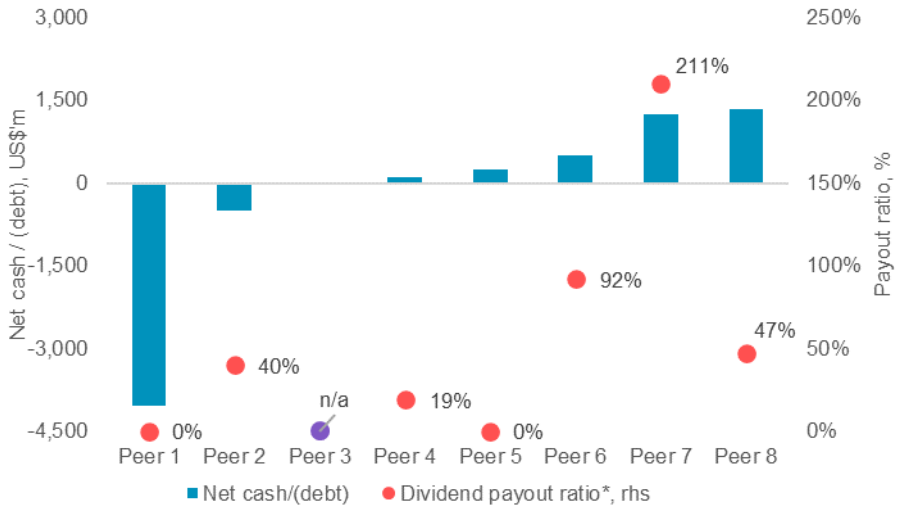
Renegotiate supply agreements:

Inflation has been a global theme for two-years and PGM miners have not been spared from input cost pressures. While material changes to a cost base are unlikely without some form of restructuring effort, producers will inevitably look at where they are able to lower costs. Variable costs are, in general, linked to inflation or some other underlying commodity indices (e.g. steel prices) and as these ease, so it should support lower cost rises in the coming twelve months for PGM miners. Furthermore, miners may leverage their scale and declining profitability to squeeze suppliers, particularly contractors, for better terms. Elsewhere, line items such as royalties and mining production bonuses will inevitably decrease due to lower PGM prices and declining profitability.

Cut dividends payments:

High PGM prices over the past three to five years has supported significant deleveraging across the PGM mining industry. As of June 2023, only two producers within a peer group of eight reported having a net debt position on their balance sheet (Fig. 9). While, of the two producers with net debt, the leverage ratios (net debt/EBITDA) appeared healthy at 1.2x and 0.5x respectively. WPIC believes this implies miners have balance sheet headroom to endure some price pressure while funding capex requirements even allowing for EBITDA compression on lower revenues.

Figure 9. The industry has well capitalised balance sheets, with only one peer operating with a leverage ratio of above 1.2x EBITDA



*Source: Company data, WPIC research, *Payout ratio defined as dividend/free cash flow, n/a declared a dividend whilst generating negative free cash flows*

Profitability in the six months to June 2023 coupled with healthy financial positions allowed 75% of the peer group to declare a dividend. In response to lower PGM prices, WPIC expects dividends payments (which are discretionary and not captured in the cost curve) to decline for the six-month period to Dec 2023.

While South African labour laws favour employees, they do not restrict restructuring unprofitable businesses.

Mining restructuring is a regulated process

There appear to be several options for miners to address declining profitability, particularly as healthy balance sheets afford miners some headroom to manage lower PGM prices. While the options discussed above may help marginal operations, if PGM prices remain at current levels for a protracted period (>12-months), it is possible that a last resort of permanent restructuring is required through mine rationalisations.

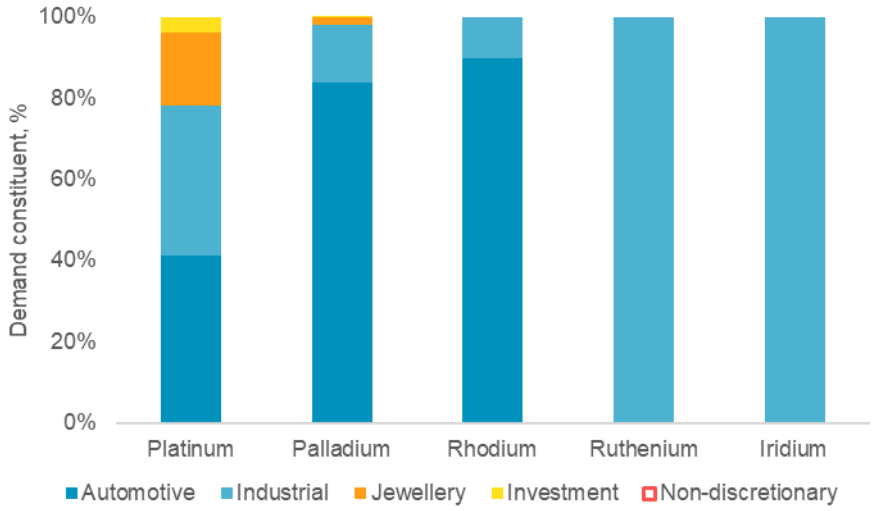
It is a misconception that due to the industry's labour intensity; some "political will" ensures South African operations must continue producing PGMs regardless of economic sustainability. It is true that several stakeholder groups consider factors such as employment, local procurement quotients, and community contributions as more important than profitability. And it is true that mine closures are not straightforward. However, Section 189(A) of South Africa's Labour Relations Act (LRA) permits employers to dismiss employees for operational requirements where operational requirements are defined as economic, technological, structural or something similar. An abridged summary of the Section 189(A) process is consultation > notification of retrenchments > opportunity for feedback > criteria for selection > notice of terminations > severance pay and payment.

Despite an upcoming national election in 2024, most South African producers are already initiating some form of restructuring, be it through Section 189 or otherwise. The pace at which miners have responded, reiterates that PGM prices are too low and raises the prospect of supply side risks.

Contextualising the supply-side risks

PGM's catalytic properties are unique, serving an important role in decarbonisation and energy and process efficiency. Accordingly, despite the high price (relative to base metals) and risky geographic primary supply profile (SA, Russia, and Zimbabwe), PGMs are considered indispensable and in many cases mandated through regulation (e.g. emission control systems). WPIC considers automotive and industrial end-uses sticky with consumption a function of production volumes rather than the choice of PGM based catalysts or using an alternative material. These markets account for 70-80% of annual platinum demand and >95% of demand for other PGMs (Fig. 10). Where PGMs can be replaced, it either takes years to materially substitute or is considered impractical since PGMs typically account for a small proportion of the total cost (low single digits in percentile terms) of a vehicle or industrial process. Indeed, most of the PGM substitution opportunities are between the PGM metals themselves.

Figure 10. PGM demand is inelastic, with consumption exposed to regulated industries

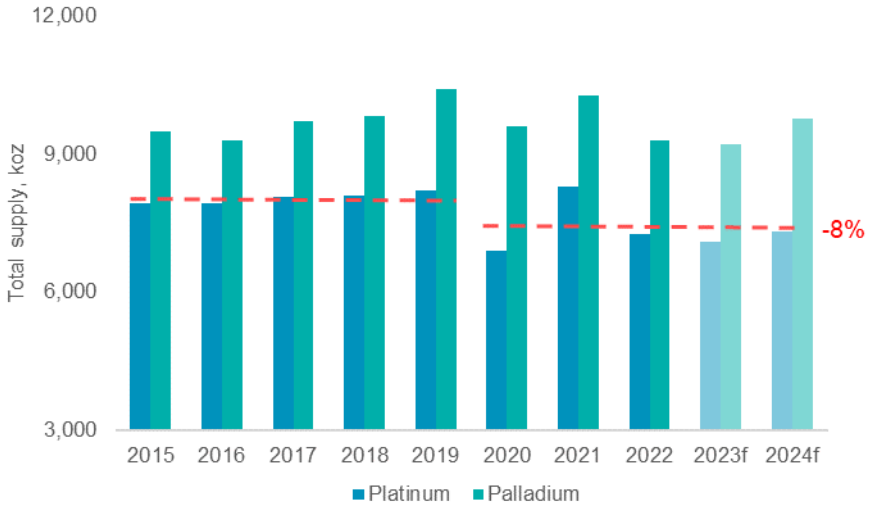


Source: SFA (Oxford) to 2018, Metals Focus, WPIC research

PGMs unique properties often make it uneconomical to replace the metals thereby suggestive that demand is inelastic to price.

The inelasticity of PGM demand makes the market susceptible to supply changes potentially stemming from restructuring loss making assets. The PGM industry has faced multiple supply side challenges since 2020 (Fig. 11). Primary platinum production is forecast to average ~5,605 koz pa between 2020 to 2024f, which is 9% lower than the five-year average production of 6,127 koz pa between 2015 to 2019. The decline in production is marginally less pronounced for palladium at -6% on average, but nonetheless meaningful. Over this period, primary supply has been impacted by COVID lockdowns, unplanned and planned processing downtime, extreme weather events, and external headwinds such as sustained electricity shortages leading to load curtailment, as well as cable theft and other crime. Alongside, lower average primary supply, recycled supply has not met pre-COVID expectations as trends in vehicle use have evolved (*link*).

Figure 11. Total platinum supply has is forecast to average 7,367 koz between 2020 to 2024f, 8% lower than the average five-year supply before 2020



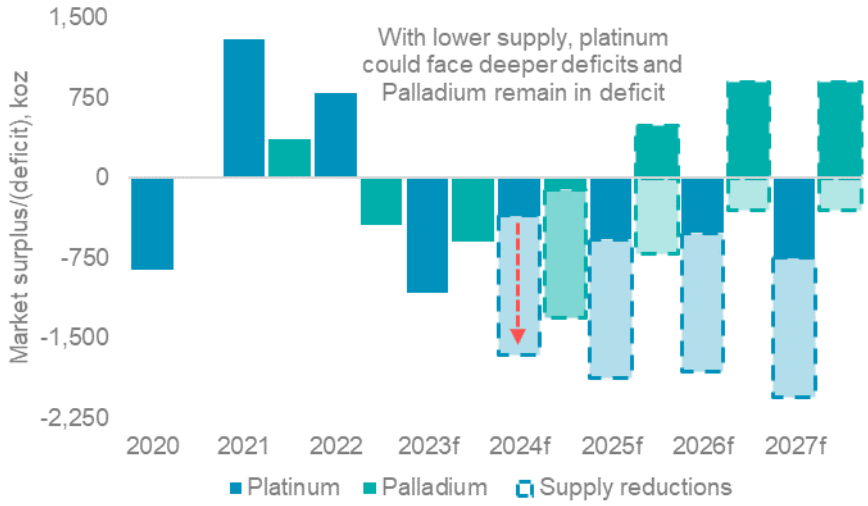
Source: SFA (Oxford) to 2018, Metals Focus 2019-2024f for Pt and to 2022 for Pd, WPIC research

COVID did not only appear to result in supply-side volatility, demand for PGMs too has evolved, particularly with the notable increase in the market share of battery electric vehicles. Palladium demand has averaged 7% less per annum since 2020 than average demand between 2015 to 2019 given the metals high exposure to the automotive sector. Yet, the point we make is that despite supply-side shocks seemingly being mirrored by demand, there have been two substantial PGM basket price spikes (>US$3,000 per 6E oz) since 2020.

This raises the question about what the impact could be on PGM markets should low basket prices persist and lead to permanent supply-side restructuring. With an estimated 35% of ex-Russian primary PGM mine supply making cash losses at current basket prices, there is potentially a far greater supply-side shock than what we have seen since 2020.

Contextualising the volume of loss making primary PGM production, we estimate it is approximately 1.3 Moz of platinum annual production which equates to 18% of average total platinum demand over the past five years. If placed on care and maintenance, there would be negligible platinum available for discretionary uses such as jewellery. We currently estimate platinum market deficits will average 8% of demand between 2023f to 2027f and supply cuts will deepen deficits. Additionally, palladium's transition to forecast surpluses may be indefinitely deferred.

Figure 12. Capacity rationalisations would compound platinum deficits and defer palladium's transition to surplus

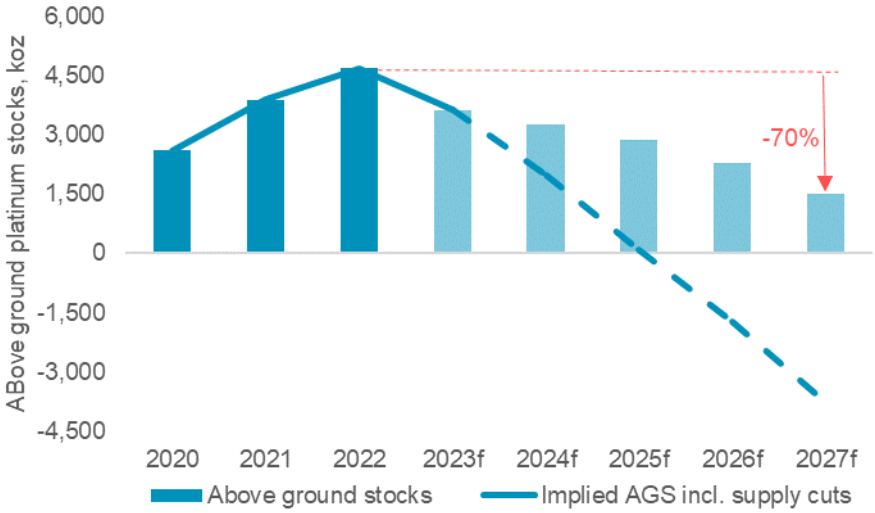


Source: Metals Focus to 2022 for Pd and 2024 for Pt, WPIC research thereafter

Platinum market deficits would deepen if uneconomic mined supply is rationalised.

Without supply cuts, WPIC expects platinum deficits to underpin a 70% reduction of above ground stocks from 4.6 Moz to 1.4 Moz. The determination of above ground stocks has caveats, but above ground stocks would theoretically erode by the end of 2025f (Fig. 13) if 1.3 Moz pa of loss making Pt supply were placed on care and maintenance.

Figure 13. Supply-side restructuring would accelerate the reduction in platinum above ground stocks



Source: Metals Focus to 2024, WPIC research thereafter

Palladium's supply side risks could be deemed greater than platinum's. We estimate that idling loss-making assets would reduce palladium supply by 1.2 Moz per annum which keeps markets in a deficit rather than our underlying forecast that supply will enter a surplus from 2025f (Fig. 12).

The polymetallic make-up of PGM ore bodies will mean that individual metals may respond differently to supply rationalisation. However, platinum and palladium are relatively liquid metals markets, whereas the minor PGMs are considerably more illiquid and are therefore likely to exhibit more extreme reactions.

To demonstrate, take palladium which accounts for ~45% of global primary PGM production by volume. Palladium has reported eight years of annual supply deficits in the past decade (incl. 2023f) leading its price to trade in a range between US$485 to US$3,000 per oz. Comparatively, rhodium (which constitutes ~5% of primary supply by volume) has seen prices trade between a range of US$625 to US$30,000 per oz and Iridium (2% by volume) between a range of US$400 to US$6,300 per oz. Thus, with inelastic demand end-uses, price volatility is understandably more volatile amongst illiquid minor metals. Supply side risks could, given the significant proportion of loss-making assets, amplify metal price volatility. This could be further amplified by concurrent demand growth from industries where PGM demand is inelastic, like the hydrogen economy.

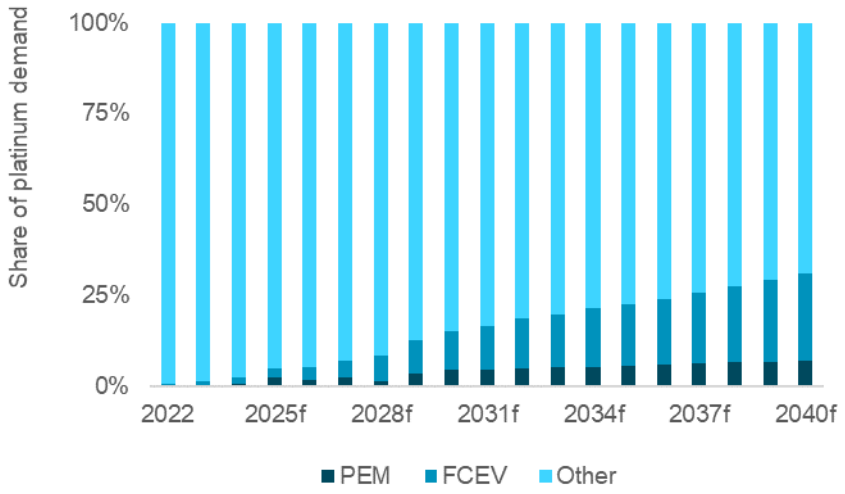
PGMs transitioning end-markets

Clean hydrogen is a key enabler of global decarbonisation efforts, particularly in hard to abate industries such as steel and heavy-duty transport. To achieve climate goals set out in the Paris accord, clean hydrogen demand is forecast to reach between 500 to 800 Mtpa (>85% green) by 2050 from 115 Mtpa of grey hydrogen consumption today. To achieve this, global electrolyser capacity will need to increase from around a 1 GW today to 500 GW by 2035 and 4,500 GW by 2050 (Fig. 15). Early consumption of green hydrogen is expected to be driven by industrial end-uses, namely chemicals, refining and steel. Road transport is expected to the third largest clean hydrogen end-market underpinned by fuel cell electric vehicles (FCEV).

Prices for the minor PGMs are more volatile than platinum and palladium due to market illiquidity.

Given forecast demand growth for platinum consuming PEM electrolysis and FCEV, WPIC expects hydrogen end-markets may account for up to 20% of total platinum demand by 2030f (Fig. 14). We expect platinum demand growth from hydrogen to offset declining autocatalytic platinum demand which WPIC believes will peak in 2025f.

Figure 14. Grow in hydrogen related platinum demand will offset declining platinum demand from catalytic converters

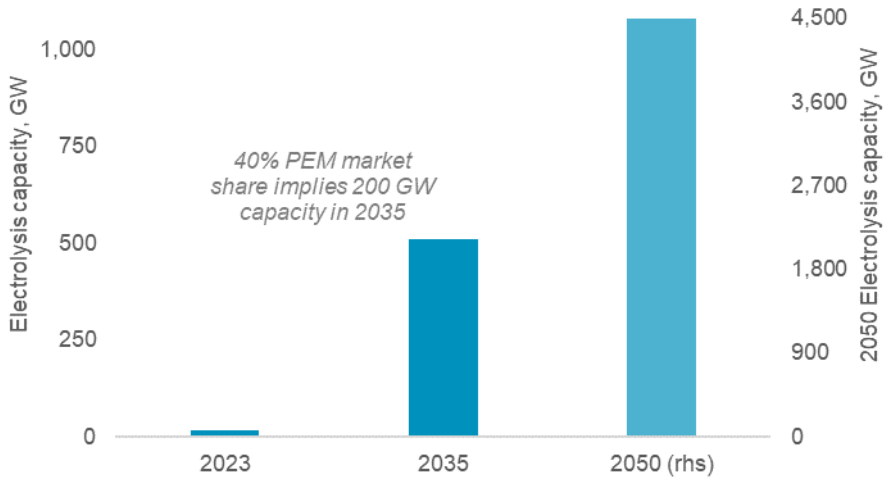


Source: WPIC research

The PGM industry needs to balance profitability requirements whilst proving it is a reliable supplier of critical minerals.

Given the role we expect the hydrogen economy to play in offsetting platinum demand losses from autocatalysts, while simultaneously increasing demand for iridium. PEM electrolysis uses PGMs whereas platinum catalysts are only just being introduced into high current density alkaline technology and is not included in our base case assumptions. Various sources suggest that PEM is likely to account for 40% of the total electrolysis market, which implies PEM electrolysis capacity of 200 GW by 2035f.

Figure 15. Electrolysis capacity needs to increase by 30x and 280x by 2035 and 2050 respectively to meet the green H_2 scale-up



Source: S&P Global, WPIC research

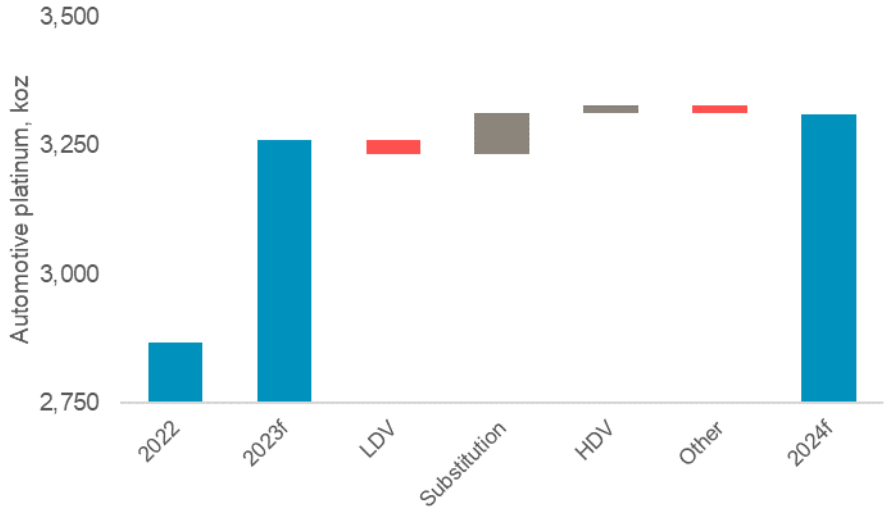
Platinum is a key metal in the green energy transition.

Knowing that our decarbonisation path requires 200 GW of PEM electrolysis capacity by 2035, what happens to iridium supply for PEM electrolysis if uneconomical South African operations equivalent to 5% of global 6E PGM supply is rationalised. South African geology leads it to produce an outsized proportion of global iridium relative to global primary PGMs. Hence a 5% reduction in global PGM supply from SA operations will result in a roughly 10% decline in iridium production, or 25 koz pa. Given commitments made to developing green hydrogen production, rising demand will likely support Iridium price increases.

Despite BEV market share gains, autocatalytic demand is unlikely to erode in the short-term.

Idling mine supply could similarly impact platinum. Our expectations are that the decline in autocatalytic platinum demand from increasing BEV market share will be gradual from 2025f. In 2024f, automotive demand is expected to increase by 2% year-on-year despite a decline in production of light-duty vehicles with PGM-containing aftertreatment systems. Tighter emission legislation, substitution and increasing heavy-duty vehicle production offset BEV market share gains in 2024f (Fig. 16). While autocatalytic platinum demand begins gradually declining from 2025f, this is offset by fuel cell electric vehicle (FCEV) production growth.

Figure 16. The impact of raising BEV market share will be gradual on automotive platinum demand and offset by other factors



Source: Metals Focus, WPIC research

As a caveat to any supply side reduction and price response is a potential for hindering demand growth of new markets. New market development needs surety of critical mineral availability and economic prices. Should “too much” PGM supply get idled, there are risks that markets trend towards low and no PGM technology such as alkaline electrolysis or BEV.

Conclusion

The decline in PGM basket prices over the last twelve months has materially undermined the economic sustainability of significant portions of primary supply. Our analysis suggests that producers have levers to withstand low prices through the short-term. However, with several mines seemingly making significant cash losses, a supply-side response could occur.

PGM prices and particularly prices of less liquid minor metals, appear particularly susceptible to supply side shocks. Given the polymetallic nature of PGM ore bodies and regional PGM compositions, WPIC suggests that mine rationalisation across South Africa could:

- Compound platinum supply deficits and accelerate the decline in above ground stocks,
- Defer palladium markets entering a surplus, and
- Increase price volatility of PGMs particularly the minor metals.

Ultimately it appears that low prices are likely to trigger a response from platinum mining supply. WPIC expects an exacerbation of platinum's supply side risks where markets are already projected to be in deficit through our two- to five-year forecast horizon. This, we believe, strengthens the investment case for platinum.

Low PGM prices may cause a supply response that ends up compounding projected platinum market deficits, costing end-users more in the long-term.

WPIC aims to increase investment in platinum

World Platinum Investment Council (WPIC) was established by the leading South African PGM miners in 2014 to increase investment ownership in platinum. This is done through both actionable insights and targeted development. We provide investors with the information to support informed decisions e.g. the *Platinum Quarterly* and monthly *Platinum Perspectives* and *Platinum Essentials*. We also analyse the platinum investment value chain by investor, product, channel and geography and work with partners to enhance market efficiency and increase the range of cost-effective products available to investors of all types.

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