PLATINUM ESSENTIALS

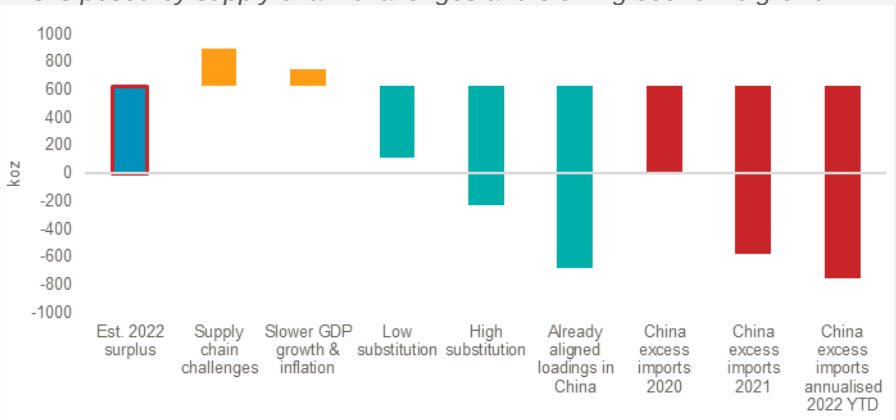
Higher substitution and loadings more than offset vehicle production risks to platinum automotive demand

This report addresses investor concerns about the potential negative impact of supply chain challenges and slowing GDP growth eroding consumer purchasing power on automotive demand for platinum, but demonstrates that these are more than offset by potentially increased demand from higher platinum substitution for palladium, and higher loadings per vehicle. Hence, risks are biased towards a reduced or eliminated surplus in 2022 and substantially increased deficits thereafter.

We estimate that the downside risk to automotive production and demand in 2022 as a result of supply chain challenges and slowing economic growth together is 271 koz as we believe that pent up new vehicle demand negates the 122 koz platinum demand risk of slowing economic growth. However, we estimate that higher substitution of platinum for palladium in new gasoline passenger vehicles could increase automotive demand for platinum by between 512 koz and 853 koz, whilst if platinum loadings per vehicle in China already match those in Europe and the US, actual China demand would be more than 1,300 koz higher p.a. than identified demand.

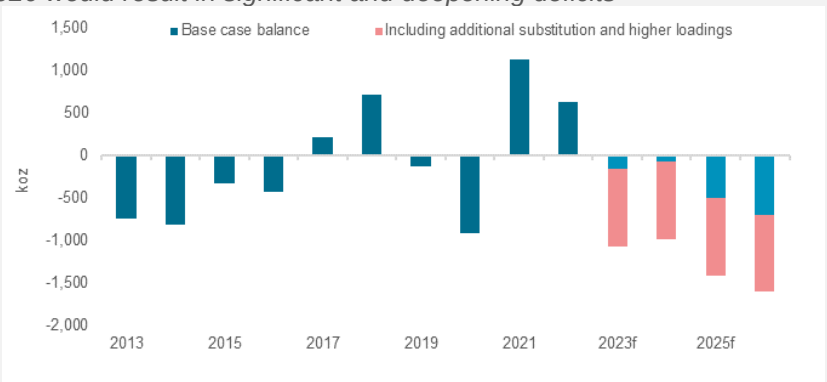
Our key conclusion is that whilst concerns around automotive supply chain challenges and slowing economic growth are absolutely valid, they are swamped by the scale of the potential impacts from higher substitution and higher loadings in China. Therefore, we see the risk bias being towards reducing or eliminating the forecast 2022 surplus, with substantially deeper deficits from 2023 to 2026 than in our base case outlook.

Figure 1. Higher substitution and loadings bias the risks to the forecast 2022 surplus towards reducing or eliminating it and override by far the risks posed by supply chain challenges and slowing economic growth



Source: Metals Focus, Bloomberg, WPIC Research, Note: Individual impacts shown separately

Figure 2. Continuing higher substitution and higher loadings from 2023 to 2026 would result in significant and deepening deficits



Source: SFA (Oxford) 2013-2018, Metals Focus 2019-2022f, WPIC Research 2023-2026

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Platinum automotive demand risks are biased towards increased demand rather than production/demand erosion from the semiconductor shortage or slowing economic growth.

Increased platinum for palladium substitution in gasoline passenger vehicles and higher platinum loadings in China could substantially reduce or eliminate 2022's forecast surplus.

A continuation of above demand imports into China could add weight to our substitution and loadings theses.

Contents

Introduction

Concerns abound, with some justification, that the slowing global economy and/or the ongoing semiconductor shortage could negatively impact automotive production and therefore automotive demand for platinum. This report estimates the potential impact these factors could have if they come to fruition, but also highlights that platinum for palladium substitution in gasoline vehicles, and/or autocatalyst platinum loadings in China already being closer to Western regions', could offset by far potential downside risks.

Key projections

We estimate that the downside risk to automotive production as a result of supply chain challenges and slowing economic growth equate to 9%, since our Q1'22 Platinum Quarterly. The potential negative impact to automotive demand for platinum is therefore estimated to be 271 koz due to supply chain challenges, whilst the 122 koz platinum demand risk from slowing economic growth is completely negated, as pent-up demand for new vehicles is unlikely to be eroded by slowing economic growth to an extent where reduced vehicle demand is below the current compromised automaker capacity. This means supply chain challenges are the primary driver of downside risk.

Automotive downside risk estimated at 9% in 2022 for supply chain challenges as 4% slowing economic growth risk is negated by pent-up vehicle demand.

At the same time, we have considered the potential impact on automotive demand for platinum due to higher platinum for palladium substitution in gasoline passenger vehicles, as well as the impact if per-vehicle platinum loadings in China are already aligned with those in Europe and the US. We estimate that in 2022 higher substitution in new gasoline vehicles only, could increase automotive demand for platinum by between 512 koz and 853 koz, whilst already-aligned loadings in China would add over 1,300 koz to identified demand.

The magnitude of automotive demand for platinum upside risk due to higher substitution or loadings is 3x to 5x higher than supply chain downside risk.

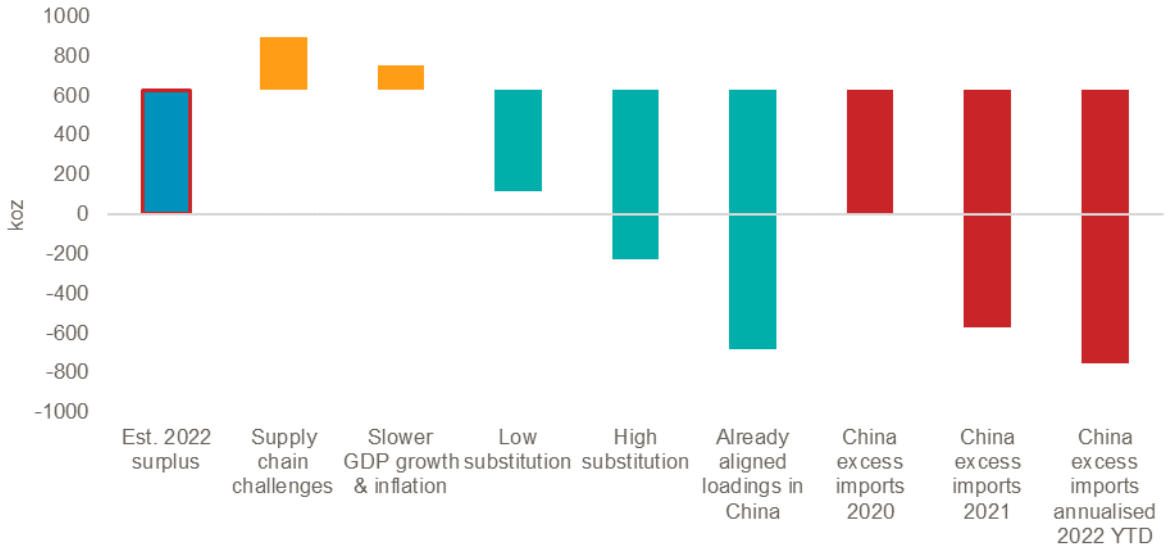
Conclusion – Risks biased to higher demand

Whilst concerns for a negative impact to automotive production are valid, we see limited risk to demand erosion at current production levels. At the same time, the risk bias appears skewed toward higher automotive demand for platinum rather than lower demand, simply due to the scale of the potential impact from increased substitution and loadings, even if these do not manifest to the extent that we have estimated in our scenario analysis.

Risks biased to increased automotive demand for platinum.

As shown in figure 3, for 2022, the calculated impact of supply chain challenges or slowing economic growth could be a modest increase to the estimated surplus, but the possible impact of higher substitution and/or loadings would be to significantly reduce or eliminate the forecast 2022 surplus. We also note, that China's imports continue to run well in excess of identified demand (1,200 koz more in 2021), which could provide some validation to our higher substitution and loading hypotheses. Furthermore, even if each of these scenarios only occurred in part, the aggregate impact would still be to significantly reduce or eliminate the 2022 surplus.

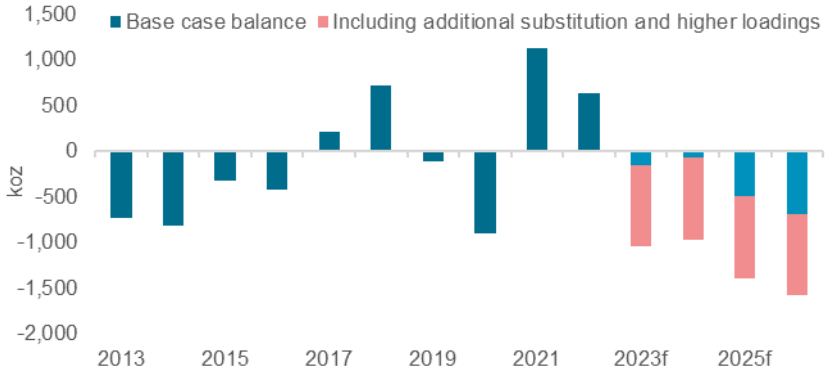
Figure 3. We see the risk bias for 2022 being skewed toward eliminating the surplus



Source: Metals Focus, Bloomberg, WPIC Research, Note: Individual impacts shown separately but risk bias is collective

Looking beyond 2022, the impact of higher substitution and loadings would remain a permanent component of annual platinum automotive demand, with a knock-on effect on supply/demand balances for 2023 to 2026 (one year forward estimates are independently produced by Metals Focus, while estimates for beyond one year forward are WPIC's). Looking at the potential impact on future supply/demand balances, the scale of higher substitution and loadings is significant. Mitigating their effects, we have added the lower substitution and already-aligned China loadings scenarios and applied a 50% risk factor to reflect confidence in the events occurring but allowing for some uncertainty regarding the extent of their impact. The outcome is to increase the deficits we forecast for 2023 to 2026 from modest but swiftly growing deficits to substantial and growing deficits.

Figure 4. Including additional substitution and higher loadings in China would significantly deepen deficits from 2023 to 2026



Source: SFA (Oxford) 2013-2018, Metals Focus 2019-2022, WPIC Research 2023-2026

Beyond 2022, sustained substitution and/or higher loadings would lead to significantly deeper deficits than in WPIC's base case forecasts.

Current vehicle production estimates

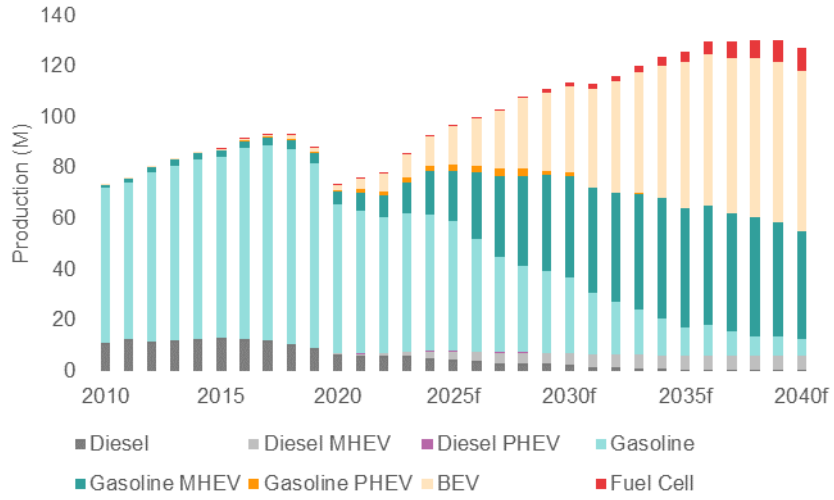
Our one year forward supply-demand estimates (currently 2022) are prepared by Metals Focus, which in terms of automotive production volumes is informed by LMC Automotive. For 2023 and beyond, we rely upon our own internal WPIC estimates.

Supply chain challenges have resulted in automotive production estimates being cut by 2% so far in 2022.

LMC's estimate for light vehicle production in 2022 started the year at 82.1 M, which was trimmed to 80.4 M and then stayed at that level since April. Our longer-term estimates are built off OICA production data, the categorisation of which does not directly align with LMC vehicle sizes. We are projecting 2022 LV production of 77.6 M and 85.2 M for 2023.

More details of our vehicle production estimates can be found in our dedicated drivetrain report.

Figure 5. WPIC light vehicle production forecast by drivetrain type



Source: OICA, ACEA, Bloomberg, WPIC Research

We project ICE to remain a core, albeit declining part of the drivetrain mix through the 2030s; not all vehicle roles are suitable for battery electrification with current technologies and grid capacity.

Potential headwinds

Automotive supply chain challenges, slowing economic growth and inflation

Investors have valid concerns around inflation and low economic growth as well as automotive supply chain challenges.

The global automotive industry is facing two potentially significant headwinds. This year has seen the rise of global economic uncertainty and the spectre of potential slowing economic growth in combination with the highest rates of inflation seen in 40 years, whilst the industry has been battling ongoing supply chain disruptions since the latter part of 2020, in particular challenges with procuring semiconductors.

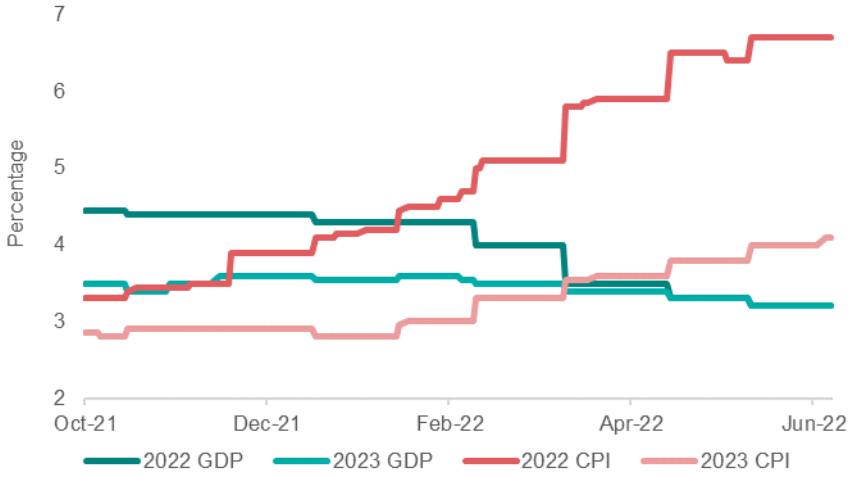
Slowing economic growth and inflation

Looking at consensus GDP projections for 2022, shows that expectations for global economic growth have been steadily trimmed, starting at 4.45% in October 2021, down to 3.2% today. The outlook for 2023 started at a more modest 3.5% in October 2021 but has seen less significant downward revisions, also standing at 3.2% today.

The sharp revisions to consensus CPI expectations reflect the rapid escalation of inflation concerns. In October 2021, the consensus estimates for 2022 average global CPI stood at 3.3% and 2.85% for 2023. Today,

those estimates stand at 6.7% and 4% respectively, changes of an additional 3.4% and 1.25% to growing inflation rates versus just nine months ago.

Figure 6. Changes to consensus GDP and CPI estimates, considered together show a significant erosion of consumer purchasing power



Source: Bloomberg

Lower growth expectations combined with higher inflation expectations point to an erosion of consumer purchasing power in 2022.

Estimates for 2023 have been less heavily adjusted, but further revisions may follow over time.

Global GDP growth in 2021 is estimated to have been 5.5%, thus the above projections are for slowing GDP growth while inflation is increasing dramatically.

What does slowing economic growth in combination with increasing inflation mean in real day-to-day life? A number of things, but to focus on two aspects, it means an erosion of consumer purchasing power, as real wages fail to keep up with prices, and it also means that consumers try to bring forward purchases, anticipating that consumer goods are only going to become more expensive and less affordable in the future. As new vehicles are not readily available at present, there is no opportunity for consumers to bring forward purchases at the moment. This means the greatest potential impact that slowing economic growth could have on the automotive industry is the erosion of consumer purchasing power, although as we shall explain later, we think that pent up consumer demand negates this effect.

A combination of slower economic growth and much higher inflation leads to an erosion of consumer purchasing power.

Since the beginning of 2022, GDP expectations have fallen dramatically, moving the forecast to a level 1.2% lower, whilst CPI has increased to a level 2.8% higher. In aggregate, this means that consumer purchasing power has been eroded to a level 4% lower as real incomes will fail to keep up with inflation. Whilst 4% may not seem like a large number, it is significant when considering that it is the more economically marginal purchasers of vehicles that would be most deeply affected by an erosion of purchasing power.

Figure 7. Consumer purchasing power is expected to be reduced to a level 4% lower in 2022

	03/01/2022	Now	Difference
GDP	4.4	3.2	-1.2
CPI	3.9	6.7	2.8
Consumer purchasing power Δ			-4.0

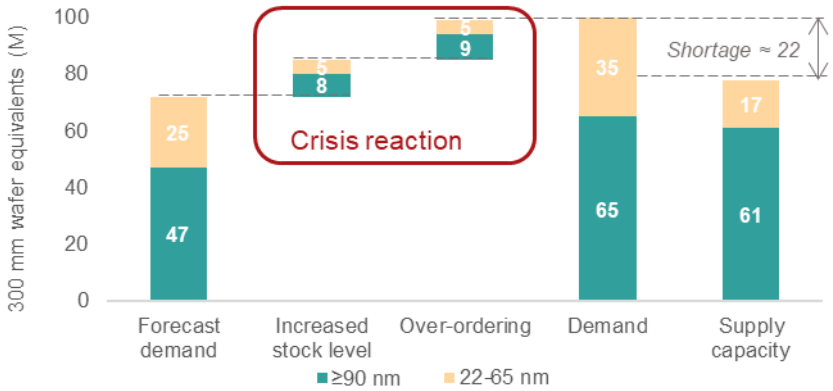
Source: Bloomberg, WPIC Research

Automotive supply chain challenges

In the wake of COVID, and partly as a result of COVID lockdowns, the automotive industry has been experiencing ongoing supply chain challenges. These have been broad-based, but the most significant and the most difficult to circumvent has been the global semiconductor shortage. This shortage has been felt in many areas, but has possibly been felt most acutely in the automotive industry due to a) automakers making sweeping order cancelations during COVID, and not being able to regain supplies, and b) the increasing sophistication of vehicle systems and automation, which means each generation of vehicles contains more and more chips.

Addressing the global shortage, McKinsey estimates that in the combined ≥90 nm and 22-65 nm chip sizes, 2022 demand stands at 100 M units and that currently projected supplies can only deliver 78 M. This results in a 22 M unit shortfall across these chip sizes. However, ~27 M of total demand reflects stock management practices that increased stocks, probably as a result of the shortage in 2021, and that has exacerbated the situation. Without which, presumably, supply would be sufficient to meet demand. Even so, unwinding the deficit would require end consumers to trade chips between themselves, which seems unlikely.

Figure 8. McKinsey estimates a 22 M unit ship shortage in 2022, but much of this seems to be a product of inventory management and overreaction as a result of the genuine shortage in 2021

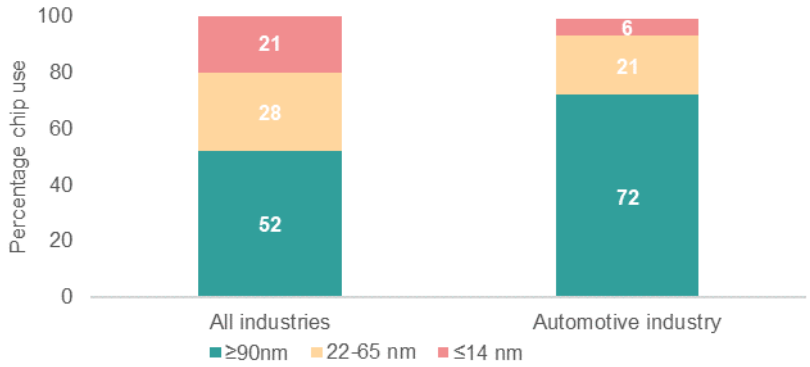


Source: McKinsey, adapted by WPIC, totals may not sum due to rounding

McKinsey estimates a 22% shortfall in semiconductor supply versus demand in 2022, but this would have been virtually zero were it not for inventory management and over-purchasing in response to the genuine shortage in 2021.

As shown in the above chart, of the chip sizes that McKinsey provides estimates for, the greatest shortage is in the newer and smaller sizes (22-65 nm), whilst as shown in the chart below, the automotive industry is much more heavily exposed to the less supply-demand stressed larger chip sizes (≥90 nm). At the same time, just one missing chip can keep a vehicle from being finished (Tesla has been delivering some vehicles without ordered features, promising to retrofit them later).

Figure 9. Automotive semiconductor demand is biased to the larger chip sizes, which are less supply constrained than the smaller chips



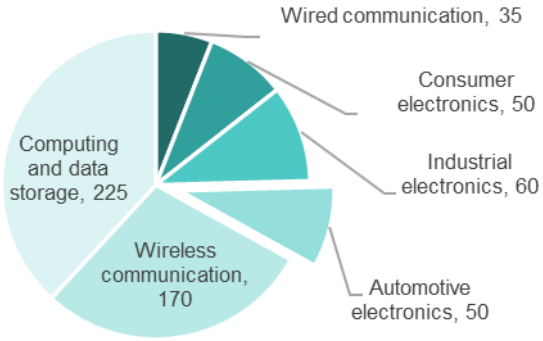
Source: McKinsey, adapted by WPIC, totals may not sum due to rounding

The automotive industry has greater exposure to the larger chip sizes where the shortage is less acute.

But only one or two chips missing from a vehicle can prevent completion.

At the same time, McKinsey, and others, project the automotive industry to be the fastest growing end industry for semiconductors, tripling to rank third behind computing and data storage, and wireless communication by 2030.

Figure 10. The automotive industry is only expected to account for 8% of semiconductor demand in 2022 (US$B)...

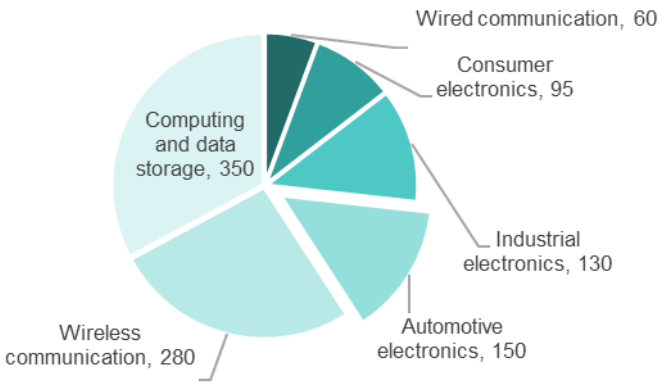


Source: McKinsey, adapted by WPIC Research

The auto-sector is expected to grow to become the third most significant source of semiconductor demand by 2030, potentially boosting automaker purchasing power.

Although forecast to remain less than 50% of computing and data storage's share by 2030, the semiconductor OEMs should be working to increase their service to the automotive industry, which may alleviate the pressure the automotive industry is currently feeling. However, the investment timeframe to bring on additional capacity is a minimum of two to three years, meaning that supply tightness could continue for another 18 months.

Figure 11. ...but McKinsey forecasts it to be fastest growing sector, tripling by 2030 to account for 14% of demand (US$B)



Source: McKinsey, adapted by WPIC Research

Figure 12. We estimate that the downside production risk due to the semiconductor supply challenges totals 11% since our Q1'22 PQ

Chip size	Potential supply demand gap	Automotive demand exposure	Exposure adjusted risk	Stocking and over-ordering adjustment	Adjusted downside risk
22-65 nm	-51%	21%	-11%	29%	-8%
≥90 nm	-6%	72%	-4%	26%	-3%
		Total	**-15%**		**-11%**

Source: McKinsey, adapted by WPIC Research

We estimate a maximum 11% downside risk to automotive production volumes due to the semiconductor shortage.

Using the McKinsey data as a base, we estimate that the downside risk to automotive production as a result of the semiconductor shortage is 11% for 2022 as a whole, or 9% after accounting for a 2% cut to automotive production forecasts already made by LMC in the first quarter of the year.

We see greater downside potential from the supply-chain challenges limiting production output, than due to the calculated slowing economic growth linked demand impact.

Figure 13. The semiconductor supply challenges present a greater risk to automotive demand than slowing economic growth

Automotive production changes		Supply chain challenges	Slower GDP growth and inflation
LMC start of year 2022 forecast	M	82.1	82.1
LMC current 2022 forecast	M	80.4	80.4
YTD Reduction	%	-2%	0%
Maximum potential H2'22 risk	%	-9%	-4%
Minimum potential LV production	M	73.2	77.1
Automotive demand for platinum in 2022	koz	3055	3055
Potential cut to demand	koz	271	122
Minimum potential automotive demand for platinum in 2022	koz	2785	2933

Source: Metals Focus, LMC, WPIC Research

We see the semiconductor shortage as presenting a greater risk to production than slowing economic growth and inflation, which are negated by pent-up new vehicle demand.

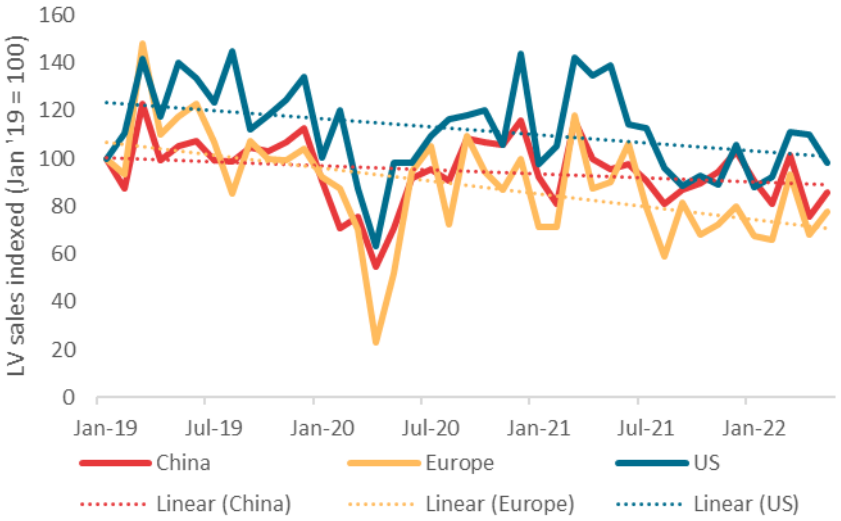
In terms of automotive demand for platinum, the potential impact is only a negative 271 koz as a result of supply chain challenges, because the calculated 122 koz for slowing economic growth is negated by pent-up demand. The potential platinum demand reduction would increase the forecast 2022 surplus from 627 koz to 795 koz.

Automotive demand vs. production

So, how worried should investors be with regard to the downside risks to automotive production and/or platinum demand due to the supply-chain challenges and/or slowing economic growth? In the short-term, there is little that the automakers can do to control the semiconductor supply-chain challenges, aside from reduce the list of optional extra's offered in order to reduce the chip count per-vehicle. However, a side effect of the supply-chain challenges is that current production rates are running below estimated demand levels. This means that there is pent-up demand for new vehicles, which in turn suggests that whilst slowing economic growth could result in some demand destruction at the margins, it is unlikely that the demand will be hit to the point where it is below current production capacity, hence platinum automotive demand will not be negatively affected in 2022.

Running through the evidence for sustained consumer demand for new vehicles: Light vehicle sales have remained strong in the major markets, although COVID and other production challenges can be seen in the trend of sales since 2019.

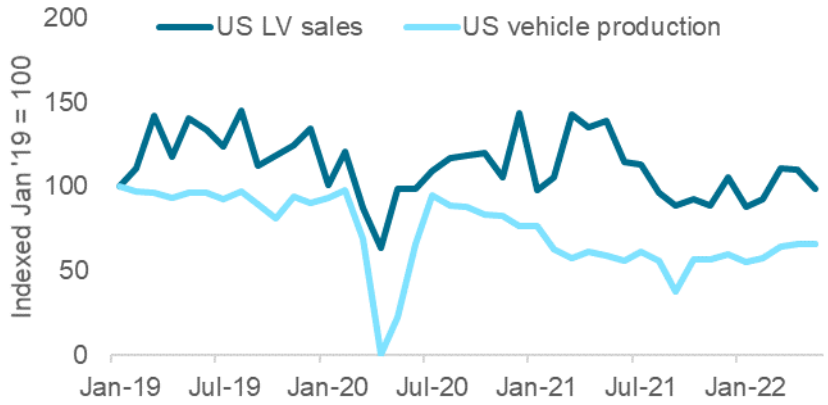
Figure 14. Light vehicle sales indices in key global markets have trended lower since 2019 as a result of production being hampered by COVID and supply chain challenges



Source: Bloomberg

US light vehicle sales have broadly tracked production rates, with the exception of for much of 2021 which when demand outstripped new supply, before falling back in line for the most part in 2022.

Figure 15. US light vehicle sales versus production



Source: Bloomberg

The divergence in 2021 resulted in a draw-down of new vehicle inventory to the lowest level ever seen, since when, ongoing consumer demand continuing to absorb vehicles as they are produced.

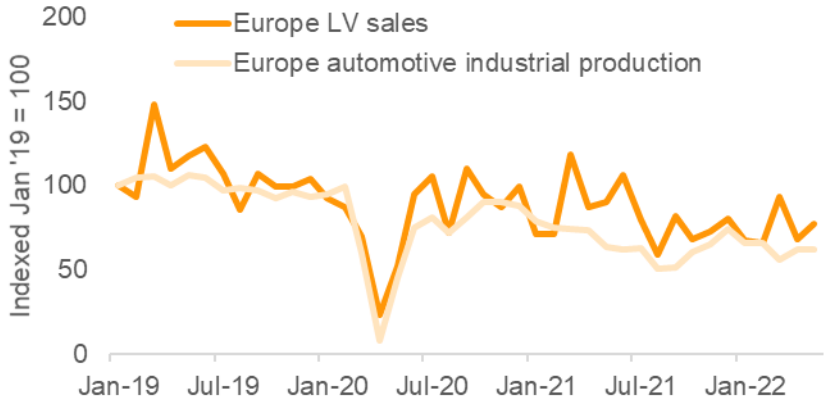
Figure 16. US new vehicle inventories have fallen to their lowest ever level as a result of production failing to satisfy demand

Source: Federal Reserve Bank of St. Louis

US new vehicle inventories have fall to their lowest levels ever.

Whilst new vehicle inventory data are not available for Europe, similar to in the US, sales have broadly tracked automotive industrial production.

Figure 17. European new vehicle sales have tracked production

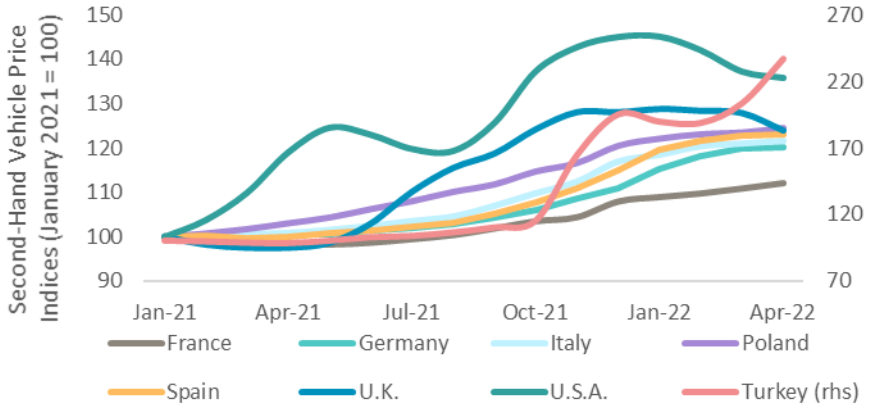


Source: Bloomberg

Strong consumer demand is also evident in sustained prices for second-hand vehicles.

Elevated used vehicle prices show that demand remains strong, with consumers forced to turn to the used vehicle market due to the lack of new vehicle availability and driving up used vehicle prices.

Figure 18. Elevated used car prices in major markets point to sustained consumer demand for vehicles



Source: Bloomberg, Office of National Statistics

Increased substitution and aligned loadings

Whilst there are downside risks to automotive demand for platinum as a result of the supply chain and a theoretical but negated impact from slowing economic growth challenges, the overall impact is small compared to the potential increased demand as a result of platinum for palladium substitution in gasoline vehicles, as well as the impact if China catalyst loadings are already aligned with levels in Europe and the US. In many regards, this explains China's platinum imports, which continue to run well in excess of identified demand.

Platinum for palladium substitution

Palladium has traded at an average premium over platinum of more than US$1,300/oz since the beginning of 2020 (peaking at US$2,014/oz on Russian sanctions), which on an economic basis alone, should have been driving additional substitution of platinum for palladium in gasoline autocatalysts. The ability to substitute in vehicle models that are already on the road has historically been relatively limited and/or expensive, but there is significant flexibility to substitute in new models, ahead of emissions control certification, on a 1:1 platinum for palladium basis.

The platinum to palladium price differential has been sufficient to incentivise substitution since 2018.

The economic incentive has been in place since the price of palladium overtook platinum in 2018, bolstered by security of supply concerns given palladium's status as a by-product of platinum and nickel production. However, Russia's invasion of Ukraine and the sanctions against Russia have further strengthened the substitution rationale. Although Nornickel, which produces 38% of global mined palladium supply, has not been sanctioned and is still able to export metal, there remain risks that it may still be sanctioned in reaction to ongoing Russian aggression. There is also a moral question as to whether companies in countries opposed to the war should be buying Russian mined material.

New model gasoline vehicles are where automakers have the greatest flexibility to adjust loadings.

We believe that up to 75% of the palladium in gasoline vehicle catalysts could be substituted by platinum without a loss of thermal stability. However, we conservatively show scenarios of 30% and 50% substitution and assume that substitution occurs on only the c.20% of annual vehicle sales that are newly launched models. Based upon production of 59M gasoline passenger vehicles in 2022 across all vehicle categories, the two scenarios could save automakers between US$671M and US$1,118M.

This would result in additional platinum demand of between 512 koz and 853 koz p.a.

Figure 19. Platinum for palladium substitution in only 20% of new gasoline passenger vehicles could substantially add to automotive demand for platinum

Gasoline vehicles (M)	Annual Pd demand (koz)	Annual newly launched models (%)	Pt for Pd substitution level (%)	Total annual Pt impact (koz)	Automaker savings (US$M)
58.6	8,529	20%	30%	512	671
			50%	853	1,118

Source: Metals Focus, WPIC Research, Bloomberg

'Already aligned' China loadings

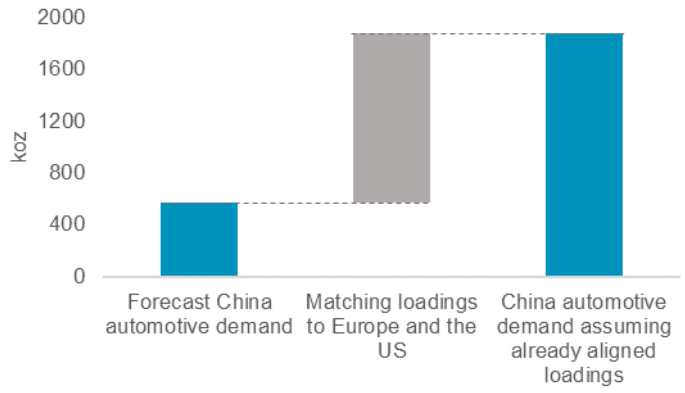
Estimated automotive demand for platinum stands at 570 koz for China in 2022. Matching this with automotive production volumes results in platinum loadings per vehicle that are 37% to 74% lower than estimated loadings in comparable vehicle segments in Europe and the US. Explaining the difference is tricky considering that China's emissions regulations are comparable, or in some areas even more rigorous, than the regulations in Europe and the US.

It is possible that part of the difference could be due to non-compliance, but the scale of the difference is so significant that this seems unlikely to be the only answer given that China's authorities generally take strict displeasure at corporate malfeasance.

Another possible solution is that loadings in China are already closer to those in Europe and the US, but that the level of disclosure through COVID has been insufficient to fully identify the change. Examining this theory more closely and modelling estimated loadings in China having already reached levels in line with Europe and the US results in forecast 2022 automotive demand for platinum increasing by 1,300 koz to almost 1,900 koz.

This is an enormous change affecting all vehicles, although the majority of the uplift is in the heavy-duty segment.

Figure 20. If estimated per vehicle platinum loadings are already aligned it results in a 1.3 Moz increase in 2022 identified automotive demand for platinum in China



Source: Metals Focus, WPIC Research

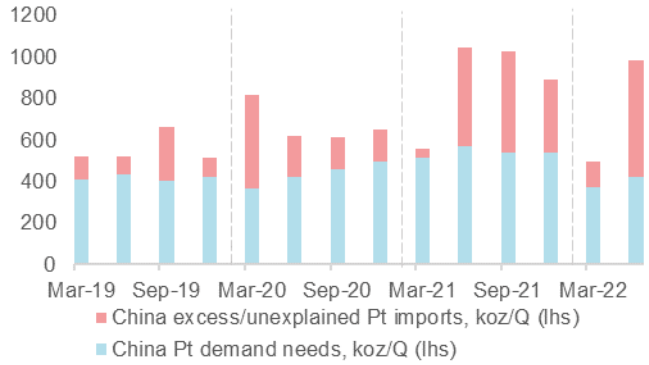
If China's loadings are aligned with Europe and the US's it suggests that China's automotive demand for platinum should be >3x higher than its identified demand.

Higher substitution and loadings may be validated by China imports

China has imported meaningful amounts of platinum, well in excess of its identified needs, since at least 2019. This could in part reflect the increased platinum for palladium substitution in gasoline vehicles, as well as higher loadings across all vehicle categories. It may also be that some of the extra imports are for unidentified industrial demand, or for semi-speculative purposes. However, even if not all of the excess imports are for the automotive industry, some of them most likely are and the scale of the imports certainly validates our loadings and substitution hypotheses, even if not quite at the scale we have presented above.

During 2020, China imported 624 koz more platinum than its identified needs, which increased to an astonishing 1,200 koz in 2021. For 2022, annualising the imports from January to May suggest that China is on track to import 1,378 koz more platinum than its projected needs, although this includes exceptionally strong demand in April. This is no doubt only circumstantial, but we note that the year-to-date 2022 import volume is surprisingly similar to the additional demand figure if assuming loadings are already aligned with those in the West.

Figure 21. China is continuing to import significantly more platinum than it's identified needs



Source: Metals Focus, Bloomberg, WPIC Research, N.B. the June 2022 quarter is the import data for April and May, divided by two and multiplied by three to approximate quarterly demand

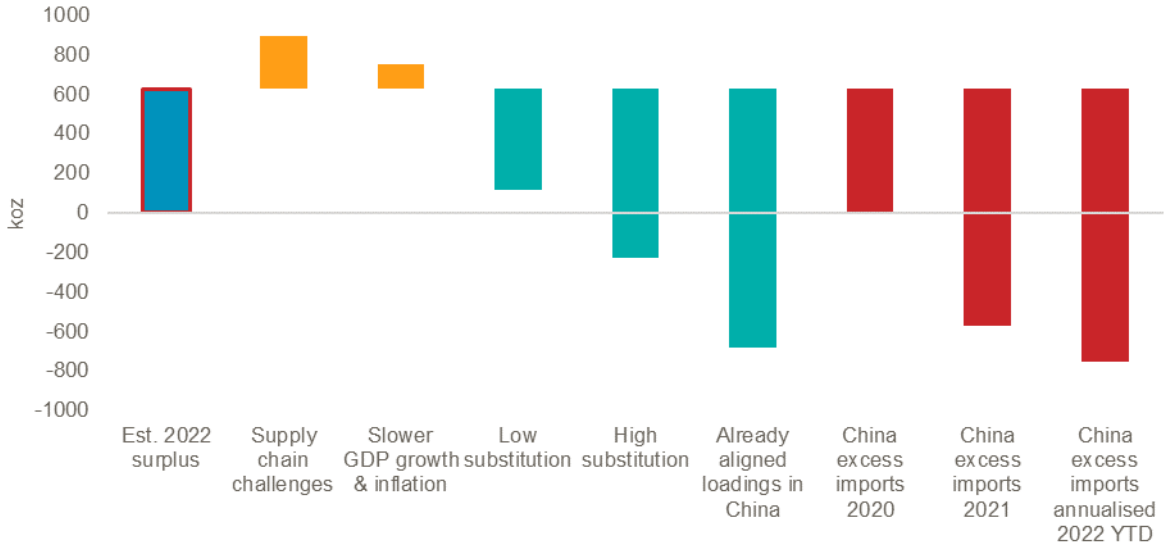
China's platinum imports continue to run well ahead of its identified demand, potentially supporting the theses of higher substitution and loadings.

Conclusion

Supply chain challenges has the potential to negatively impact automotive production and consumer demand in 2022. We believe that because of significant pent up consumer demand due to automaker production challenges it is unlikely that slowing economic growth and reduced consumer purchasing power will erode vehicle demand to below the production capacity of automakers. In addition, the supply chain risks to vehicle production are small in comparison to the potential increases to platinum automotive demand from higher substitution and loadings. Thus, the risk bias is towards events that would reduce or more than eliminate the forecast platinum surplus in 2022. A perspective which is supported by China's seemingly insatiable demand for platinum.

Demand downside risks from supply chain and slower GDP/inflation headwinds are more than offset by the potential scale of upside risks from higher substitution and loadings.

Figure 22. Although the semiconductor shortage could pose risks to automotive production and demand, the calculated impact of slowing economic growth is negated and the risk bias is heavily skewed to factors that could increase automotive platinum demand and reduce or eliminate the surplus



Source: Metals Focus, Bloomberg, WPIC Research

Looking beyond 2022

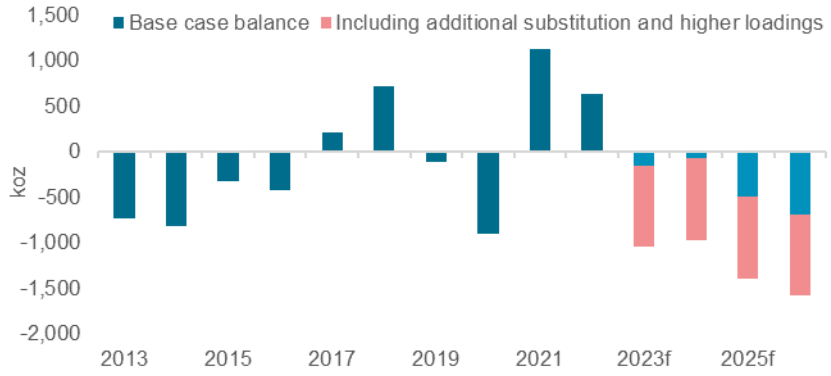
At present, we are unable to obtain publishable confirmation to definitively prove the current or future levels of platinum for palladium substitution in gasoline vehicles, or for higher loadings in China. However, the circumstantial evidence of other industry participants pointing to substitution rates at twice our base case assumptions, and China's excess imports, are highly supportive of our substitution and loadings scenarios.

Importantly, higher substitution and loadings would be expected to remain a permanent component of annual demand, which will have a knock-on effect on our forecast supply/demand balances for 2023 and beyond (reminder: one year forward estimates are independently produced by Metals Focus, estimates for beyond one year forward are WPIC's).

To look at the potential impact of this on supply/demand balances, we have added the lower substitution scenario to already-aligned China loadings and applied a 50% risk factor. Although we believe that substitution in new model gasoline vehicles and higher loadings in China are already in place and underway now, the risk factor recognises some uncertainties in the exact extent to which they are occurring. Indeed, China's continuing above requirement platinum imports are potentially supportive of this thesis. The net impact is to increase the deficits we forecast for 2023 to 2026 from modest but swiftly growing deficits to substantial and growing deficits.

Carrying through higher substitution and loadings to 2023 to 2026 would result in significantly deeper deficits than our base case assumptions.

Figure 23. Including additional substitution and higher loadings in China would significantly deepen deficits from 2023 to 2026



Source: SFA Oxford 2013-2018, Metals Focus 2019-2022, WPIC Research 2023-2026

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