DECEMBER 2022

Ti Observer™ Insights

TiO_2 Forecast Pricing Report

TiO_2 Pricing Trends & Outlook 2022-2027

TiPMC Consulting

Consultants to the Financial, Chemical and Minerals Industries

2022-2027 TiO_2 Price Forecast

This chart illustrates the pricing trends in the TiO_2 industry as we look forward to the first half of 2023, along with research, TiPMC insights and hands-on experience in presenting the forecast through 2027. The outlook is developed with market strategies that do not focus only on price. TiPMC shares forecasted numbers by region, and calculations of future results include many additional factors.

		4Q22	1Q23	2Q23	3Q23	4Q23	1Q24	2Q24	2H24	2025	2026	2027
NA	*High*											
	Mid											
	Low											
AP	*High*											
	Mid											
	Low											
C&SA	*High*											
	Mid											
	Low											
EU	*High*											
	Mid											
	Low											
Global	*High*											
	Mid											
	Low											
China Export	*High*											
	Mid											
	Low											

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Note: All prices are USD/t, with exchange rates assumed to be at current levels.
Changes are expressed as probabilities for average pricing in time period in question.

TiO_2 GLOBAL OUTLOOK

TiO_2 Forecast & Strategic Review: 2023 A Year of Transition?

The TiO_2 industry continues to feel the impact of the dramatic downturn in demand in Europe and Asia. Additionally, other markets, including North America, are seeing the usual seasonal slowness coupled with recessionary headwinds. The destocking in Europe and Asia is now occurring in the Americas. TiPMC believes 2023 will be a year of transition, but would expect to see some rebound from 4Q22 to begin to occur in the first half of the year continuing into the second half. It is difficult to see conditions getting significantly worse. The timing and extent in each region remain highly uncertain. However, the year overall is likely to see lower total TiO2 demand vs. 2022. Brighter prospects will not likely appear until 2024.

The destocking and reduced underlying demand that started in Europe and Asia is now spreading in North and South America. Some sources indicate sales may be down as much as 20-25% in the Americas as compared to 4Q21. The volume decline described by the Multi-National Producers (MNPs) in their last investor calls do not appear to be improving.

TiPMC sees some positives moving into 2023:

- Destocking in Europe appears to be heading to completion. Some reports indicate that there was some pick-up in order patterns in November and December. There are also reports that some of the idled facilities in Europe are preparing to restart in 2023.
- MNPs reportedly held price in nearly all regions. North America saw some price increases, particularly for customers with AVA contracts. There are reports of some price concessions in Europe and Asia, but not as dramatic as price decreases from China. Chemours reported increased prices by USD200/t in China.
- China is reported to be dealing with an Outbreak of COVID-19 variants in several provinces. At witnessed earlier, social unrest in China from lockdowns will grow as the country recovers. This may lead to central government actions to move forward beyond the No COVID policies. The lifting of travel restrictions appears to be a good start. Any good economic news in China is good for Asia. Asian economies are increasingly tied to China and will remain so for the foreseeable future.
- The rapid idling and reduced production by Multi-National Producers (MNPs) in Europe and elsewhere will reduce inventory build within the supply chain. Although Europe has been getting the most attention, MNP utilization throughout the world has been reduced to manage inventory and reduce costs. Variable costs associated with energy, feedstock, and other raw materials remain high. Tonnes produced into inventory have a huge

impact on cash flow, providing plenty of incentive to keep finished product inventory very low. Government assistance, in the form of furlough programs, have reduced the fixed costs burden of reduced production for some European producers. Capping of natural gas prices in Europe will provide more stability to producer costs.

- Policies in Europe to cap energy prices provides more certainties for consumers as well as the industry.

Downsides into 2023 that cloud the positive news:

- The housing market in North America continues to slow. Interest rate increases may be slowing but have not peaked. There are signs of reduced TiO_2 consumption in plastics, related to housing and packaging.
- Continually weak economies in Europe remain, as energy and overall inflation weigh on the consumer. TiPMC expects sales will be significantly improved vs. the second half of 2022, but much lower than the first half of 2022, when sales were more robust.
- Uncertainty around Chinese demand, and overall demand in Asia remains. The likelihood of a return to strength in 2023 seems conceivable, but the degree of the recovery remains in question.
- Some impact of the recent rapid increase in Chinese capacity, led by LB Group is anticipated. All observers are stunned by the expansion despite domestic and foreign market weakness and low prices. Upward price movement in China is being driven by costs vs. market conditions. TiPMC believes this will persist through 2023. TiO_2 price in China will increase, particularly as demand recovers, but increased production capacity will limit the extent of the increase.
- Exports from China have decreased over the past several months. But net imports are being impacted by reduced imports into China. This will continue to be an interesting trend to observe. The lingering question becomes if Chinese producers displace imports or if imports recover with Chinese demand.
- Export trends from China will be closely observed in 2023. Traditionally, slower markets have decreased Chinese exports. New capacity is very focused on increasing exports, particularly the new chloride capacity from LB Group. This will provide a test to traditional norms.

Predicting the timing of an upturn is not simple. Given the unique nature of the developments in each region, this cycle offers to be complicated. TiPMC continues to believe 1Q23 in Europe will need to be closely watched, as destocking will end, and underlying demand becomes the major determinant of overall demand. Recent developments in stabilizing energy prices will help consumers. Asia will see some recovery but may not be of the order observers have come to expect. Slowing demand in the Americas is almost a certainty.

Pricing strategy continues to be a major differentiator between MNPs and Chinese producers. Without question LB Group is the main influencer in China. China's producer will follow LB Group's lead. Some exceptions are recognized as marginal producers will choose between price increases and shutting down operations, as margins are stressed. LB Group has clearly indicated that becoming the number one producer globally is the primary goal, with price management secondary.

TiPMC continues to see cost inflation as a primary headwind for 2023. Inflationary impacts may be reduced, as governments move to stabilize energy costs in Europe, while supplier markets and supply chain become more stable. Although some level of feedstock cost relief may occur, substantial relief is unlikely. The same scenario exits for chlorine in North America. Chinese producers may see some relief from foreign feedstock, but most observers do not see substantial relief from other raw materials. Prices have been reduced to levels believed to be unsustainable despite the most favorable developments in terms of costs. TiPMC continues to see Chinese prices substantially lower the competitors in export regions.

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One thing seems certain. The first half of 2023 will not compare favorable to the first half of 2022. Conversely, the second half of 2023 appears destined to be improved vs. 2022, perhaps because it can't get any worse.

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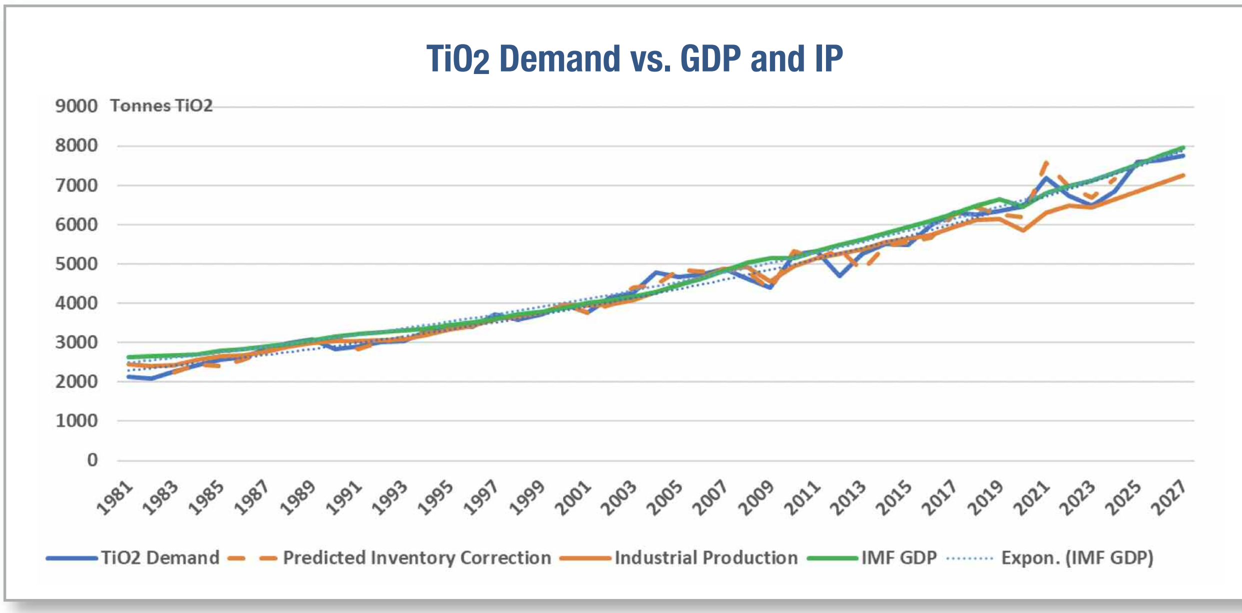
TiPMC has highlighted these elements within its forecast development.

Macro-economics and Leading Indicators

TiPMC has reviewed its demand models for Yearly TiO_2 demand comparing demand to GDP and Industrial Production over the last 40+ years. The correction in 2022 brought sales in line with long term growth trends.

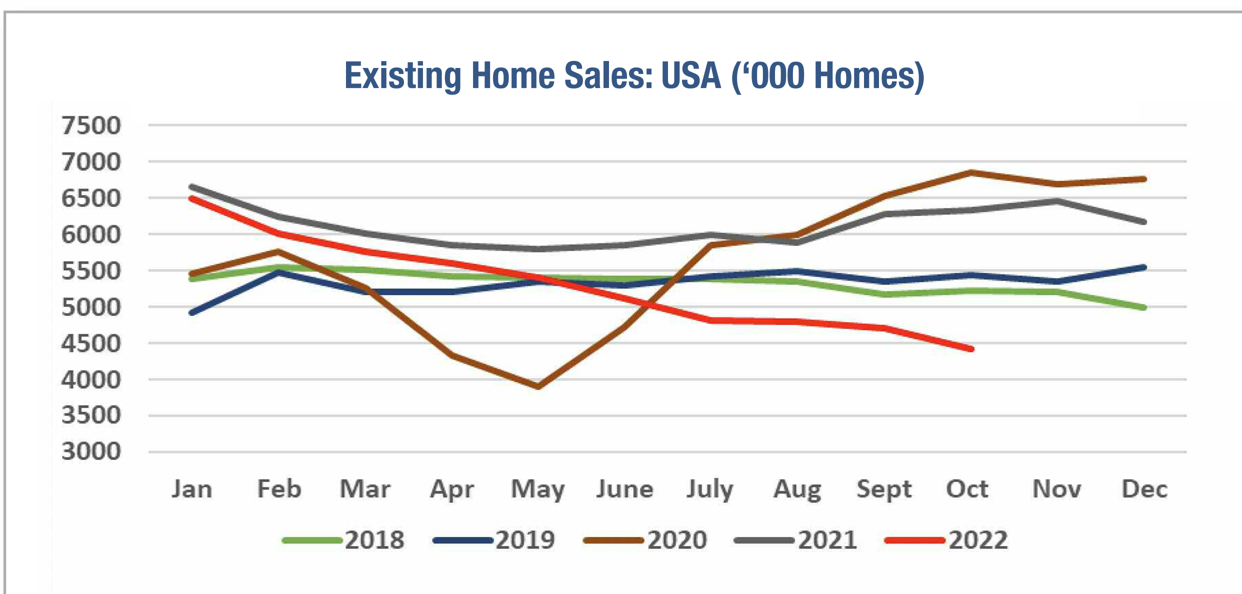
The correction witnessed in 2022, corresponds to traditional movement of demand. The swiftness and degree of the correction was unique in the history of the industry. The inventory correction based on global industrial production correctly indicated the trend. Given the current state of the industry and the world economies, predictions indicate further reduced demand in 2023. TiPMC believes the industry will move back toward the long term trendline to TiO_2 normal TiO_2 sales growth in 2024 of TiO_2 of 2.6% CAGR.

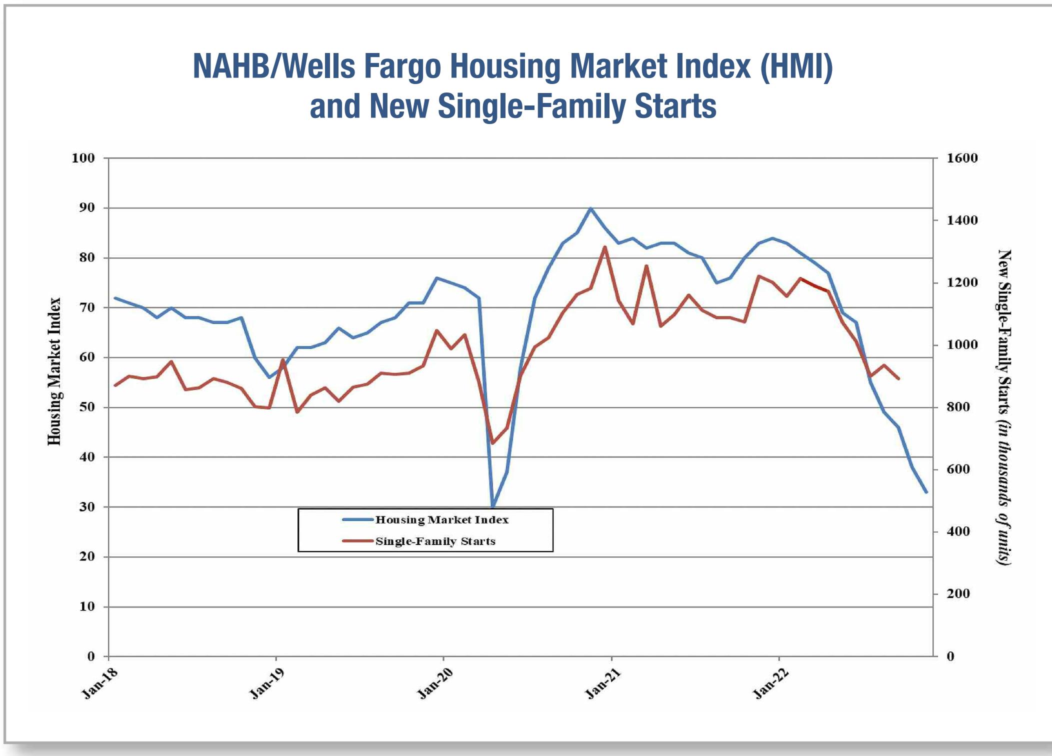
Housing demand in the US is dropping at an accelerated rate since the beginning of 2022. The only period where rates were below current rates were in the middle of the COVID-19 pandemic in the spring of 2020.



Source: Ti-Insights / Titanium Advisory / TiPMC

The same commentary applies to the Housing Market Index and Housing Starts within the US.





Source: NAHB / Wells Fargo Housing Market Index. U.S. Census Bureau.

Short-Term (2023 moving into 2024)

Demand in 4Q22 can best be described as "stalling". Given the current state and the leading indicators, TiPMC believes 2023 will be a transitional year.

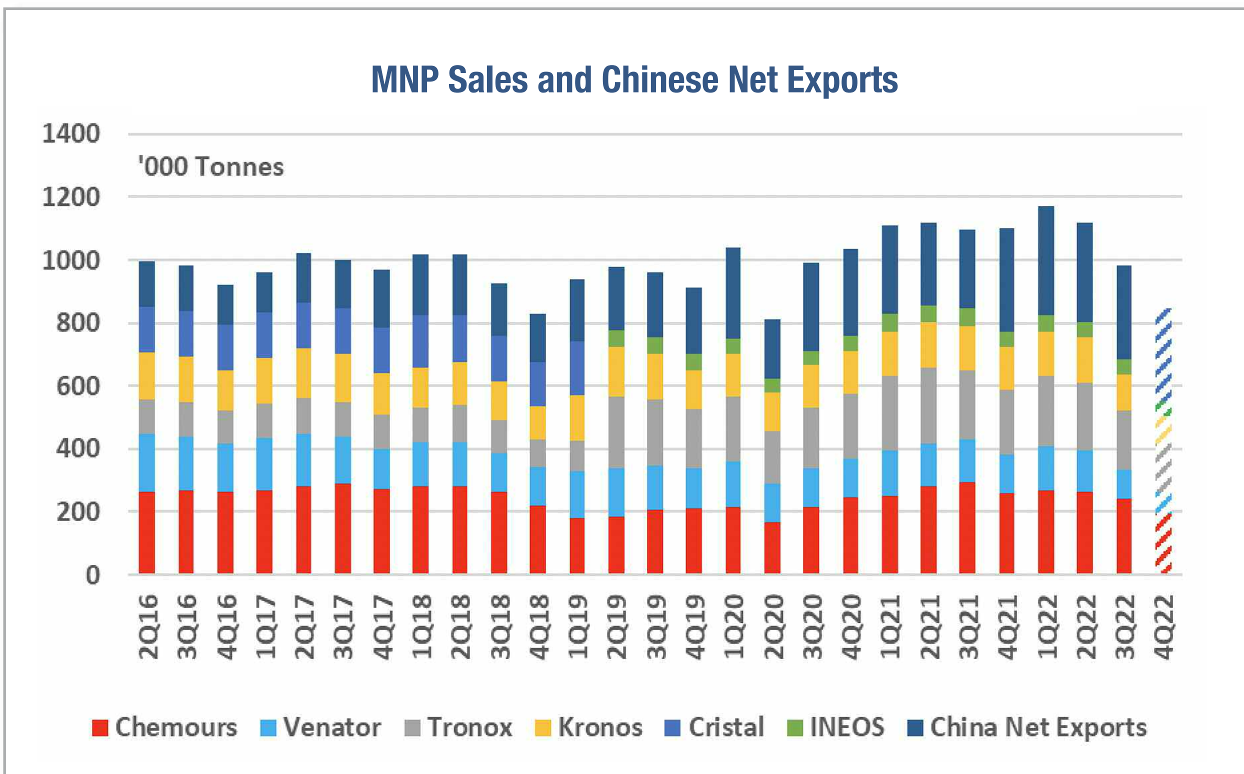
Given the most recent information available, TiPMC believes sales outside of China could be down in the 23-25% for 4Q22. Although highly speculative, Chinese demand is expected to be down in the 3-5% range for 2022. In terms of volume, that would equate to about 400-450kt in the second half of 2022 as compared to 2021.

AkzoNobel noted in their latest investor update that 4Q22 volumes were assumed to be down high single digit %YoY, excluding any M&A. They noted weakening consumer confidence in Europe and softer demand in China as impacting their Q3 results. They also noted they significantly cut back on buying key categories extensively in the fourth quarter. Outgoing CEO Thierry Vanlancker noted orders to some supplies dropped to zero for one or two months. His comments are echoed elsewhere, as destocking of raw materials on the part of TiO_2 consumers is a large part of the drop in European demand. The combination of softer underlying demand and destocking explains the current dynamics with TiO_2 volume reduction around Europe.

Robert Fry expects global GDP growth to fall below 2% in 2023, meeting a commonly used definition for a global recession. He expects outright declines in GDP in the US and in most countries in Western Europe, with Germany feeling the biggest impact. Growth in China is likely to be highly volatile and difficult to forecast as the economy shuts down and reopens in response to COVID-19 outbreaks.

From a TiO_2 perspective, TiPMC highlights these events in developing its forecast:

- Despite destocking ending in Europe, inflation and struggles with key economies will reduce first half volumes, particularly compared to the prior year comparison.
- Asia will recover in 2023, likely beginning in 2Q. The uncertainty around China remains, which impacts all APEC. As lockdowns become less of a concern, economic conditions will be favorable, particularly as compared to 2022. Given the recent COVID outbreaks in China, the timing remains a significant uncertainty.
- North America is seeing significantly reduced sales entering the recession.
- Latin America is seeing similar dynamics to North America.



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Source: Company 10Qs / TiPMC Estimates

TiPMC believes demand will rebound in the first half of 2023 relative to the end of 2022. Given the terrible conditions of the last quarter, this statement does not endorse a strong market. Comparable to the same period in 2022, the market will be weaker. Underlying economics in key regions do not support rapid growth in any region.

The combination of seasonality, restocking and improving underlying demand in Asia will offset some volume. MNPs will also struggle with transitional customers, particularly in Asia and Latin America, where the Chinese hold significant market share. Given reduced utilization rates, some price reductions are likely to occur to keep plants operating at reasonable rates.

Although extremely speculative, TiPMC sees the results of 4Q22 and developments for the next several quarters in this way:

4Q22: This quarter has been a very deep bottom for the industry. For comparison, our current view of 4Q22 is nearly 15% below 2Q20, the most severe quarter impacted by COVID-19. Markets that were resilient in 3Q22, primarily North and South America, are reported to see sales well below seasonal norms. The impact of the housing market is being felt throughout the coatings supply chain. DIY sales that helped carried architectural coatings through COVID-19 are depressed, and disposable income is reduced.

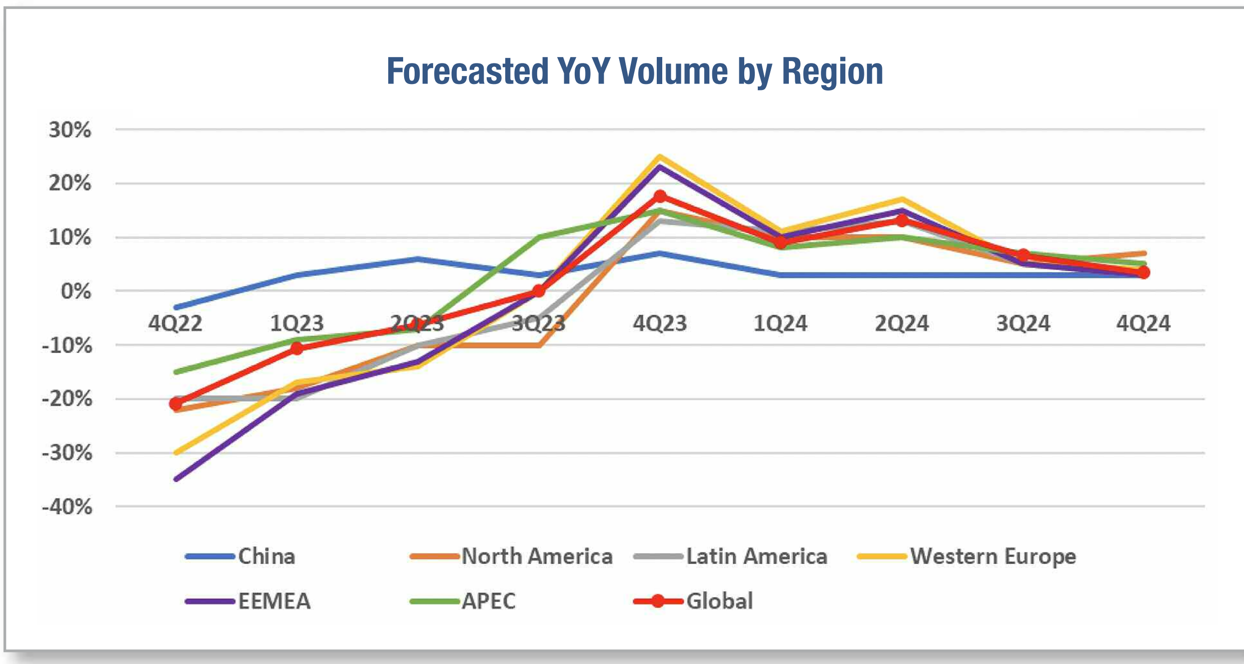
Also worth noting is the impact of reduced housing starts and overall residential construction on PVC, also reported to be off significantly. Plastic segments not related to housing are reportedly impacting sales, as downstream customers are destocking resins, not requiring colorants, lowering TiO2 demand. Some signs of improvement in Europe are being reported, as order patterns are beginning to see the end of destocking. Energy and the impact of the war in Ukraine continues to weigh on the local economies.

1Q23: The actions of the MNPs to moderate operating rates in 4Q22 are critical to controlling inventory. Underlying demand is not reaching 1H 2022 levels. TiPMC believes comparable to the first half of last year to be down 15-20% in 1Q23. South Korea did see an increase in imports in October and November vs. prior months. One data point is difficult to call a leading indicator. The faster China moves from COVID lockdowns, the quicker all regional economies benefit. Given the difficult comparison, coupled with strengthening recessionary headwinds, TiPMC believes the Americas will remain down 15-20%.

2Q23: TiPMC believes downstream consumers will see some restocking needs, as coatings season approaches in the Northern Hemisphere. Industry utilization rates are expected to remain well below traditional coatings season levels and well below the 2022. TiPMC believes YoY volume decrease in regions outside of China remain in the 15-20% range. China and the rest of Asia generally sees a strong period post Chinese New Year, which did not happen last year due to COVID-19 lockdowns. Uncertainty remains as to the potential for further lockdowns, coupled with a poor housing market weighing on Chinese recovery.

3Q & 4Q23: TiPMC expects the second half of 2023 to be favorable verus 2022. TiPMC does not see a fuller recovery until 2024. Uncertainty remains in North America, as to the length and depth of the recession. Housing markets will be very dependent on the decisions of the US Federal Reserve around interest rates. Energy costs and availability in Europe remain extremely uncertain, particularly their impact on overall economic growth.

Overall, TiPMC expects demand to be 3-5% lower than 2022, with an additional loss of 200-300kt of volume. The two years of depressed sales sets the market up for strong growth in 2024, as sales are well below the typical trendline, and improving economic conditions allow for a rebound.



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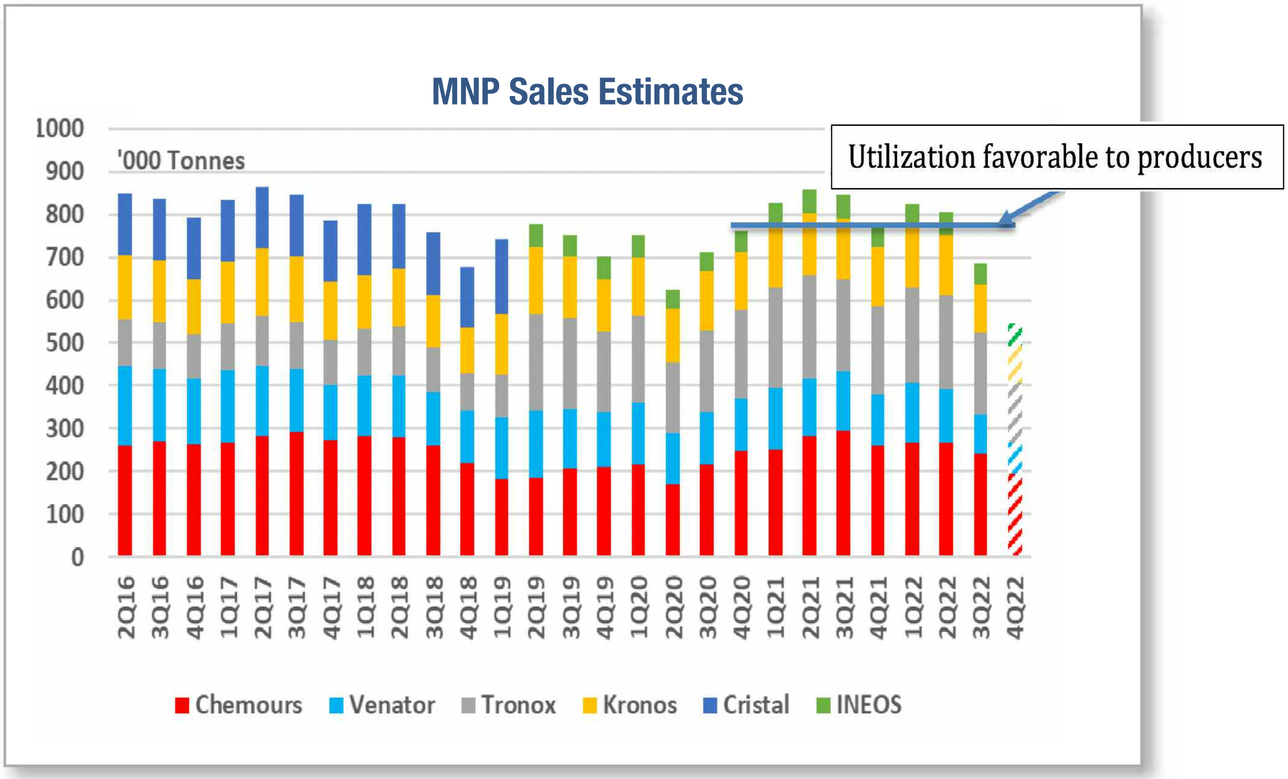
Source: TiPMC Estimates

China's Impact: Growing Capacity Despite Poor Market Conditions

Adding to the complexity is the outlook for the supply side. TIPMC believes given their current operating footprint, MNPs will need to increase sales by 160-180kt tonnes per quarter above the average of the last 2 quarters of 2022 to reach utilization levels indicative of higher levels of pricing power. That means a 20-25% increase in sales.

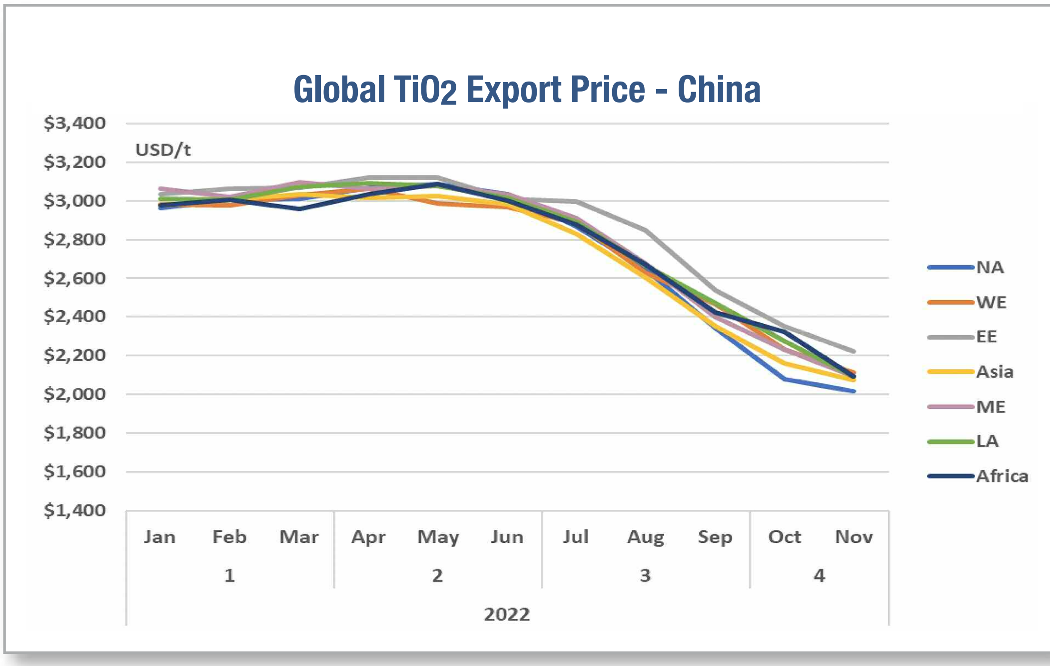


Source: Company 10Qs / TiPMC Estimates

Recovering sales will be more difficult, given the current operating footprint in China. Chinese net exports have averaged a nearly 30kt per quarter increase over the last 5 years. Capacity additions in China have accelerated since late 2021. The additional capacity does not help the market in its current downturn.

Production among large Chinese producers is reported to have recovered, despite concerns with domestic demand. Reported production in November reached levels not since 2Q22. However, rhetorical evidence exists that many smaller producers are not near full operation.

The reported production from LB Group, indicates a slower November, more in line with expectations given the seasonality of the industry. Costs continue to be a concern. Chinese prices are reported to be up USD100/t in several regions since mid-November. Export data indicates a new low for Chinese export prices in November.



Source: Global Trade Tracker

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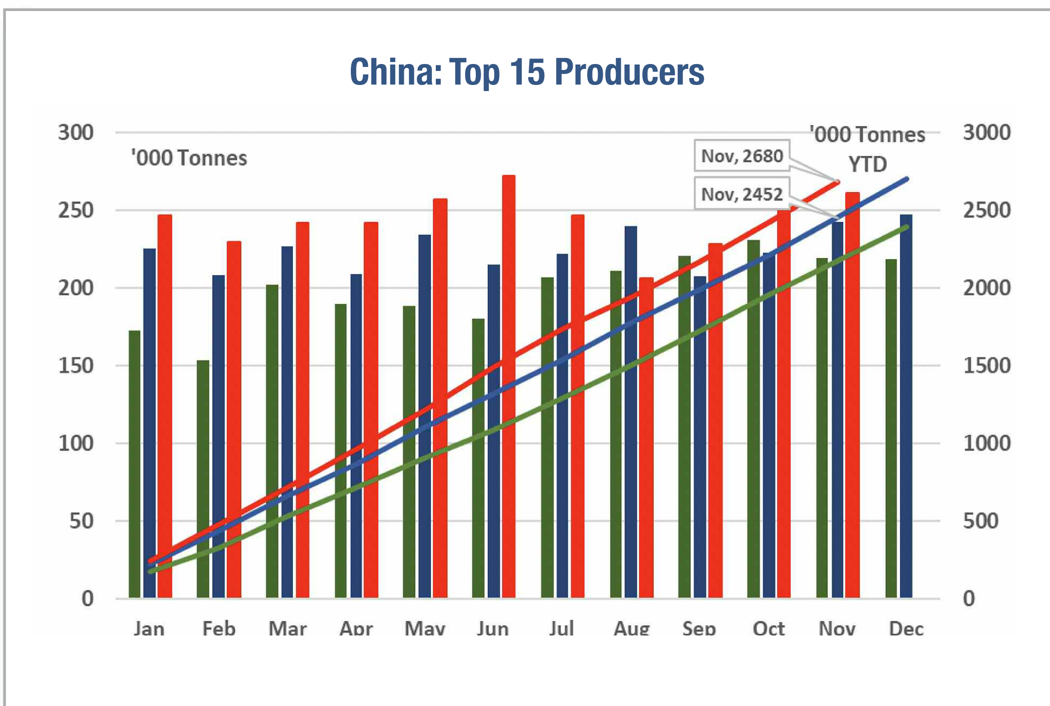
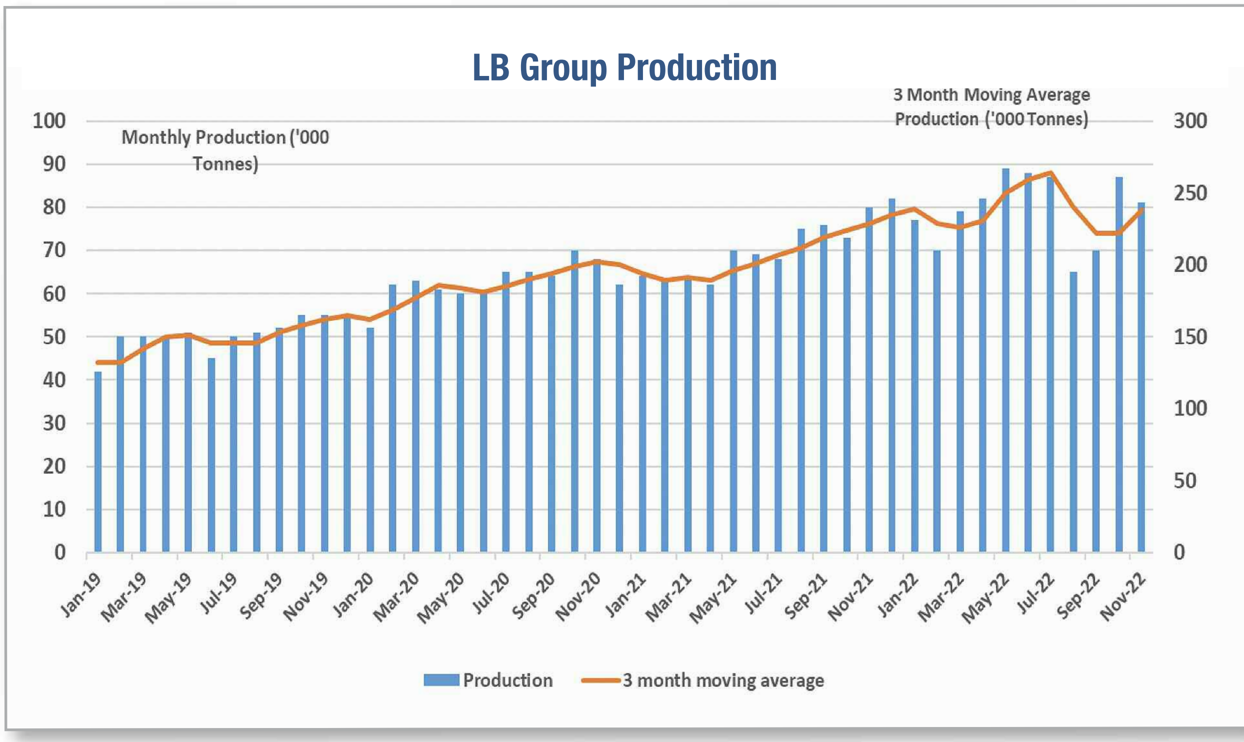


Source: Ferroalloynet

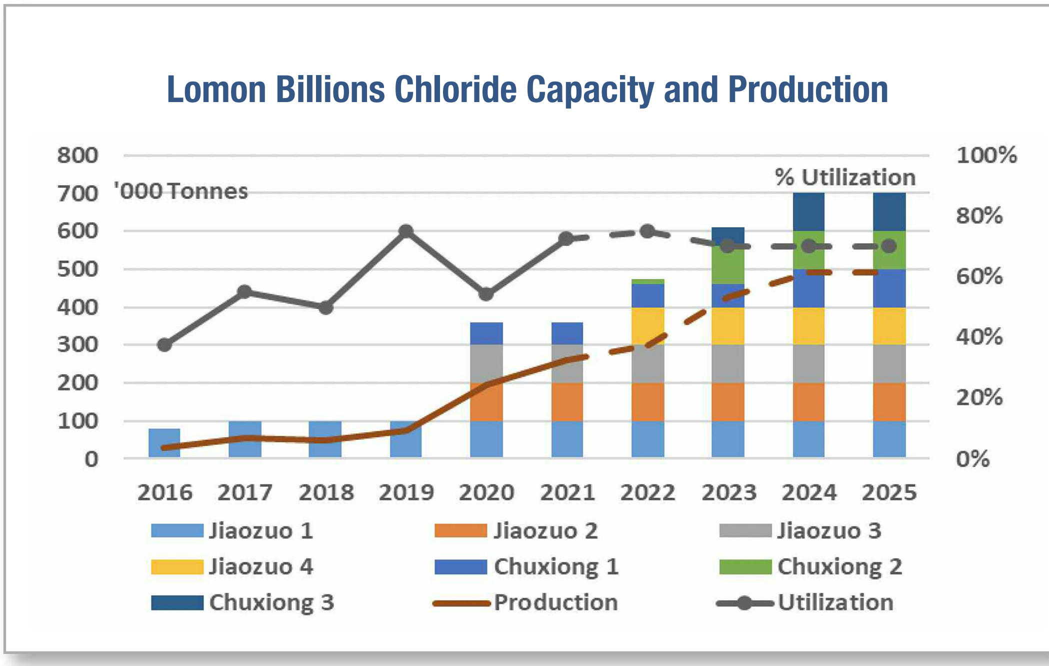


Source: Ferroalloynet

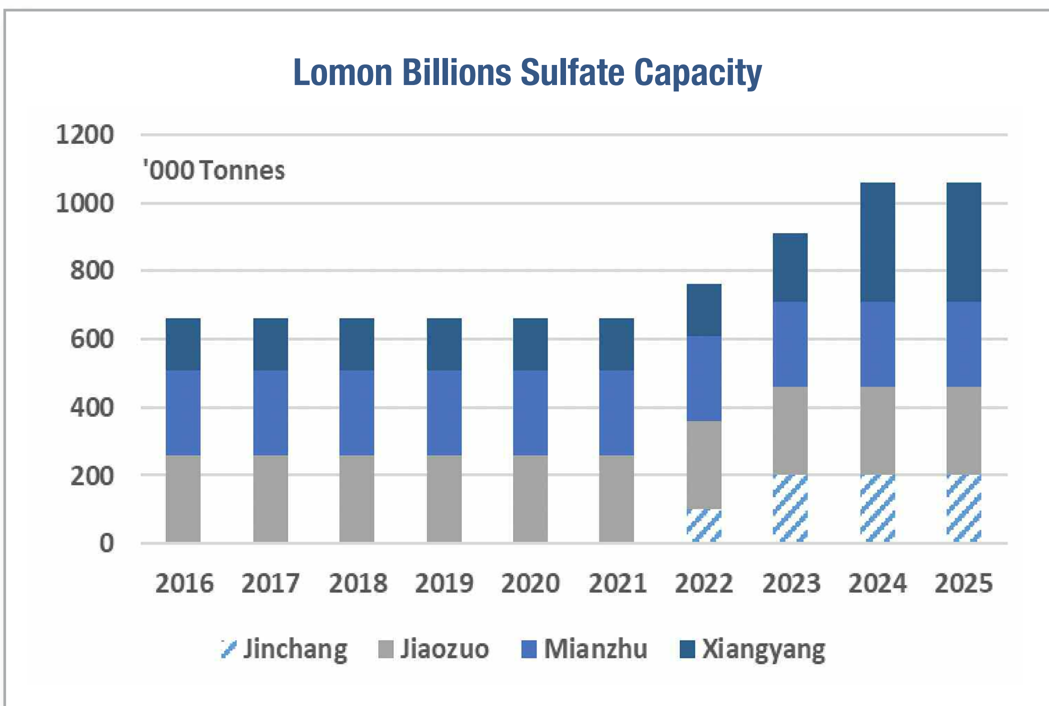
The Chinese appetite to expand has begun to see its impact in 2022. Although extremely difficult to predict, TIPMC analysis indicates that available capacity within China at the beginning of 2023 will be 425-475kpta greater than the beginning of 2021. In early 2021, a combination of high demand, both domestic and export, caused great difficulties for Chinese exporters to meet demand, leading to rapid price increases and a tightening of the overall global market. Coupled with earlier expansion plans, this incentivized Chinese producers to expand capacity.

The LB Group expansion plan is well documented. The company recently presented its progress in 2022, including:

- The start-up of a new 100ktpa chloride line at its Chuxiong Site (4Q).
- The commissioning of a new 100ktpa line at Jiaozuo, bringing site chloride capacity to 400ktpa.
- Production of unfinished TiO_2 (calciner discharge) at its subsidiary site in Jinchang, Gansu. Available capacity in Q4 2022, with a further 100kt available in 2023. Pigment is currently finished at other LB Group sites.
- Plans for a new finishing plant in Xiangyang, allow expansion of finished pigment at the site up to 350ktpa.



Source: Company Presentations / TiPMC Estimates



Source: Company Presentations / TiPMC Estimates
Note: Jinchang is Spray Dryer Discharge only

Multiple reports indicate the company is planning further capacity increases across China, both sulfate and chloride. LB Group is not alone in their expansion in 2021 and 2022. Chloride growth continues as CITIC, Lubei, and Yibin Tianyuan, progress on new projects and continually improve existing operations. Yan Steel expects to commission its first line soon, as part of the complete supply chain expansion, including new smelters fed by the Sheffield's Thunderbird project.

Other large producers, such as ChiTi (CNNC), Jinhai (Lubei Group), and Shangdong Dawn are reported to have added sulfate capacity. The official Chinese capacity number is being reported more than 5M Tonnes at the end of 2022.

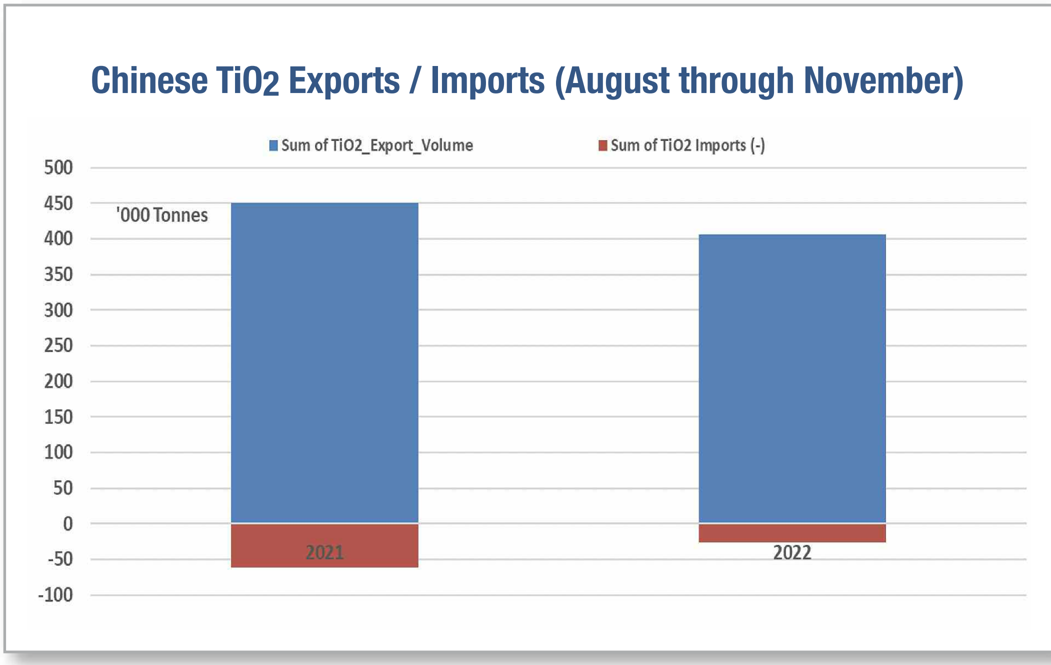
TiPMC emphasizes that neither available capacity nor production capability are in line with the official capacity numbers. Outside of production capability, feedstock supplies are unable to support these levels of production, and new projects cannot be developed instantly.

TiPMC believes the ability of Chinese pigment to maximize penetration into the export market will be tested in 2023. A key question becomes how much more Chinese pigment will be accepted into the overseas markets. Previous cycles have indicated limits become reached on additional volume that can be exported, as quality and the depth of required products and grades have outweighed price. There is no question that quality has improved from Chinese producers, particularly LB Group over the last several years.

Source: Global Trade Tracker

Current analysis does raise some concern for MNPs. As it is early in the downcycle, limited information is available as to the degree of market penetration by Chinese exports. The seasonally slow fourth quarter allows for little clarity.

A combination of poor domestic demand and available market saw Chinese exports surge in late 2021 and early 2022. Compared to 2021, exports are reduced from August through November by 43kt, or about 9.5%, despite continuous pricing declines.



Source: Global Trade Tracker

Although this is good news for MNPs, it is still small relative the sales decline for MNPs during this period. Another concern is the lost sales into China, particularly for Chemours. September and October imports have been slowed to a trickle. The weak domestic market, coupled with the increasing price differential between domestic and imported TiO_2, are weighing substantially on imports into China. TiO2 imports are down 45kt, or 27%, in 2022 through October. Prior to September, imports were on track with 2019 and 2020. Imports from Taiwan saw the greatest impact.

Most observers believe both domestic and export prices in China have bottomed. TiPMC believes foreign ilmenite prices may be reduced, but domestic ilmenite prices are beginning to increase. Energy and sulfuric acid prices are also increasing. Chlorine prices are reported to be low, but several chloride producers are seeing an increased chloride slag prices, as energy, electrodes, foreign ilmenite price weigh on smelter costs.

TiPMC believes domestic demand will improve following Chinese New Year, but the increase in demand will not be explosive. Housing market fundaments do not support growth in coatings and pigments in China. TiPMC expects growth in China to be limited for the foreseeable future.

TiPMC believes cost pressure and available market will reduce production volumes in China. Prices will increase as cost pressures mount. The level of price increases may be limited, due to the perceived over-capacity in 2023.

In 2023, it is difficult to envision Chinese exports being limited by domestic demand and full capacity utilization. Exports will be limited by the addressable market. TiPMC believes smaller producers are likely to limit production, as costs increase, and large producers maximize asset utilization at the expense of price.

TiPMC does not see a scenario in 2023, where regional import prices from China become more in line with MNP prices.

Basis for Short Term Price Forecast

TiPMC sees 2023 as a year of transition. MNPs are facing numerous challenges:

- Little relief is seen for MNPs on the cost side, as feedstocks and other ingredient costs are not providing cost relief.
- Value and margin stabilization contracts will still see the ability to increase prices, as PPIs promise to remain elevated as contracts are renewed.
- Outside of North America, holding price will be difficult. Key MNP accounts will see decreased sales. Conversely, price stability programs, coupled with little cost relief for low margin producers, will support higher prices.
- Reduced volumes force MNPs toward transitional customers, where competition with Chinese producers is fierce. Without higher utilization throughout China, current pricing differentials make it increasingly difficult to compete without significant price reduction. Again, costs limit the degree MNPs can compete at current pricing levels.
- Differences in exchange rates offer some price flexibility when selling in USD, while producing in devalued currencies.
- TiPMC believes the price gap between Chinese product and MNP product will remain high in 2023. The resolve of MNPs to maintain prices will be tested. Stabilization initiatives will support the price differential.

TiPMC still believes the pattern of the last cycle will continue. MNPs will support the high differential in terms of price with Chinese producers. MNPs may seek opportunistic sales in certain regions and markets to increase sales and utilization rates. The key question becomes if the resulting margins are acceptable, vs. forgoing sales. The market will determine the balance customers seek between low-cost material and the other advantages MNPs bring within their product offering. TiPMC believes a balance will be struck. MNPs may reduce pricing more aggressively in the regions they see as opportunistic, or a cost advantage gained through exchange rates.

Financial results for MNPs will be challenging. We have already seen significant margin compression early in the cycle, as noted in third quarter results. Fourth quarter results promise to be even more challenging. The combination of potential share gain by Chinese producers and decreasing demand create an unwelcomed scenario for the industry.

TiPMC believes some difficult decisions around assets will be required for MNPs in 2023. TiPMC believes some capacity will remain idle through 1Q23 and potentially longer. At a minimum, many facilities will be operated at lower rates, or for short campaigns, increasing fixed costs.

TiPMC believes 1Q23 holds a major test in terms of the level of penetration of Chinese producers in to export markets. Chinese prices will continue to be very attractive. The degree of saturation and the true size of the addressable market should become clearer.

Despite the appearance of doom and gloom, all is not lost. TiPMC believes signs of recovery will be increasingly apparent late in 2023, with markets returning closer to long term trendlines in 2024.

TiPMC has incorporated its view of 2023 in its forecast. As the year evolves, answers to the questions noted above will need to be answered. TiPMC will adjust its forecasts as required.

Long Term (2024 and Beyond)
Demand Recovery / Chinese Export Capability / Differentiation

Capacity and Expansion

TiPMC believes expansion in the foreseeable future will come from Chinese producers. As we have seen in the past, Chinese capacity announcements tend to be continuous and large. TiPMC believes several projects that have been commissioned or have begun construction will serve the growth needs a significant part of the industry over the current forecast period.

LB Group is positioned to become the largest global producer within the next 2-3 years. The over-riding desire to add capacity is well noted. The market does not appear to be part of the calculus considered by the company.

Chinese producers, particularly LB Group, have continued to expand despite decreasing demand. They are expanding on a schedule, independent of market or their current reliability of production. TiPMC believes implementation may prove much slower, even if facilities are constructed.

Addressable market, costs, and raw material supply will be limiting factors to Chinese production. Although segmentation and tariffs will prohibit Chinese expansion in some regions, LB Group appears determined to ensure transitional customers have supply available and are not forced to turn to other sources based on available product. Looking into the future, this could limit price increases for all producers. This will continue until a combination of Chinese domestic demand, higher costs, and higher utilization rates for all Chinese producers force Chinese export prices to levels seen in early 2022.

Given the coming ESG requirements for producers, TiPMC sees segmentation accelerating in the coming years. We also do not see Chinese producers wavering from the volume over value strategy. At some point, cost issues and continual expansion will conflict. It was only a few quarters ago that Chinese producers were concerned about profitability, with prices nearly USD1000/t higher than today's prices.

TiPMC believes the long-term view of the industry needs to incorporate some critical thoughts, in terms of how it progresses into the future. TiPMC sees the following trends.

- Chinese producers have numerous long term trends providing benefits, including:
    - o The high value for copperas by Lithium Iron Phosphate producers in China, proving a high return co-product stream longed for by sulfate producers for many years. Many new projects are closely linked to phosphate projects. TiPMC sees this as a major driver for multiple new sulfate projects.
    - o A large domestic market, that although potentially slowing in growth, will still be a major portion of the global demand and future growth.
    - o Beneficiation facilities in country, and a potentially large source of domestic ilmenite that can be developed.
    - o Increasing the link between foreign concentrates, smelters, and TiO_2 plants. The Thunderbird project, linked to the Yan Steel smelters and TiO_2 plants, are a prime example. Full implementation will be slow, with the TiO_2 plant being the slowest to develop. TiPMC sees this a longer-term trend, but its impact will begin to be felt during the current forecast period.

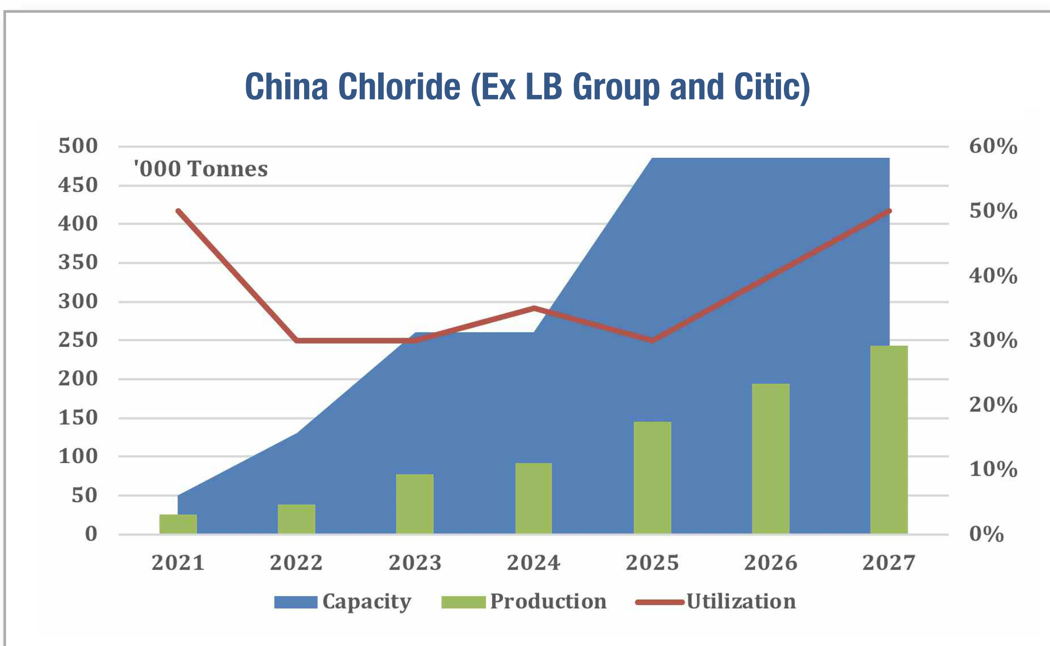
Conversely, Chinese producers will face increasing challenges:

- o The requirements of the global community around ESG, which is not factored into current Chinese expansion plans. MNPs are positioning products and services to meet the needs of customers to source from suppliers with a lower carbon footprint.

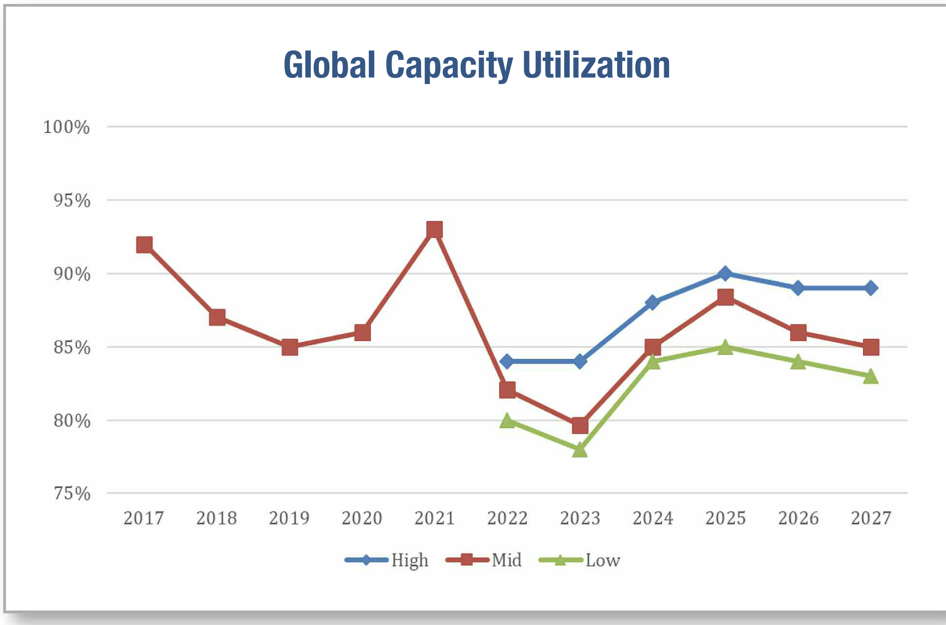
- o Ilmenites required for the chloride process are not available in China. A significant technology breakthrough would be required.
- o The increasing dependence on concentrates for ilmenite. Costs are high and depend on monazite and zircon credits for profitably.
- o Success of numerous feedstock projects enabling the growth within China. Chinese expansion will be based on ilmenite, as feed for smelters of direct feed for sulfate plants. Projects are progressing to support the growth, but timing and availability remain question.
- o The impact of rising costs on Chinese producers, as economic recovery progresses will bring higher input costs.

Some measure of consolidation will be required in China. Numerous smaller producers do not always close, but limit operations over a period until profitability can be maintained. Given the expansion of larger producers, this practice does not seem to be sustainable. Shutdowns of less competitive producers will be required, as markets will not support the capacity.

Global Capacity Utilization and Key Uncertainties



Source: Ferroalloynet / TiPMC Estimates



Source: TiPMC Consulting

Reduced demand, coupled with the Chinese expansion, weigh heavily on Global Capacity Utilization. TiPMC believes the wave of capacity announcements in China will not be sustainable in term of costs and available market. New chloride operators are still on a steep learning curve. Sources believe Lomon and CITIC still do not operate at world class operating rates. Demand will begin to catch up with recent expansion in 2024, and accelerate through 2025, providing increased utilization rates for MNPs.

TPMC notes key assumptions utilized to develop the forecast:

- The demand trend begins to turn in 2023, with demand restored to more normalized trendlines in 2024. Global demand will see a fuller recovery in 2025.
- Some form of industry consolidation is likely in 2023. TIPMC has incorporated a capacity reduction within its utilization rates post 2023. TiPMC believes as much as 130-170ktpa of capacity outside China could be removed by mid-decade.
- Chinese chloride production with continually increase, driven primarily by the LB Group. TiPMC expects Chinese chloride to grow 350-400kpta relative to 2021.
- Chinese sulfate capacity outside of LB Group will much more moderate than current announcements. 2023 will see low utilization rates among Chinese sulfate producers, given lower than anticipated demand and the increase of available capacity.

Expansions will accelerate with increasing demand. TiPMC expects net sulfate capacity growth to accelerate as the market recovers mid-decade, likely over 200ktpa.

- Chinese utilization rates are limited by product demand and their production costs. Weaker producers will remain idle or potentially shut down if internal capacity utilization rates remain low. Stronger demand will increase prices from larger competitors, allowing others to increase production, stabilizing prices.
- MNP cost inflation will moderate in the later years of the forecast. Cost reduction will be a continued focus, with capital allocated further towards costs vs. growth. Coupled with stabilization programs and Chinese competition, TiPMC expects more moderate increases during the next upturn in the industry.
- TiPMC believes moderating demand and increased Chinese capacity will moderate pricing later in the forecast period, as has been exemplified during the current cycle.

TPMC notes key uncertainties included in the forecast below. The developments within the Chinese industry are by far the greatest question.

- Demand in 2023 could be better, if economies recover quicker than expected. Recovery in Europe and Asia may be hastened, as the rate of destock was severe. If inflation in the US comes under control, the USD Fed may reduce interest rates to stimulate the economy through the recession.
- Actual Chinese capacity and their ability to penetrate export markets creates a great deal of uncertainty. Current projects create downward pressure on domestic pricing due to overcapacity. As the markets return in 2024, utilization rates in China should increase. It is uncertain if this leads to more capacity or higher prices. LB Group appears to have capacity readily available, based on its reported production profile and the state of recently commissioned projects.
- If Chinese margins are not increased, the potential exists for economic failure of some Chinese TiO2 enterprises. Back in 2017, the belief was numerous enterprises would be closed due to lack of environmental compliance. Fiscal failure carries a whole different dynamic.
- The rate of Chinese chloride and sulfate growth continues to weigh heavily on the industry. If expansion schedules are maintained, China will see significantly sustained low margins for all but the best producers. Although highly unlikely, this scenario may exist for an extended period. Pricing would be maintained at mid-level producer costs, while lower tier produces idle capacity.

- The ability of Chinese producers to expand the export markets at the rate observed for the last several years.
- The future of marginal MNP and regional producer facilities. This is a greater uncertainty in earlier years of the forecast, given the current state of demand and available product from China.

Summary

The events of the past 6 months are nearly unprecedented in the industry. The sudden drop in demand switched the industry from long lead times and low inventories to destocking almost overnight. Despite significant price increases since the beginning of 2021, costs kept earnings depressed. The significant loss of volume and pricing power decimated 3Q earnings and promise to see further decline in 4Q22.

Numerous uncertainties about 2023 persist. Demand both in and outside of China continues to weigh heavily on the industry. Chinese producers, led by LB Group, expanded in 2022 and will continue. Questions about the domestic market in China and the state of export markets point to growing underutilization. The viability of actual growth of Chinese producers is brought into question.

LB Group holds numerous cards in determining the future pricing within the industry. Their success with the chloride process, and continual improvement in grade development and overall quality provides them a unique position to impact the future of the industry. They are well positioned to decide the future of Chinese competitors. Not only does their size help them determine the price of pigment in China, but their beneficiation, ilmenite back integration, and vast requirements for foreign ilmenite determines the cost of Chinese competitors. LB Group is well positioned to benefit from their own battery materials business. Iron sulfate is a key raw material for lithium iron sulfate. LB Group and other Chinese producers can incorporate future TiO2 expansions to provide feedstock through TiO2 co-products for this business.

TiPMC continues to believe strong MNPs and regional producers will perform well in the long term. Chinese products will see pressure from growing ESG requirements and suitability for all markets. Costs within China will continue to grow, putting into question their ability to profitably price well below competitors in foreign markets. However, the Chinese threat cannot be ignored. Some form of consolidation will be required. Depending on the success of the Chinese strategy, the rate of consolidation may increase vs. previous cycles.

2023 appears to be a challenging year for producers. For those that plan well and continue to progress on cost and product initiatives, the future is still positive.

TiPMC Price Forecast

The TiPMC Price Forecast is based on the following assumptions: No macro-economic event, such as global recession, occurs before the end of the decade; Exchange rates, particularly the Euro, remain at current levels; No assumptions are made for the impact of political events, continued monetary easing, or outbreak of hostilities.

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