PLATINUM ESSENTIALS

Steady, strong growth in platinum chemical demand highlights the benefits of platinum's diversity of end uses

World Platinum Investment Council

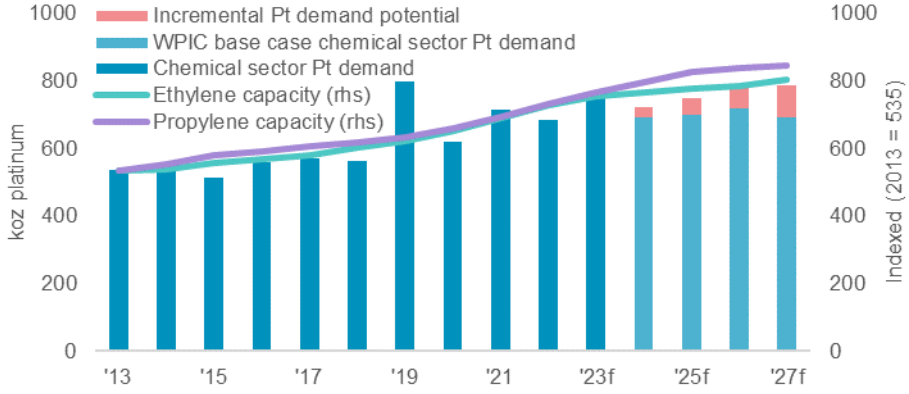
This report examines the consistent strong growth in demand for platinum exhibited by the chemical sub-sector. It draws parallels with similar platinum industrial demand growth driven by diverse end uses and the increasingly important carbon reduction catalytic benefits of platinum during a period of great change – the global energy transition.

Platinum chemical demand from 2013 to 2023f has grown at a 3.4% CAGR, higher than global GDP growth of 2.7% CAGR over the same period, suggesting increased appreciation for platinum's role in improving process efficiency with lower energy use and higher yields. Looking ahead and including a cautious economic overlay, we project 1% growth in platinum chemical demand between 2022 and 2027f. However, based on historic correlations with growth in chemical manufacturing capacity, we estimate that platinum chemical demand could be c.100 koz higher in 2027f than in our current forecasts (fig 1).

While platinum chemical demand accounts for only 8-10% of total platinum demand, platinum's overall industrial demand whose diverse industrial end uses typically have different economic drivers, also demonstrate growth in excess of global GDP growth (4% v 3% CAGR, 2013 – 2023f) for similar reasons. In addition, the diverse end uses result in lower volatility of demand as capacity expansions across uses seldom align. Platinum demand is further diversified across automotive, jewellery and investment demand and reduces variability in demand significantly versus that seen in its sister PGMs, where changes in automotive demand, their dominant use, aggravate variability in demand and price. Consequently, platinum is somewhat insulated against drivetrain electrification whilst in parallel is set to experience demand growth from the hydrogen economy (both through installed electrolyser capacity and FCEVs). Whilst this report focuses on platinum's use in the chemicals industry, its dynamics of consistent growth are typical of many other end-uses for platinum.

Our key conclusion is that platinum's diversity of end-uses and key role in decarbonisation results in demand growth being insulated from broader market risks.

Figure 1. Correlating Pt chemical demand growth to installed capacity growth implies 100 koz additional Pt demand above our 2027 forecast



Source: NexantECA, SFA (Oxford) 2013 - 2018, Metals Focus 2019 - 2023, Company guidance, WPIC Research from 2024

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2 August 2023

Platinum's diverse demand end-uses, and catalytic roles should continue to combine for a smoothed platinum demand growth profile akin to historic trends for industrial demand, particularly due to its importance to the hydrogen economy

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Introduction

This report explores platinum's role in the chemicals sector, which has exhibited a consistent history of platinum demand growth. While the chemicals sector may only account for a modest component of total platinum demand (8-10% of total demand), we highlight that the chemicals sector is just one of the many diverse end uses of platinum. When compared to its sister metals, palladium and rhodium, platinum's demand from multiple end-uses (each underpinned by various economic and application specific drivers), should better insulate it's demand from exogenous risks.

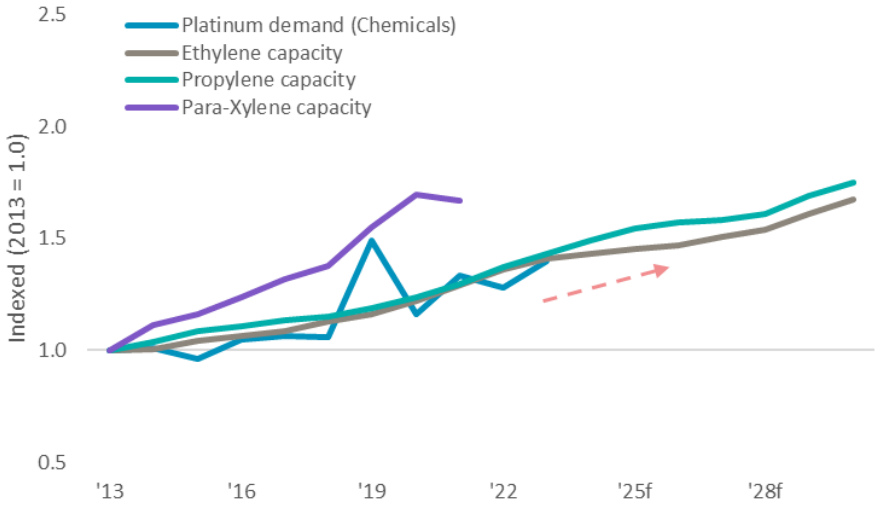
Diverse end use demand with differing economic drivers should better insulate platinum from market shocks

Platinum in the chemicals sector

The global petrochemicals sector serves a diverse market of end-uses including plastics, adhesives, fertilisers, and detergents. Platinum's catalytic properties support its use across several chemicals' derivatives including paraxylene, mono-ethyl glycol, nitric acid, propylene, silicone, and dehydrogenation.

In the majority of chemical applications, platinum is used as a catalyst to speed up reactions, to reduce the energy requirements of a process, and/or to improve the yield. In general, the platinum catalysts are used until they have been degraded, at which point they are recycled within the industry, with a small amount of additional platinum added to top up for any losses that have occurred during the manufacturing process. An exception to this is platinum cured silicones, where the platinum becomes locked up within the silicone and is therefore consumed during manufacturing.

Figure 1. Platinum chemical demand broadly tracks long-term installed capacity trends of the petrochemicals industry (indexed 2013 = 1.0)



Platinum chemical demand has grown at 3.4% CAGR since 2013

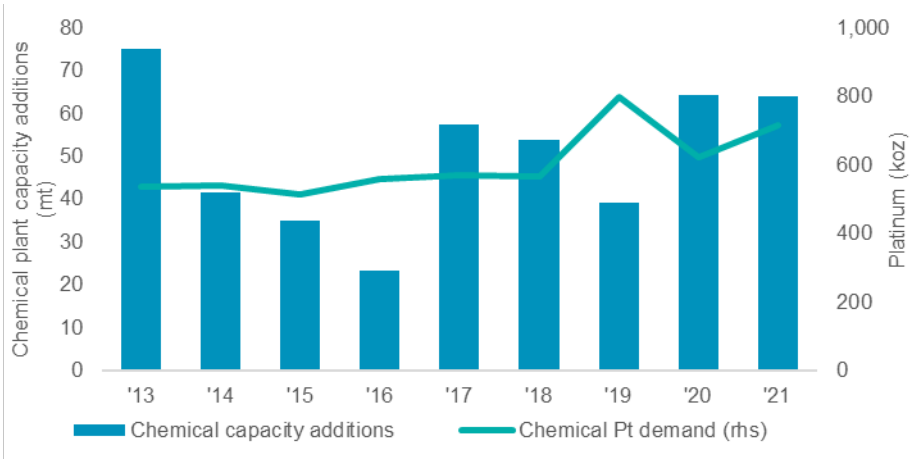
*Source: NexantECA, SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2021, WPIC research, *No forecast data for Para-Xylene capacity*

Year-to-year chemicals demand is linked to broader economic growth. Whilst macroeconomic volatility may impact short-term output from existing plants, capacity investment decisions must be undertaken with a long-term view of global economic growth which generally results in greater consistency in the timing of new plant commissioning.

Tracking underlying olefins capacity, ethylene, and propylene, to approximate the broad chemicals industry, installed capacity has increased by 3.5% and 3.7% CAGR since 2013, respectively. Installed capacity growth broadly reflects platinum chemical demand growth which, net of closed-loop recycling, has run at a 3.4% CAGR since 2013. Comparative growth rates suggest a strong correlation between installed chemicals capacity and platinum chemical demand (see fig. 2). We attribute the correlation between cumulative installed chemicals capacity and plant demand to "top-up" consumption which is necessary to replace ounces lost during the production process.

"Top-up" platinum consumption is typically less than the platinum requirements for capacity additions, however somewhat surprisingly, there is no evident correlation between chemicals platinum demand and chemicals capacity commissioning's (see fig. 3).

Figure 2. Platinum chemical demand versus annual chemical plant capacity additions



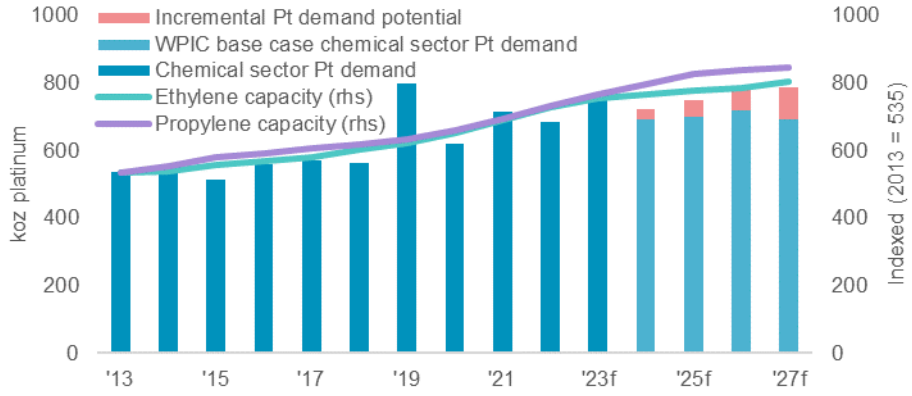
Source: NexantECA, SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2022, WPIC research

Platinum industrial demand constitutes a number of distinct end-markets

Looking ahead, NexantECA forecasts that ethylene and propylene installed capacity will increase by 2.6% and 3.1% CAGR to 2030 respectively, supporting ongoing platinum chemical demand growth (both new commissioning and top-up ounces).

Assuming a 2.85% CAGR in chemicals capacity going forwards (the mid-point of the NexantECA estimates above), would result in platinum chemical demand being ~100 koz higher in 2027f than in our most recently published two-to-five-year supply/demand outlook (see fig. 4) and a ~25% increase in platinum chemical demand by 2030f. Note that our current two-to-five-year platinum supply demand outlook assumes chemical sector platinum demand of 693 koz in 2027f which is less than the average demand between 2021 to 2023 of 716 koz, with the assumptions reflecting current economic uncertainties.

Figure 3. Correlating Pt chemical demand growth to installed capacity growth implies 100 koz additional Pt demand above our 2027 forecast

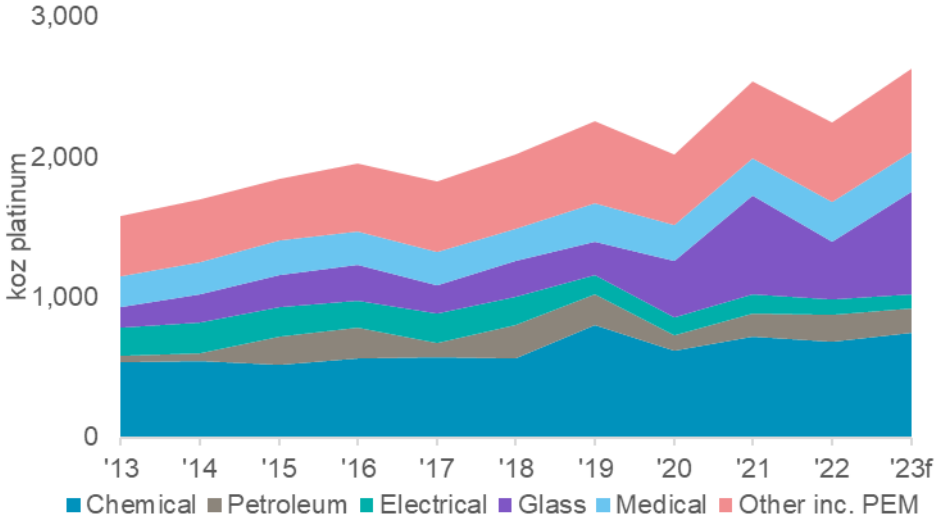


Source: NexantECA, SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2023, WPIC research

Chemicals, a consistent industrial demand source

Platinum demand from industrial applications comprises the chemical, petroleum, electrical, glass and medical sectors. Each individual industrial end-use experiences specific factors which may impact demand and subsequent timing and magnitude of annual platinum consumption. Diversification appears to mitigate individual end-use demand volatility supporting broadly consistent total industrial platinum demand growth. The combination of diverse demand end-uses could be considered to net off and approximate global economic growth. However, the growing appreciation of platinum's catalytic properties which enhance process efficiency with lower energy use and increase yields has underpinned industrial platinum demand growth of 4.0% CAGR between 2013 to 2022 (see fig. 5), ahead of global GDP of 2.7% over the same period.

Figure 4. Platinum chemical demand accounts for the largest portion of industrial platinum demand on average

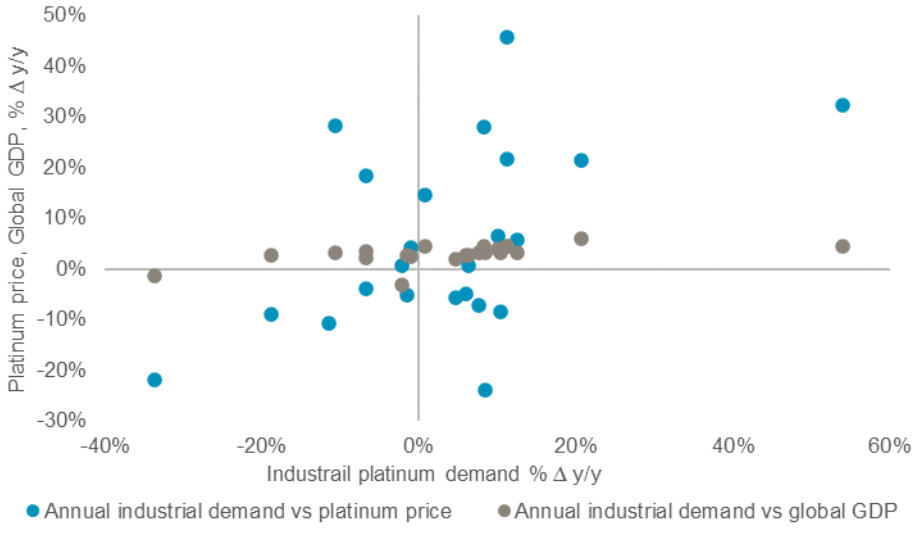


Source: SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2023, WPIC research

Platinum chemical demand acts as a broad and stable underpin for total industrial platinum demand

Although platinum prices have decreased since 2013, increasing industrial platinum demand does not appear to be strongly correlated to changes in the platinum price (see fig. 6). Platinum catalysts' yield and energy efficiency benefits in industrial applications therefore must outweigh price considerations as changes in industrial platinum demand and the platinum price have been modestly positively correlated since 2000 (R^2 of 0.49), suggesting inelastic demand (a negative correlation would indicate price elastic demand). Industrial platinum demand has a greater correlation to global GDP (R^2 of 0.56) than to platinum prices.

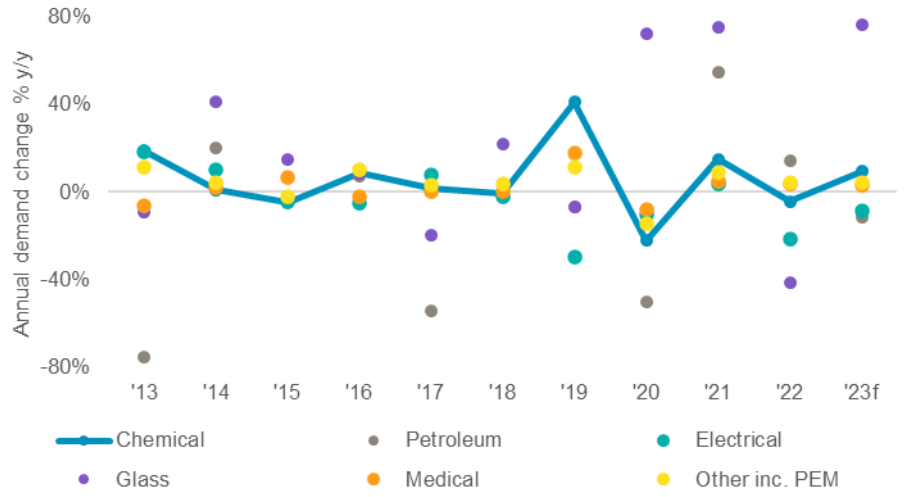
Figure 5. Since 2000, annual platinum industrial demand has shown no specific correlation to platinum prices, which, particularly in the lack of a negative correlation, suggests demand inelasticity



Source: Johnson Matthey 2000 to 2012, SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2022, World Bank, WPIC research

Since 2013 the chemical sub-sector has reported demand growth (3.4% p.a.), slightly below the collective industrial sector at 4.0% p.a. Whilst underperforming the collective industrial platinum demand, we highlight that platinum chemical demand has in general reported less volatile growth patterns than other industrial segments (see fig. 7). Notably glass and petroleum are highly volatile albeit with demand running ahead of collective Industrial demand at 16% and 12% CAGR respectively since 2013. We believe platinum petroleum demand volatility is indicative of broader energy markets and expect the sector to become a drag as energy majors diversify further into petrochemicals to mitigate risks the energy transition weighs on underlying crude oil and gas demand. As installed petrochemicals production capacity increases, the chemical sub-segment is likely to remain the core constituent of industrial platinum demand (which has averaged 30% of total platinum demand over the past five-years) over the medium-term.

Figure 6. Platinum chemical demand is less volatile than most other industrial end-uses, particularly petroleum and glass demand

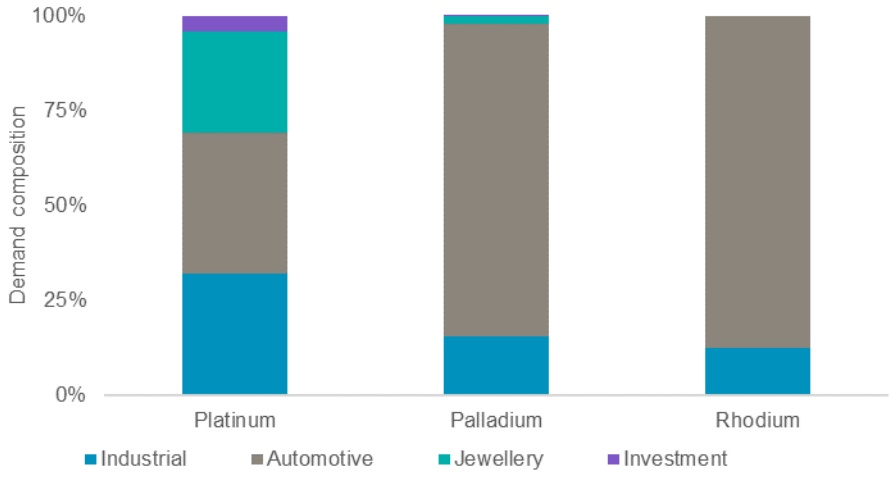


Source: SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2022, WPIC research

Platinum's diversification is a relative advantage

As well as the diverse end uses of platinum industrial demand, total demand is also diverse, being split across the industrial, automotive, jewellery, and investment segments (see fig. 8). In comparison to platinum, palladium and rhodium demand are far more concentrated to the automotive sector, with demand for autocatalysts representing 82% and 85% of demand, respectively on average over the past five years (vs. 37% of platinum demand).

Figure 7. Platinum's demand constituents are more diverse than its sister PGMs which are heavily exposed to the automotive sector

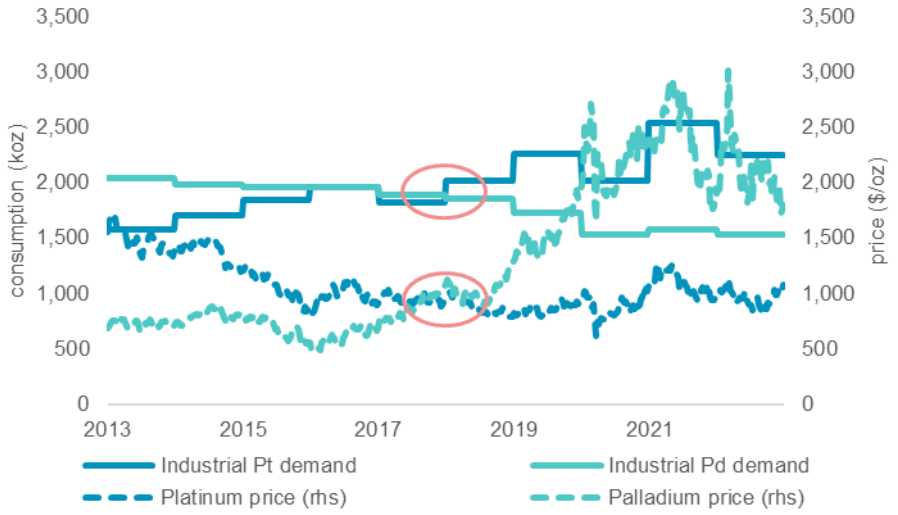


Source: Metals Focus 2019 to 2022, WPIC research

Platinum's diverse end-markets better insulate demand from sector specific trends

Platinum's diverse of end uses, which have individual economic and application specific demand drivers, imply platinum is relatively less exposed to industry specific risks such as the electrification of the drivetrain. Moreover, the ongoing price premium of palladium and rhodium has further incentivised thrifting and substitution towards platinum in industrial applications. Platinum industrial demand growth of 4.0% CAGR since 2013 stands in sharp contrast to declining industrial demand for both palladium (-2.8% CAGR) and rhodium (-4.1% CAGR). The trend of switching to platinum and thrifting of palladium and rhodium became more prevalent with price. Platinum industrial demand has been sustainably higher than palladium industrial demand since 2018 which was a year after platinum prices began trading at a discount to palladium prices (see fig. 9).

Figure 8. Platinum Industrial demand increased above industrial palladium demand as palladium prices began trading at a premium to platinum prices



Source: Bloomberg, SFA (Oxford) 2013 to 2018, Metals Focus 2019 to 2022, WPIC research

Potential headwinds

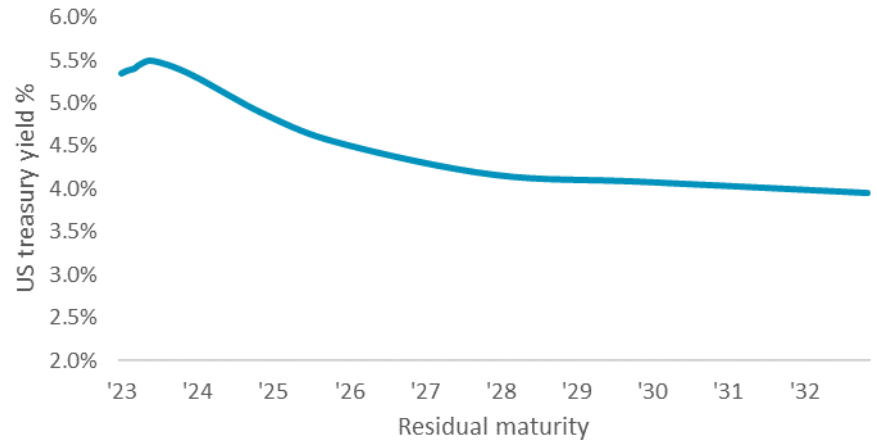
Increasing platinum chemical demand faces two potential headwinds, namely, rising interest rates and reverse substitution.

Higher inflation, rising rates and slower economic growth

Like many commodities, the chemicals sector is cyclical. Although chemical demand and prices face volatility, the petrochemical industry has exhibited consistent growth in installed production capacity. Whilst economic uncertainty may be overlooked in long-term capacity investment decisions, the rise in interest rates since early 2022 may weigh on return projections and cause a slowing of chemical capacity growth capex.

Interest rate uncertainty detracts from long-term investment decisions

Figure 9. The inverted US yield curve suggests markets expect the Federal Reserve to reverse its current restrictive monetary policy



Source: Bloomberg, WPIC research

Interest rates have risen by an average of 500 basis points in the United States since quarter one of 2022. Central banks have increased borrowing costs to manage inflation. However, inverted yield curves suggest that Central Banks will begin reducing interest rates as inflation reverts to target ranges from 2024 (see fig. 10). Should borrowing costs be reduced from current levels, we expect growth investments in the petrochemicals sector could normalise.

Rising prices have likely underpinned palladium and rhodium thrifting in industrial end uses

A shift in preference away from platinum to palladium/rhodium for industrial applications

An example of substitution being in the glass industry, which has moved towards 100% platinum bushings at the expense of using less rhodium

As discussed above, platinum industrial demand has grown, in contrast to industrial demand for palladium and rhodium, both of which have shrunk. The divergent demand trends resulted from rising automotive palladium and rhodium demand that caused supply deficits leading to rising palladium and rhodium prices, thereby disincentivising industrial demand.

Price differences between platinum and palladium incentivise substitution of platinum for palladium in gasoline internal combustion engines. In our latest Platinum Quarterly for Q1 2023, we highlight our automotive palladium for platinum substitution estimate is 615 koz in 2023, supporting a 2023 platinum supply deficit of 983 koz. Sustained platinum deficits and a closing of the pricing differential with palladium could incentivise reverse substitution, causing industrial platinum users to explore increased use of palladium or rhodium.

A further consideration of reverse substitution would be the impact of returning metal to the market. Through Q1 2023, rhodium market sentiment and prices have been negatively impacted by glass manufacturers returning rhodium to the market as rhodium was thrifted and substituted from bushings in favour of platinum. The negative response of rhodium highlights its illiquid and undiversified market, whereas platinum markets which constitute diverse participants are likely to be less responsive to such reverse substitution from a single end-use.

Conclusion

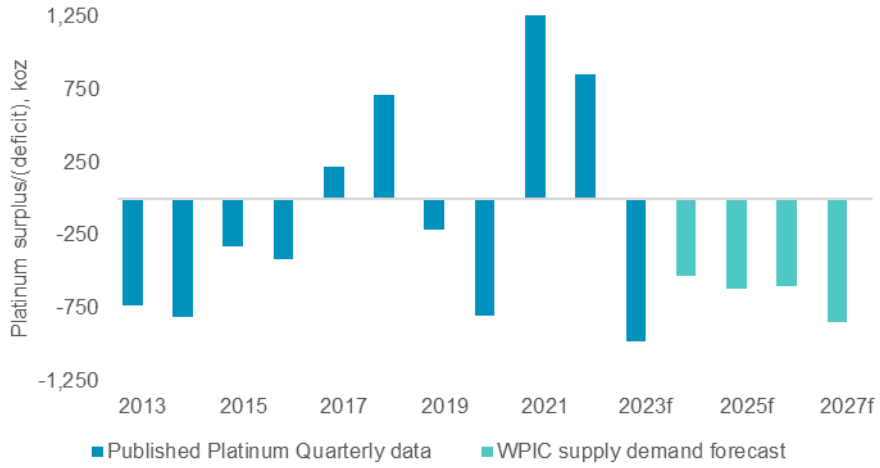
Platinum demand is diversified amongst a number of end-uses, more so than its sister metals palladium and rhodium. With the automotive sector accounting for 37% of platinum's demand over the past five years compared to 82% of palladium and 85% of rhodium demand, we believe that platinum's demand diversity better insulates the metal from drivetrain electrification risks and other exogenous factors. Looking ahead, platinum's demand end uses will further diversify as the hydrogen economy continues to grow (both through installed electrolyser capacity and fuel cells, including FCEVs). The hydrogen economy has its own economic and application specific drivers which we expect to play a role in future platinum demand.

Whilst reducing platinum's concentration risks, industrial end-uses have also proven resilient over the long-term, increasing platinum consumption by a 4.0% CAGR since 2013. Within industrial demand, the chemical sector has proved particularly resilient, reporting platinum demand growth of 3.4% p.a. since 2013 and constituting the largest component of industrial platinum demand at ~30%.

Platinum markets are forecast to enter a sustained period of supply deficits from 2023

Given the correlation between platinum chemical demand, chemical capacity additions and installed capacity, we estimate that platinum chemical demand could add an incremental ~100 koz by 2027 if chemical demand growth matches third party projections. This would accentuate our forecasts for platinum supply deficits. We note that our current two to five-year platinum supply demand outlook (see fig. 11) assumes platinum chemical demand of 693 koz in 2027f which is less than the average demand over the past three years of 716 koz.

Figure 10. Platinum markets are forecast to enter a sustained supply deficit from 2023, suggesting a supportive investment case



Source: SFA (Oxford) from 2013 to 2018, Metals Focus from 2019 to 2023, Company guidance, WPIC Research from 2024-2027

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