



ANALYSIS OF THE IMPACT OF RAPID DEPLETION OF BARYTE RESERVES ON ENERGY SECURITY



1. Executive Summary

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Baryte is a critical input to oil and gas exploration. Its unique combination of density, chemical stability, and cost-effectiveness makes it irreplaceable for preparing drilling muds that stabilise boreholes and prevent blowouts. In addition to oil and gas, baryte is also used in defence applications, particularly in radiation shielding, radar systems, and missile components where its high density and stability are critical. There are no substitutes for barytes for oil and gas drilling operations.

Without adequate baryte supply, India cannot sustain hydrocarbon extraction in the Andaman Basin where significant oil reserves have been found. Yet the country's only major deposit at Mangampet, Andhra Pradesh, which holds 95% of national reserves, is on the verge of exhaustion.

The Depletion Crisis

Proven deposits at the Mangampet reserve have declined from **49 million tonnes in 2015 to less than 23 million tonnes in 2024**—a 53% fall in under a decade. At the current extraction rate of 2.7 million tonnes per year, reserves will be fully within a decade.

This depletion is not driven by domestic demand but by exports. The Andhra Pradesh Mineral Development Corporation (APMDC), which operates the Mangampet mine, allocates majority of its production for exports. Nearly INR 10,000 crore bond has been raised against revenues from baryte exports by APMDC. This model forces revenue generation rather than long-term resource conservation.

Globally, oil producing nations have either restricted baryte exports or have several decades of reserves left. China restricted baryte exports in 2018 to preserve domestic reserves for their own domestic oil extraction; the United States imports majority of its barytes despite having abundant deposits to create a reserve for future use; and Iran, Russia, and Kazakhstan have placed conservation above short-term gains. India is the only country which is on the verge of depleting its baryte reserves.



Challenges Due to the Export Policy

India has an estimated 22 billion barrels of oil equivalent still unexplored across four key sedimentary basins – Mahanadi, Andaman Sea, Bengal, and Kerala-Konkan. The Andaman Basin, in particular, has emerged as the most promising frontier. To unlock these resources, India would require over **600 million tonnes** of baryte for drilling operations. Currently, only 10% of India's sedimentary basins are under active exploration and the government aims to increase this figure to 16%.

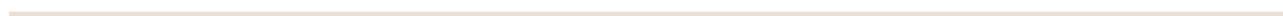
However, due to the rapid depletion of domestic baryte reserves, India would soon be dependent on imports from countries such as China within just a decade. Such dependence could expose India to potential geopolitical arm-twisting in the future. Moreover, this dependency would expose India's hydrocarbon program to external shocks and compromise our ability to extract oil.

Potential Policy Options:

- (1) Imposing immediate export restrictions on barytes from India and start importing to build a strategic reserve.
- (2) Develop a fiscal transition plan to reduce APMDC's debt obligations based on baryte extractions
- (3) Revise APMDC's export policy to prioritize domestic demand and future oil and gas explorations.
- (4) Designate baryte as a critical mineral under the National Critical Minerals Mission (NCCM)

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1. Barytes: Critical input for Oil and Gas Exploration



Barytes is a naturally occurring mineral that has become an indispensable part of modern oil and gas drilling operations. Its defining characteristic is its exceptionally high specific gravity of about 4.5 grams per cubic centimetre, which is nearly twice the density of common rock-forming minerals. This density, combined with its chemical inertness, non-magnetic nature, and relative non-toxicity compared to alternatives such as lead, has made barytes the mineral of choice for weighting drilling fluids.

Barytes also has wide applications in the defence sector used in radiation shielding, radar systems, and high-density components where stability and absorption properties are critical.

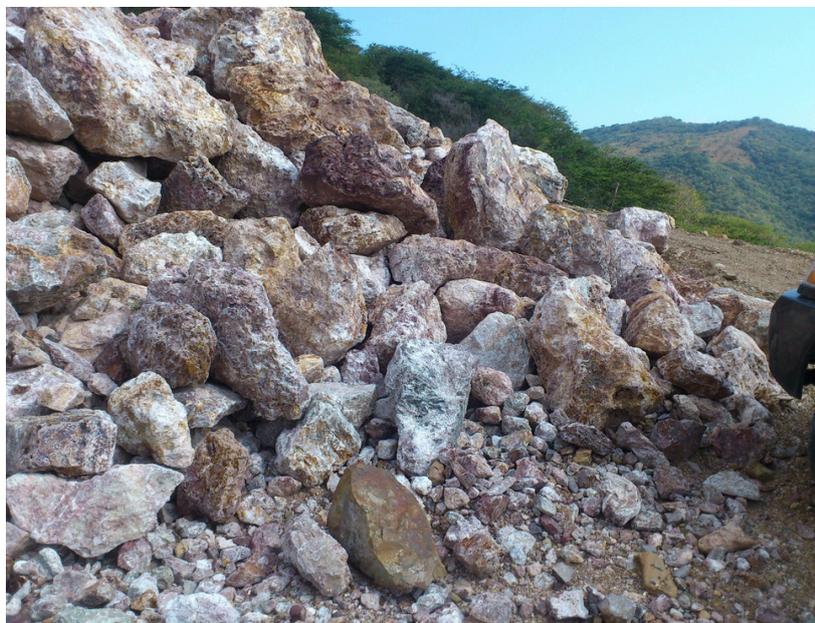


Figure 1: Raw Baryte

Barytes is grounded into a fine powder and added to drilling muds, where it performs two critical functions. First, it raises the density of the fluid, enabling drillers to counteract high-pressure formations encountered deep underground. Second, it provides stability to the wellbore, preventing collapse or caving of the formation walls. These properties cannot be replicated at scale by other minerals such as hematite or ilmenite, which are either too expensive, less effective, or available in insufficient quantities. For this reason, barytes has long been recognised by the global oil and gas industry as a non-substitutable input.



The critical role of barytes in oil and gas drilling becomes evident when looking at how wells are constructed. As drilling progresses, the borehole must be filled with a special fluid, known as drilling mud. This mud has three essential functions: it cools the drill bit as it cuts through rock, it carries the broken rock fragments back to the surface, and most importantly, it exerts downward pressure to counter the natural pressure of underground formations.

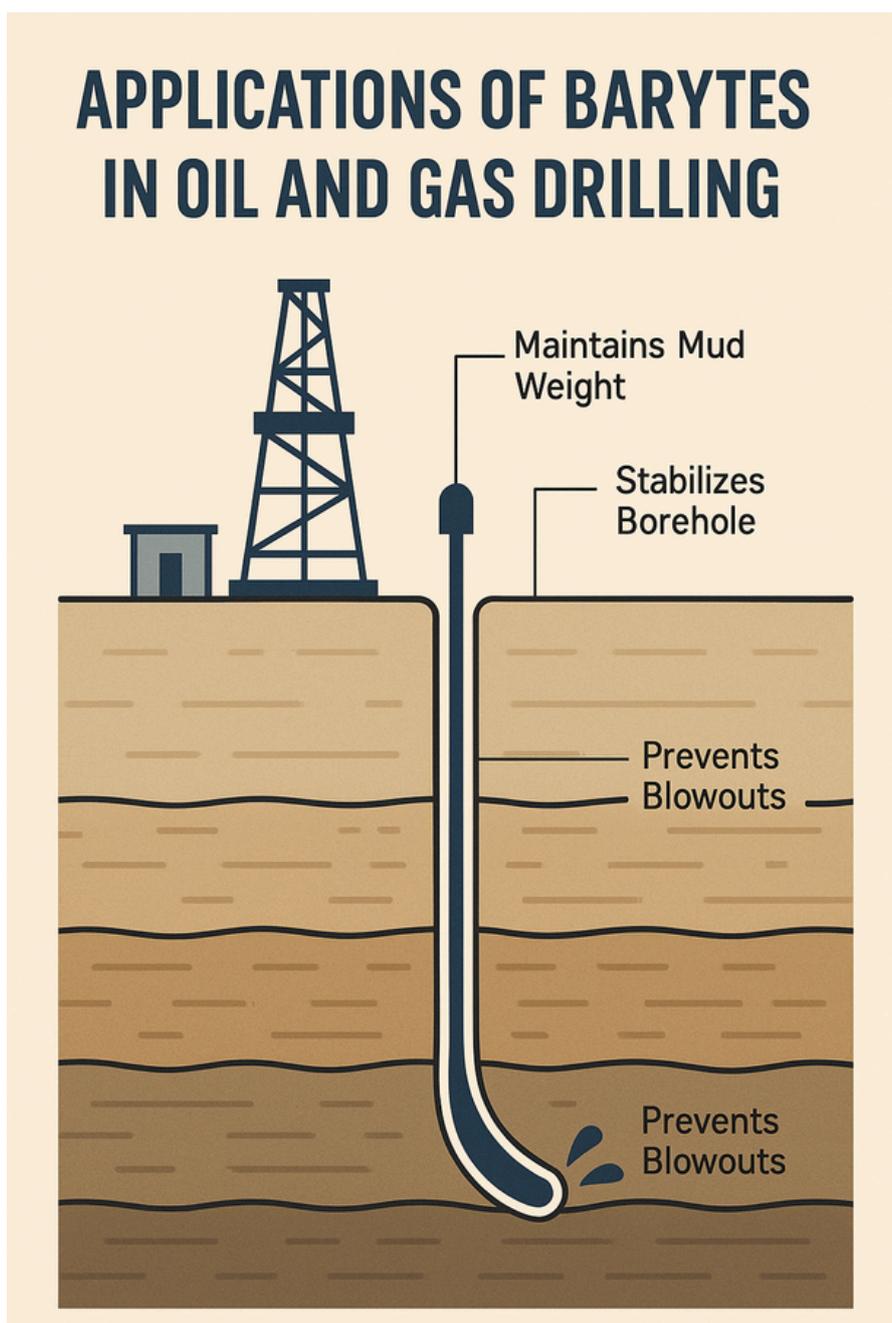


Figure 2: Application of barytes in oil and gas drilling



If the mud is not heavy enough, formation fluids such as gas or oil can rush uncontrollably into the wellbore, creating a dangerous situation known as a 'kick,' which can escalate into a blowout. To prevent this, the mud's weight is increased by adding barytes, whose high density ensures the well remains stable and safe throughout the drilling process.

Alternative weighting materials have been studied, but none offer a combination of cost-effectiveness and performance comparable to barytes. Hematite, for instance, has a higher density than barytes, but it is far more expensive and can cause wear on drilling equipment. Ilmenite and synthetic materials are similarly constrained by cost and availability. As a result, the global oil industry continues to rely almost exclusively on barytes, reinforcing the notion that this mineral is not just another industrial input but an irreplaceable enabler of exploration.

India's dependence on barytes for its oil exploration programme is therefore absolute. Any disruption in availability, whether due to depletion of reserves or external supply shocks, would directly translate into delays, cost overruns, and reduced capacity to increase domestic oil and gas production. In this sense, the security of barytes supply is inseparable from India's energy security.





In addition to oil and gas drilling, barytes are critical for several downstream industries. Most noteworthy amongst them, are its uses in defence applications such as radiation shielding materials and explosives. Baryte powder is also widely consumed by the Paints and Coatings industry. The table below gives a detailed overview of the various applications of barytes.

Table 1: Downstream application of barytes

Sector	Application	Significance
Oil and Gas	Weighting agent in drilling muds	Prevents blowouts, stabilises wellbores, ensures safe and efficient exploration
Defence	Used in explosives and radiation shielding materials	Enhances munition density and provides protection against radiation
Paints & Coatings	Acts as a filler and extender; improves brightness and smoothness	Lowers production costs while enhancing durability and appearance
Plastics & Rubber	Serves as a filler to increase density, improve strength, and reduce shrinkage	Widely used in automotive and consumer goods manufacturing
Medical & Nuclear	Component in barium meals (medical imaging) and radiation shielding in reactors	Critical for public health diagnostics and nuclear safety
Other Industrial Uses	Glass, ceramics, and paper industries	Provides weight, opacity, and resistance to wear

2. India's Baryte Wealth Is Concentrated and Rapidly Vanishing



India is geologically well-endowed with barytes, though its distribution is highly uneven. Approximately **95 per cent of the country's barytes reserves are concentrated in a single deposit at Mangampet in Kadapa district, Andhra Pradesh**, which is one of the largest deposits globally. The remaining reserves are scattered in smaller pockets across a few other states. The Mangampet baryte deposit **is managed by the Andhra Pradesh Mineral Development Corporation (APMDC), a state-owned public sector enterprise.**

The Mangampet deposit alone accounts for nearly all of India's commercially viable barytes, with the other deposits being relatively small or of lower grade.

Table 2: Distribution of India's Baryte Reserves

State/Region	Major Desposits	Share of national baryte reserves
Andhra Pradesh	Mangampet (Kadapa district)	~95%
Rajasthan	Alwar, Barmer, Udaipur	Minor reserves
Himachal Pradesh	Mandi, Chamba	Minor reserves
Maharashtra	Satara, Pune	Trace occurrences
Tamil Nadu	Salem	Trace occurrences
Jharkhand	Hazaribagh	Minor reserves

3. Exports vs Energy Security: The Baryte Policy Paradox



India's approach to barytes over the past decade has been characterised by a paradox. While the country has been endowed with one of the world's largest single deposits at Mangampet, India has pursued **an export strategy that has rapidly eroded this resource**, leaving domestic oil and gas exploration increasingly vulnerable.

At the heart of this issue is **APMDC's export-oriented policy, which allocates 60% of the mined barytes for exports** and the remaining for the domestic market.

The turning point came in 2018, **when China, which was the dominant supplier of barytes in the world market, began to impose restrictions on exports**. As a result, global supply contracted sharply. Due to the vacuum created, APMDC stepped up its exports to monetise from the unmet demand. Therefore, exports from India, primarily from barytes extracted from the Mangamepet mine, more than tripled in the years that followed.

By 2018, India had become the largest exporter of barytes in the world as China curtailed its exports in order to conserve its barytes. This increase has come at the cost of making India's energy supply-chain resilience.

Baryte exports (China vs India)

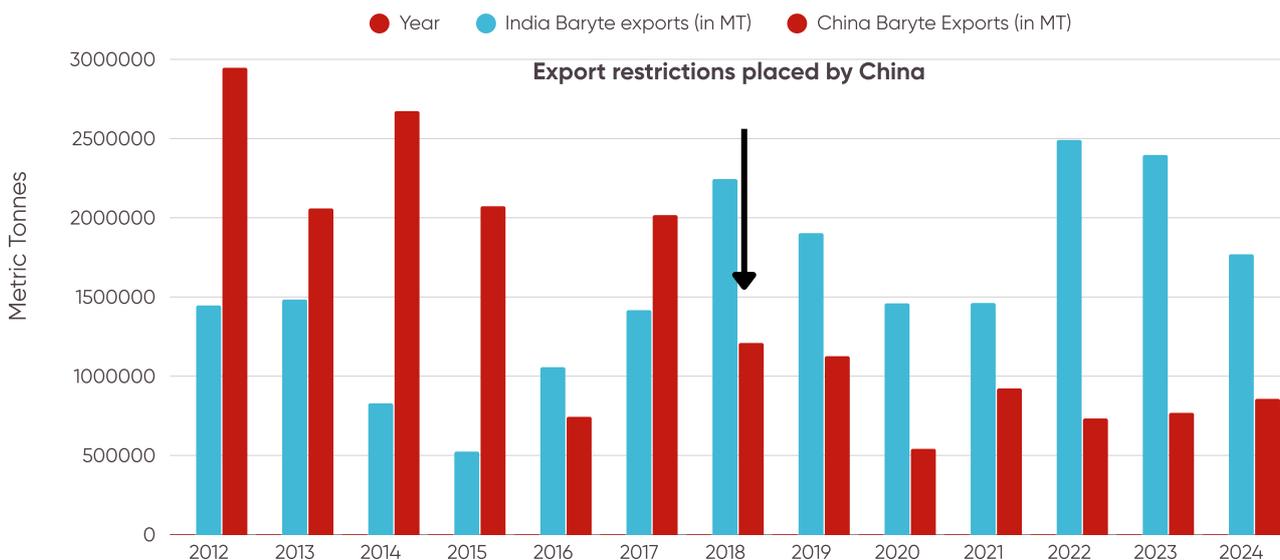


Figure 4: India displaced China to become the largest exporter of barytes after they restricted exports from 2018 to conserve baryte reserves

Source: UN Comtrade Database



The scale of this export surge is captured in trade data captured in Figure 4. **By 2024, India supplied nearly 44% of all barytes imported by the United States in 2023. China's share of the US market, which had once been dominant, collapsed to just 17%.**

The United States' decision to exclude baryte imports from India from its reciprocal tariffs underscores the country's growing reliance on Indian supply of barytes.

Percentage share of Baryte imports to the US by country in 2023

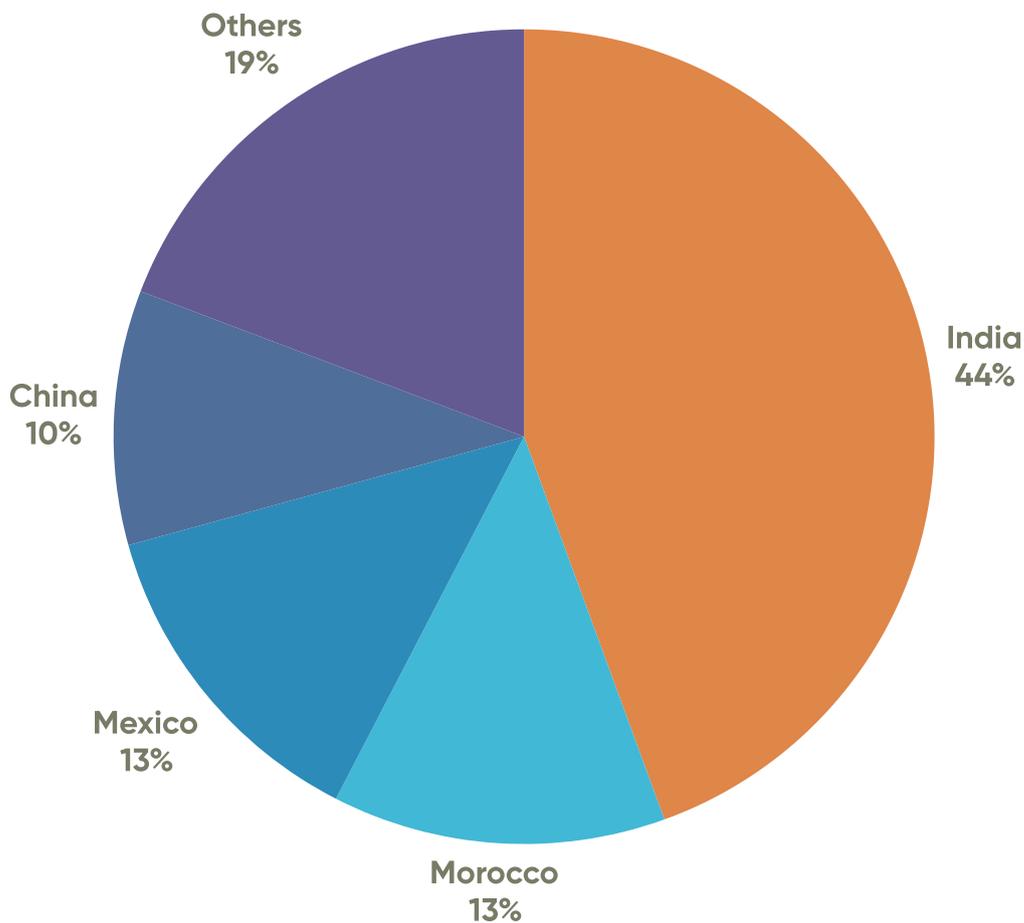


Figure 5: India is now the largest supplier of barytes to the US
Source: World Integrated Trade Solution (WITS)

4. Mangampet Reserves Facing Rapid Depletion



The consequences of an export-driven approach for barytes have been severe. Official figures from the APMDC show that reserves at Mangampet have collapsed from 49 million tonnes in 2015 to less than 23 million tonnes in 2024. More than half of the deposit has been extracted in less than a decade.

Rapidly depleting Mangampet Baryte reserves

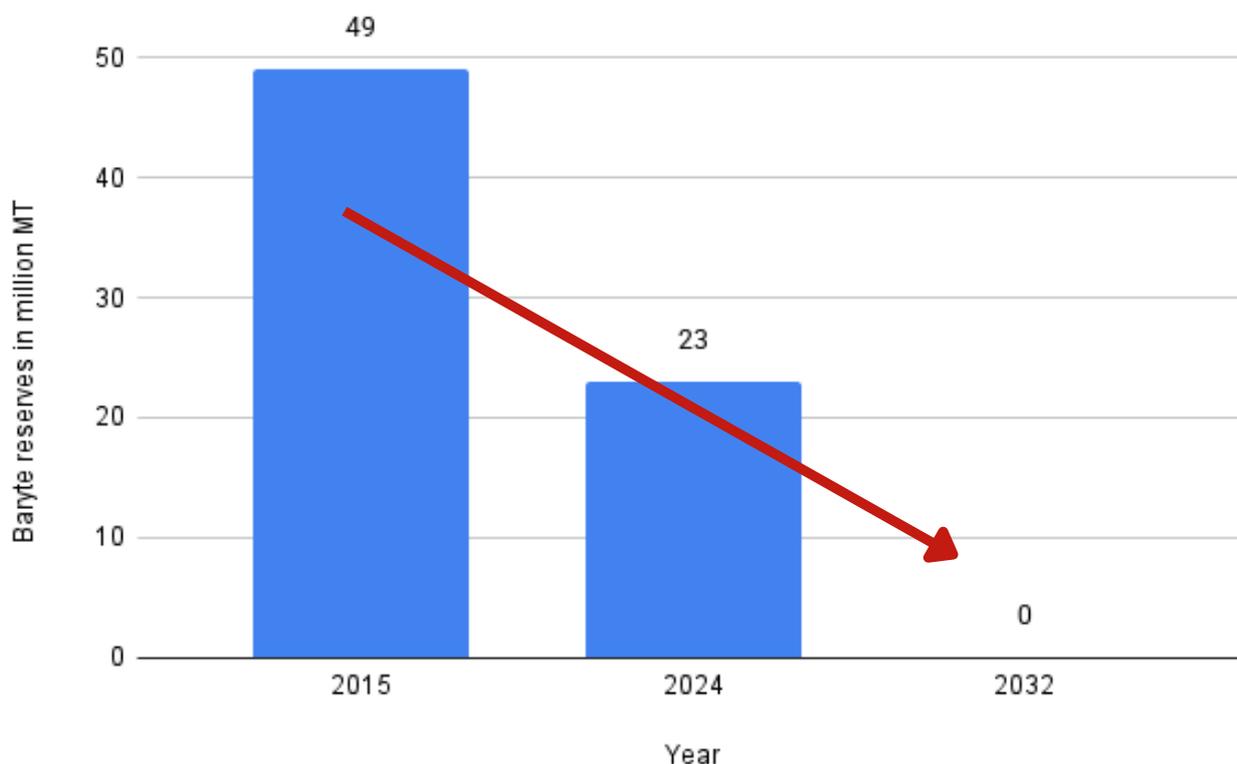


Figure 6: At the current rate of extraction, baryte deposits in Mangampet will be depleted within 8-10 years

Source: C-DEP research

Current production levels, averaging between 2.5 and 3 million tonnes annually, mean that India has less than 10 years of reserves left at present rates of depletion. This estimate does not take into account the likely increase in domestic demand from new exploration projects, which would compress the depletion horizon even further.



Industry observers have already begun to raise alarm. At the Houston Oilfield Minerals Forum in June 2024, one of the most authoritative platforms for oilfield mineral markets, experts warned that **“Indian barytes of all grades will not be available at historic volumes in coming years as the Mangampet mine becomes depleted.”** This is not speculative forecasting but a sober recognition of geological realities. Once the Mangampet deposit reaches exhaustion, India has no other significant reserves to fall back on.

Table 3 : Baryte Extraction in India (according to United States Geological Survey)

Year	Rate of extraction (in million MT)
2021	1.6
2022	2.6
2023	2.6
2024	2.6

Despite this grave picture, exports of barytes continue to account for a large share of output produced by APMDC. Given APMDC’s 60:40 allocation policy, domestic industries have reduced baryte supply available for building downstream products based on barytes. Without urgent intervention, the country will soon face the risk of having to import barytes despite once having one of the largest baryte reserves.



Debt Obligation of APMDC tied to mining of barytes

APMDC's financial structure adds an important dimension to the discussion on sustainable baryte extraction.

The Corporation has raised approximately ₹9,000 crore through government-backed bond issuances, supported by an unconditional guarantee from the Government of Andhra Pradesh. These borrowings were undertaken to fund broader mineral development and infrastructure activities within the state. However, such a financing framework naturally necessitates steady revenue flows to ensure timely debt servicing.

Given that baryte exports constitute a major share of APMDC's income, the Corporation is institutionally positioned to continue higher levels of production and export activity. Any policy recalibration toward moderated extraction or prioritised domestic allocation will therefore need to factor in APMDC's existing financial obligations to ensure a balanced and implementable transition.

In summary, India's barytes situation reflects an emerging policy and fiscal vulnerability. A revenue-driven export model has compromised long-term resource security, while APMDC's ₹9,000 crore bond obligations have entrenched a dependence on sustained extraction to meet repayment commitments.

The depletion of the Mangampet deposit is no longer a distant concern but an imminent constraint on domestic availability. Addressing this challenge will therefore require not only calibrated export and conservation measures but also a restructuring of APMDC's fiscal framework to align its financial incentives with India's long-term mineral and energy security objectives.

Depleting baryte reserves to service APMDC's debt is counterproductive for long-term goals. If Mangampet reserve is exhausted, India loses not just its reserves but also its strategic autonomy to explore domestic oil without becoming dependent on imports.

5. Limited alternate sources for import of barytes



Table 4: Countries with largest baryte reserves, annual rates of production and estimated years left before the reserves get depleted

S.No	Country	Reserves (in million MT)	Annual Production	Years Left	Comments
1	China	110	2.1	52.38	Export restrictions from 2018 prioritizing long-term domestic requirement.
2	Iran	100	0.31	322.58	Iran is under international sanctions and faces regional instability, making long-term supply to India unreliable.
3	Kazakhstan	85	0.65	130.77	Likely to be Europe and Russia focused.
4	Turkey	34	0.25	136	Recent alignment with adversary and diplomatically unreliable.
5	Russia	12	0.25	48	Russian policy is not to encourage exports of Barytes
6	USA	150	2.3	65.22	The US imports more than 75% of its current barytes demand despite having significant reserves. It is unlikely to export its reserves in the future
7	Morocco	NA	1.3	-	Public reserve data is unavailable; however, Morocco remains a significant global producer of barytes
8	India	22.97	2.7	8.51	Only major economy to be running out of barytes reserves within a few years. With demand set to grow, the risk of reserves depleting in less than 5 years is significant



India's current approach to barytes extraction and export stands in sharp contrast to the strategies adopted by other major reserve holders. **Countries such as China, the United States, Russia, Iran, and Kazakhstan—all of which possess substantially larger deposits—are pursuing policies aimed at conserving their reserves for domestic industrial and energy needs.** For instance, China has maintained export restrictions since 2018 to prioritise internal demand, while the United States, despite holding nearly **150 million tonnes of reserves**, continues to import more than three-fourths of its baryte requirements rather than draw down its own deposits. Similarly, Iran, Kazakhstan, and Russia have aligned their production with long-term national objectives, ensuring supply security for their respective oil and gas industries.

In contrast, India, with less than 4% of global reserves, is extracting and exporting barytes at one of the fastest rates in the world. With less than 23 million tonnes remaining and an annual production of around 2.7 million tonnes, domestic reserves could be exhausted within a decade. The table below illustrates that other major producers have between five and thirteen decades of reserves at current extraction rates, whereas India's depletion horizon is less than ten years.

Estimated baryte reserves left in years by country

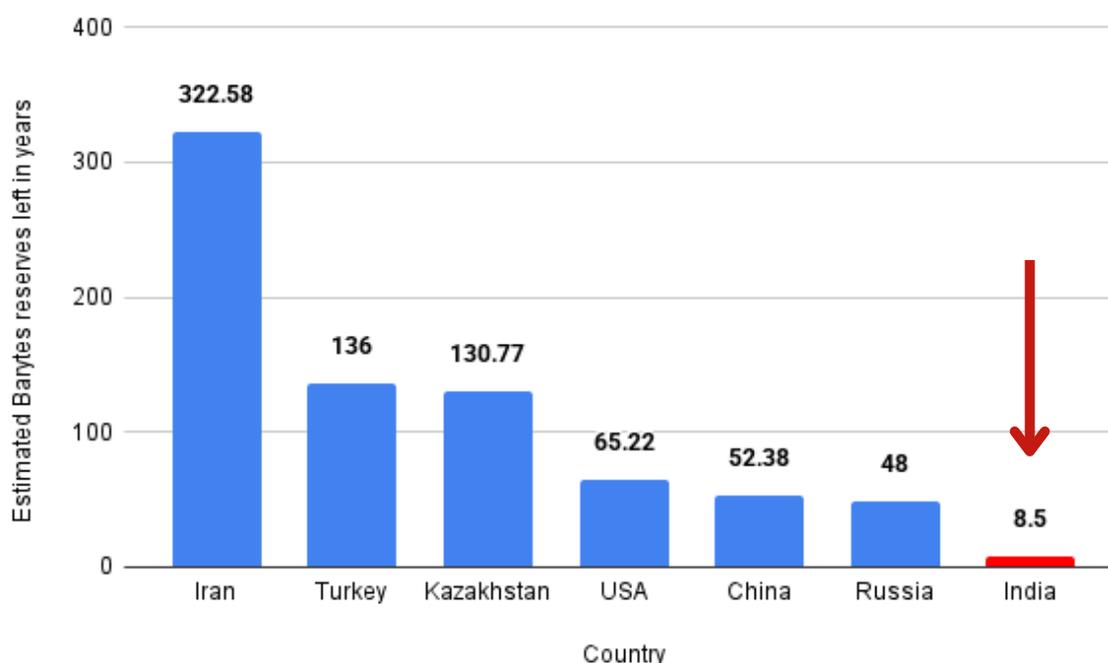


Figure 7: India is the only major economy with less than 10 years of barytes reserves left.

Source: United States Mineral Commodity Survey 2025



Even when looking beyond the major reserve holders, India's import options remain limited.

The next five leading exporters after India are

- (a) China,
- (b) Turkey,
- (c) Kazakhstan,
- (d) Mexico, and
- (e) Pakistan.

None of these represents viable long-term supply alternatives for India. China and Pakistan pose significant reliability and geopolitical concerns; Kazakhstan's exports are largely oriented towards Europe and Russia, while Mexico's trade is primarily aligned with the United States.

This combination of shrinking domestic reserves and unreliable global supply underscores the urgent need for policy recalibration. India's oil and gas exploration ambitions are expanding, with new offshore blocks and deep-sea drilling projects expected to drive future demand. Without a reliable domestic baryte supply, these projects could face severe input bottlenecks. The way forward lies in aligning fiscal, mineral, and trade policy to conserve remaining reserves, moderate exports, and ensure long-term availability for strategic domestic use.

6. 22 billion barrels of oil equivalent reserves yet to be explored



India's accelerating energy ambitions have brought renewed optimism to the upstream oil and gas sector. The recent discovery of hydrocarbon potential in the Andaman and Nicobar Basin has been hailed as a strategic breakthrough. Government statements describe the basin as a "frontier of immense promise," capable of significantly reducing India's crude oil import dependence. With expanding deep-water exploration, enhanced recovery operations, and new licensing under the Open Acreage Licensing Policy (OALP), India is positioning itself for a new phase of domestic energy growth.

However, this promising outlook comes with an important caveat—barytes. The mineral is indispensable for oil and gas drilling operations, where it is used as a weighting agent in drilling mud to stabilise well pressure. As India's exploration activities intensify, the requirement for barytes will rise sharply, placing additional stress on already depleting reserves at Mangampet.

Since there is no official dataset on baryte consumption, domestic demand has been estimated using the formula:

Estimated annual domestic demand = Total production – Total exports + Total imports.

Table 5: Estimated demand for barytes in India

Year	Estimated demand for barytes in India (in million MT)
2021	0.13
2022	0.10
2023	0.2
2024	0.83



The sharp increase in 2024 mirrors the surge in upstream exploration and drilling activity under national energy programmes. This trajectory is expected to continue as India advances deep-water projects in the Andaman Basin and expands the portfolio of ONGC and private exploration blocks. Conservative projections indicate that domestic demand for barytes could exceed 1.2–1.5 million tonnes per annum by 2030.

At current depletion rates, domestic reserves will not be able to meet projected requirements of 1.2–1.5 million tonnes annually by 2030. This creates a strategic vulnerability—India’s energy expansion could face supply constraints for a mineral that major producing countries conserve for their own industries.

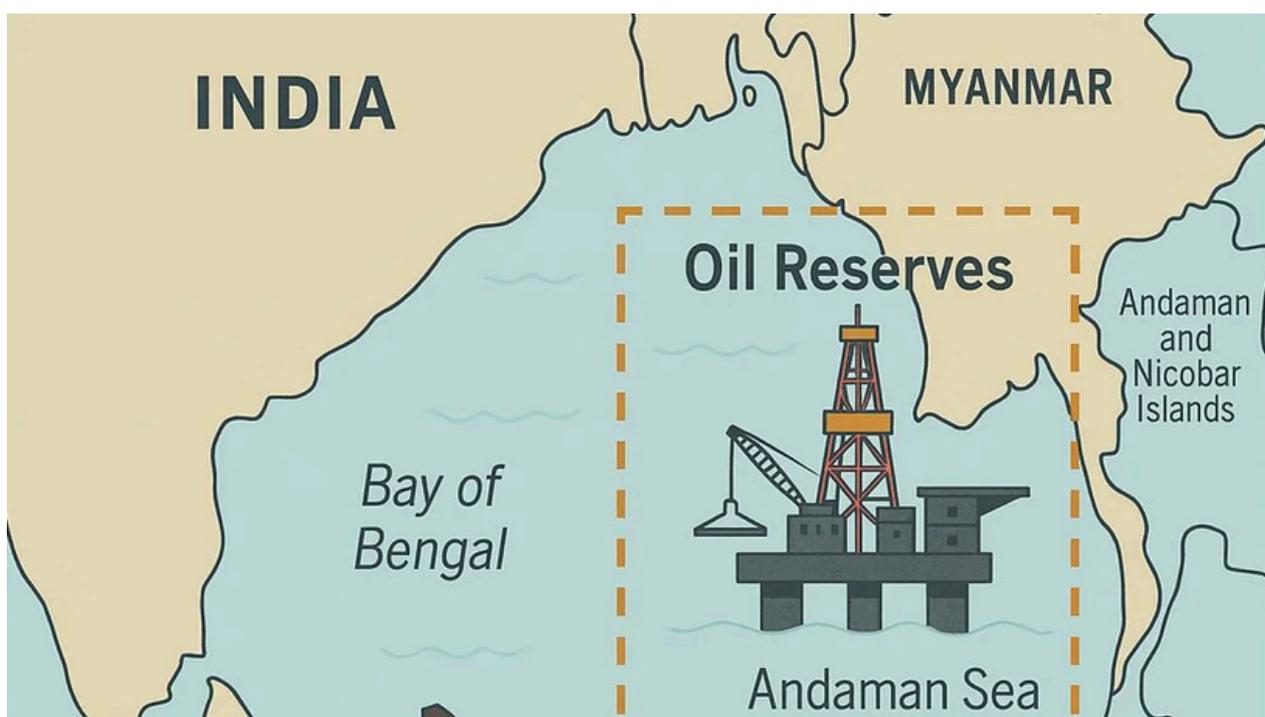


Figure 8: Significant oil and natural gas reserves found in the Andaman Basin



Import dependence carries geopolitical risks. Countries such as China, which dominate the global baryte trade in the Asia-Pacific region, could try to weaponise our dependency on barytes to ensure that India cannot unlock its economic might by capitalising on the oil reserves found off of Andaman islands.

Not just the Andaman Basin, India also possesses significant hydrocarbon reserves in the Krishna–Godavari (KG) Basin, which holds the potential to produce millions of barrels of oil and substantial volumes of natural gas.

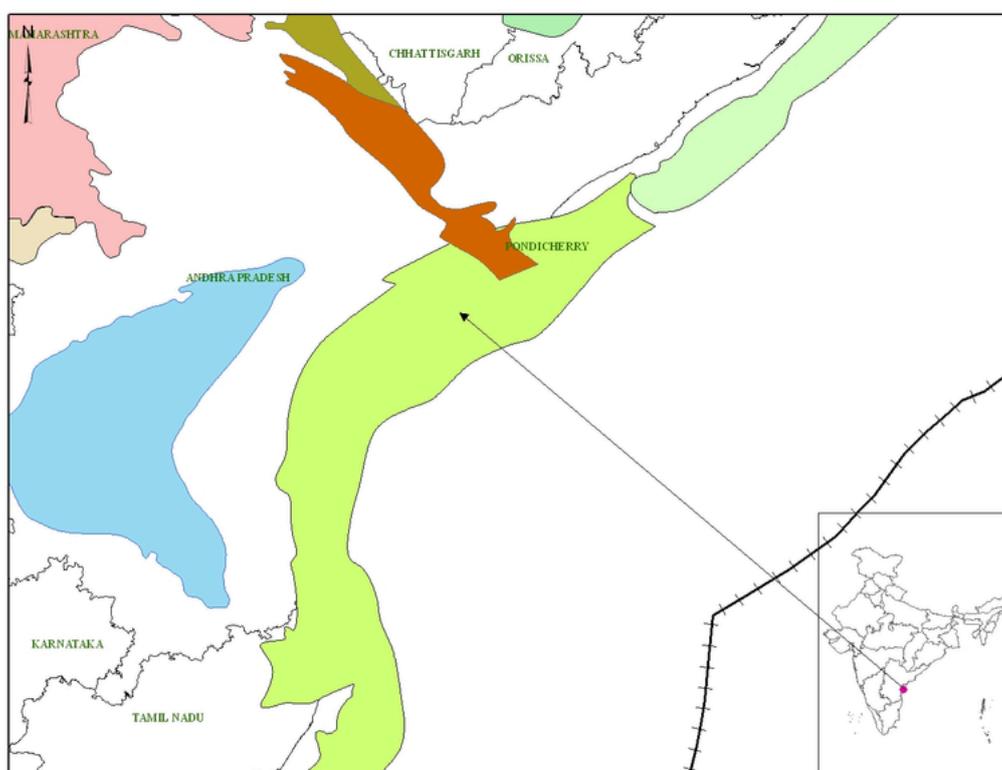


Figure 9: Krishna–Godavari oil basin

To secure the Andaman opportunity and sustain the ongoing operations of the KG basin, barytes policy must shift from revenue maximisation to resource stewardship. This calls for calibrated export controls, prioritised allocation for domestic exploration, and inclusion of barytes in the Critical Minerals List to align its management with India’s long-term energy security objectives.

7. Impact of export on downstream industries



India's export-heavy approach to barytes is creating distortions in the domestic value chain. Even as large volumes of high-quality barytes are shipped abroad, downstream industries within India are increasingly compelled to import the mineral to meet their requirements.

Increasing imports of Natural Barium Sulphate "barytes" (HS: 251110)

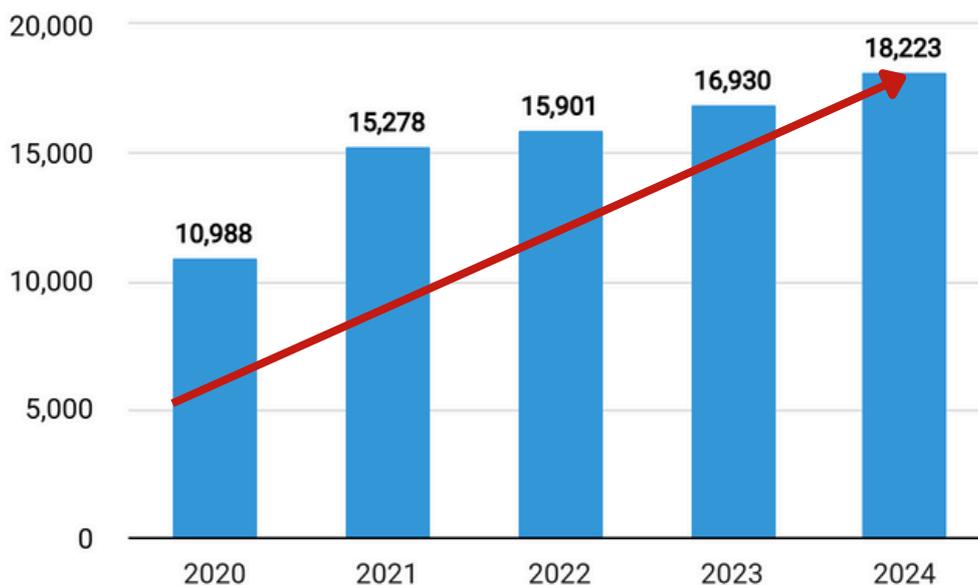


Figure 10: Domestic downstream industry importing barytes despite having sufficient capacity in India

Source: ITC World Trade Map

This paradox is evident in the oilfield services, paints, plastics, and defence industries, where steady access to barytes is essential. With a significant share of Mangampet production locked into export contracts, domestic users have no choice but to turn to international markets. This dependence on imports is especially concerning given that India is one of the world's leading producers of barytes.

Another consequence is the price differential. Indian exports are being shipped at competitive, and often discounted, rates to retain global buyers, while domestic industries are importing barytes at higher international market prices. This results in a direct loss of foreign exchange, as more is being spent on imports than earned from exports.



Forfeiting downstream value addition and supply chain resilience

Beyond the foreign exchange imbalance, the current strategy represents a missed opportunity to build domestic processing and beneficiation capacities. India has the geological advantage of reserves, but without investment in downstream processing, the country remains confined to exporting raw barytes rather than moving up the value chain into higher-value products such as micronised barytes, chemical-grade barytes, and advanced composites.

Playing into China's hands: How processed baryte imports from China is increasing (HS code: 2511020)

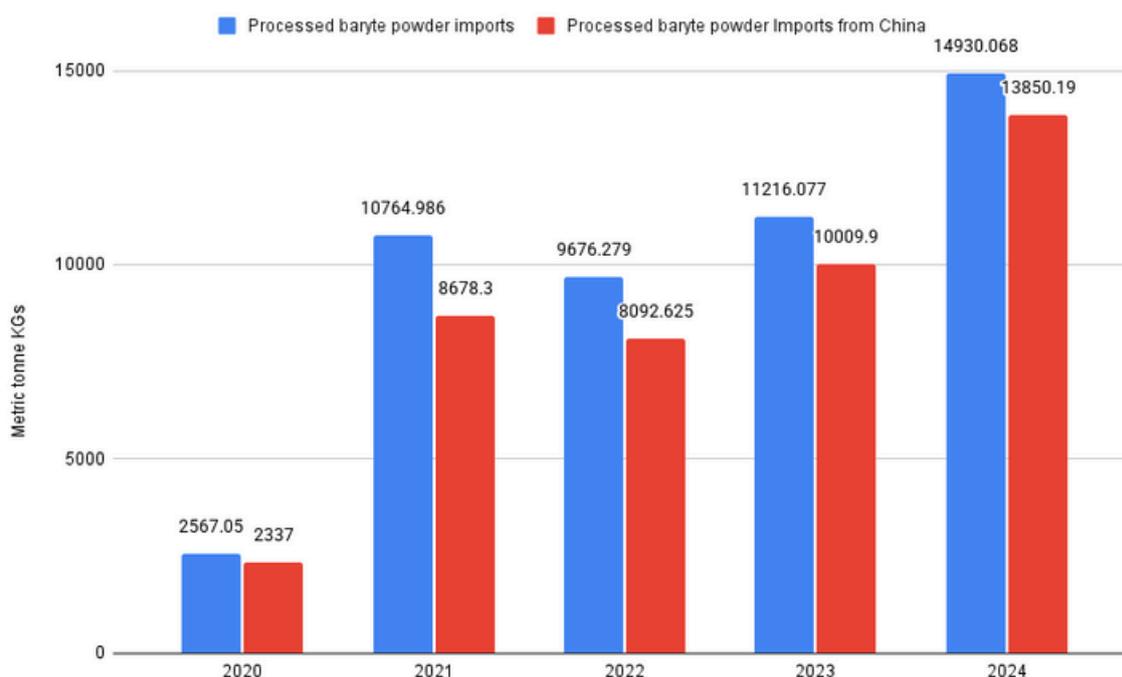


Figure 12: Lost opportunity to build downstream capacity due to current export policy of raw barytes

Source: Ministry of Commerce Dashboard

The net effect is two fold: erosion of India's foreign exchange reserves and loss of domestic value addition. Instead of leveraging domestic reserves to catalyse investments in barytes-based industries, the present trajectory risks losing out both reserves and industrial competitiveness.



8. Potential policy options

1. Export Restriction on Barytes

The Government may consider introducing calibrated export restrictions on barytes to conserve reserves for domestic oil and gas exploration. Export permissions could be reviewed periodically after meeting domestic requirements, particularly for ongoing and upcoming projects in the Andaman and Krishna-Godavari Basins. Given that India would require approximately **600 million tonnes** of barytes to extract its untapped oil reserves, it may also be prudent to explore importing barytes to build a strategic reserve for future consumption and energy security.

2. Fiscal support to ease APMDC's bond obligations

A fiscal transition plan may be examined to gradually reduce APMDC's debt obligations linked to baryte extraction. This would also account for existing bond commitments that currently necessitate sustained production and export volumes, ensuring financial stability while supporting conservation goals.

3. Revision of APMDC's Export Policy

The existing Andhra Pradesh Mineral Development Corporation (APMDC) policy allocating majority production for exports requires urgent revision. The allocation ratio could be revised to prioritize domestic value addition, ensuring majority of mined barytes are reserved for internal use for manufacturing downstream products such as drilling fluids, chemical derivatives, and other industrial applications.

4. Classification of Barytes as a Critical Mineral under NCMM

Baryte could be considered for being categorized as a critical mineral under the National Critical Minerals Mission (NCMM), considering its indispensable role in oil and gas exploration, defence applications, and strategic industries. This designation would enable its inclusion in national stockpiling programmes, attract targeted R&D investment, and enable the government to impose conservation and export-control measures.



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