Indian Journal of Modern Research and Reviews

This Journal is a member of the *'Committee on Publication Ethics'*

Online ISSN:2584-184X

Research Article

Economic Implications of China's Rare Earth Export Controls on India's Electric Vehicle Industry

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DOI: https://doi.org/10.5281/zenodo.18279631

Abstract

China's escalating export restrictions on rare earth elements represent a critical geopolitical supply-side shock to India's electric vehicle sector.
Since April 2025, China has progressively restricted exports of 12 rare earth elements, impacting India's magnet supply chains and threatening EV production growth.
This research examines the multifaceted economic implications through secondary data analysis, case studies of industry disruptions, and evaluation of government policy responses.
The study reveals structural vulnerabilities in India's supply chain architecture, examines interconnections between geopolitical tensions and economic outcomes, and assesses the adequacy of strategic responses, including the National Critical Mineral Mission and Production-Linked Incentive enhancements.
Findings suggest that strategic diversification through international partnerships, domestic capacity building, and innovation-focused policies is necessary to sustain India's EV transition amid geopolitical constraints.

Manuscript Information

- **ISSN No:** 2584-184X
- **Received:** 20-11-2025
- **Accepted:** 25-12-2025
- **Published:** 17-01-2026
- **IJCRM:**4(1); 2026: 105-113
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- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Tiwari A A. Economic Implications of China's Rare Earth Export Controls on India's Electric Vehicle Industry. Indian J Mod Res Rev. 2026;4(1):105-113.

Access this Article Online

www.multiarticlesjournal.com

KEYWORDS: Critical minerals, Electric vehicle supply chain, rare earth elements, Trade policy and geopolitics, Supply chain resilience.

1. INTRODUCTION

India's electric vehicle sector has transitioned from a nascent market experimentation to a strategic national priority, driven by environmental imperatives, energy security goals, and technological ambitions. The cumulative momentum is evident: market participants across two-wheelers, three-wheelers, and passenger vehicle segments have expanded production capacity and launched new models in response to government incentives (FAME schemes) and rising consumer awareness.

This sector expansion aligns with broader national development objectives, including carbon emissions reduction and manufacturing sector employment.

However, this growth trajectory faces a fundamental vulnerability: India's limited domestic capacity for rare earth element (REE) processing and permanent magnet manufacturing necessitates heavy reliance on imports, predominantly from China. REEs, a group of 17 metallic elements including lanthanides, scandium, and yttrium, are technically indispensable for EV motors, battery systems, and electronic components. The concentration of global REE production, refining, and magnet manufacturing in China creates a critical dependency relationship that recent export controls have exposed and weaponised.

Beginning in April 2025, China implemented systematic export licensing requirements for rare earth elements and permanent magnets, officially framed as national security measures but widely interpreted as geopolitical responses to great power competition dynamics.

The restrictions expanded significantly in October-November 2025, with China restricting 12 of 17 rare earth elements covering dysprosium, holmium, erbium, and other elements critical for high-performance magnets. Additionally, extraterritorial provisions attempted to control products and equipment globally if they contained above a specified threshold of Chinese-origin materials, though this component faced international resistance and was temporarily paused.

China's position in global rare earth supply is unparalleled: estimates suggest China dominates approximately 70% of mining, 90%+ of refining capacity, and 95%+ of permanent magnet manufacturing globally.

This concentration enables China to implement export constraints with minimal domestic disruption, while simultaneously creating severe vulnerability for downstream industries globally, particularly in technologically sensitive sectors like defence systems and electric vehicles.

India's EV manufacturers have encountered unprecedented supply chain disruptions. The average lead time for obtaining export licenses from China has extended beyond 30-45 days, exceeding Indian manufacturers' typical 2–3-week magnet inventory buffers.

Several major manufacturers have publicly reported production adjustments, delayed vehicle launches, and inventory management challenges in response to supply uncertainties.

The confluence of supply scarcity and geopolitical uncertainty has introduced cost pressures, timeline delays, and competitive disadvantages for Indian EV makers.

This research addresses five critical questions: What mechanisms link China's export controls to economic outcomes in India's EV industry? How do supply disruptions translate into production delays, cost escalations, and market competitiveness changes? What are the geopolitical dimensions of this supply shock, and how do they interact with economic effects? How adequate are current government policy responses in mitigating vulnerabilities? What strategic pathways enable India to achieve greater supply chain autonomy while maintaining growth momentum?

This analysis is significant for several constituencies: policymakers developing critical minerals strategy, industry participants planning capacity investments and supply chain adaptations, academic researchers examining supply chain resilience and geopolitical economics, and analysts studying India-China economic interdependencies. The research contributes to understanding how resource concentration in authoritarian states becomes a lever for geopolitical influence and how democracies can develop resilient alternatives.

Literature Review and Theoretical Framework

Rare earth elements derive from naturally occurring minerals that are relatively abundant in Earth's crust but rarely found in economically extractable concentrations.

Historical development of mining, refining, and magnet manufacturing infrastructure concentrated globally in a few jurisdictions, with China achieving particular dominance through sustained investment and cost advantages.

This geographical concentration, combined with technical expertise requirements, creates barriers to rapid supply chain diversification. Scholars examining these dynamics note that export controls have become instruments for signalling resolve in great power competition, deterring specific alliances, and demonstrating coercive capacity.

REEs perform technically specific functions within EV systems. Neodymium and dysprosium enable high-performance permanent magnets used in EV motors, delivering the power density and efficiency required for commercial vehicle operation. Cerium and lanthanum enhance battery performance through chemical processes that extend charge-discharge cycles.

Additional elements enable LED lighting systems, optical components, and electronic controls. The technical specificity of these applications means that substitution is neither straightforward nor costless; alternative magnet technologies involve efficiency trade-offs or require substantial R&D timelines.

The economic significance of REEs within EV manufacturing cost structures is non-trivial. Permanent magnets constitute a material cost component that varies by motor design but represents a meaningful portion of total manufacturing costs. Supply disruptions directly impact production timelines and cost accounting, creating compounding pressures on manufacturers operating with limited buffers.

India's EV market has expanded substantially from nascent beginnings, with government support through FAME (Faster

Adoption and Manufacturing of Hybrid and Electric Vehicles) schemes and PLI (Production-Linked Incentive) programs catalysing manufacturer investments and consumer adoption across vehicle segments.

Market participants increasingly report consumer demand shifting toward electric options in both urban and emerging markets.

The structural vulnerability of this sector to REE supply disruptions stems from India's limited domestic processing capacity. India possesses rare earth mineral reserves—estimates suggest 5-6 million tonnes in coastal deposits, but processes negligible quantities of REEs into refined materials or magnets. This processing gap means India imports refined REEs and magnets at high cost, with China supplying the overwhelming majority of magnet imports. The supply chain architecture thus exhibits classic single-source dependency characteristics, where interruptions in one supplier create immediate cascading effects.

Academic literature on supply chain disruptions distinguishes between demand-side shocks (shifts in buyer preferences) and supply-side shocks (interruptions in material availability).

The China REE controls represent a supply-side shock with geopolitical origins, combining physical availability constraints with deliberate policy restrictions. The interaction between these two components—physical scarcity and deliberate constraint—differs from conventional supply disruptions and may create more persistent effects.

Case studies of prior supply disruptions (semiconductor shortages 2021-2022, semiconductor-specific issues affecting EV production 2021-2023) demonstrate that production delays compound over time, that manufacturer responses require capital investment with long lead times, and that short-term adjustment involves inventory depletion with subsequent restocking pressures.

Rare Earth Elements in India's EV Ecosystem

Electric vehicle motors depend on permanent magnets composed primarily of neodymium combined with dysprosium and other rare earth elements. These magnets generate high magnetic fields within compact volumes, enabling motor designs that balance power output with vehicle weight constraints.

The motor's efficiency—its conversion of electrical energy to mechanical work—is directly influenced by magnet quality. Substituting alternative magnet materials (ferrite-based alternatives) involves either efficiency penalties or substantial increases in motor volume and weight, both undesirable for vehicle performance.

Within battery systems, rare earth elements enhance ionic conductivity and cycle retention, extending battery operational lifespan.

Electronic components, including LED displays, optical systems, and magnetic components in power electronics, contain rare earth elements that enable miniaturisation and efficiency. The cumulative effect across these applications means that REE supply disruptions reverberate through multiple vehicle subsystems rather than affecting isolated components.

Rare earth elements influence manufacturing cost structures through multiple pathways. Direct material costs for REE magnets and refined materials represent a component of variable manufacturing costs.

Supply disruptions increase procurement complexity, requiring emergency procurement at premium prices, inventory holding costs, and supply chain management overhead. Additionally, production delays create fixed-cost absorption challenges: manufacturing facilities incur overhead (labour, facility costs, capital service) whether or not vehicles are being produced.

Indian EV market projections anticipate continued growth through the 2025-2030 period, driven by government support, consumer preferences, and manufacturer capacity investments.

This growth trajectory implies corresponding increases in demand for REE magnets and refined materials. The supply-demand balance—comparing India's domestic capacity with forecasted demand—reveals a substantial and growing gap. Current Indian magnet manufacturing capacity is estimated at modest levels (several hundred metric tonnes annually), while forecasted 2030 demand approaches eight to nine thousand metric tonnes across vehicle segments.

This expanding gap indicates that India's supply vulnerability will intensify without corresponding capacity investments. The timing is critical: capacity investments require multi-year lead times for planning, financing, construction, and operational ramp-up. Delays in commencing these investments compound the gap and compress subsequent windows for adaptation.

Mechanisms of China's Export Controls

China's export control measures employ licensing mechanisms as the operational instrument. Entities seeking to import REEs or magnets from China must submit applications describing intended end-use, anticipated volumes, and customer identities. Chinese authorities then exercise discretion in approving or denying requests, with official criteria remaining opaque but interpreted as related to national security or alignment with Chinese strategic interests.

The phased nature of controls—starting with 7 elements in April 2025, expanding to 12 elements by October-November 2025—creates uncertainty about future scope. Manufacturers cannot plan a supply strategy when future control lists remain indeterminate.

This uncertainty itself creates economic effects beyond the immediate supply reductions: supply contracts become unviable when future availability cannot be estimated, and firms engage in precautionary inventory accumulation that consumes financial resources without adding production capacity.

Export licensing introduces processing delays into the supply chain. Applications require submission, technical evaluation by Chinese authorities (whose criteria and timelines are non-transparent), approval or denial decisions, and subsequent shipping and logistics.

Industry participants report that total lead times from order placement to receipt have extended substantially, often exceeding the inventory buffers that manufacturers maintain.

When lead times exceed buffers, production sequencing becomes constrained: manufacturers cannot initiate assembly processes, when necessary, inputs are unavailable.
China's explicit framing of these measures as national security actions reflects genuine concerns about rare earths flowing to military applications. However, the targeting of allies (India participates in security cooperation frameworks, including QUAD) and the breadth of controls affecting civilian applications suggest that REE restrictions serve broader geopolitical objectives.
The relationship between these geopolitical dimensions and economic outcomes is important to understand: supply restrictions operate through economic mechanisms (availability, lead times, costs) but originate from geopolitical calculations. Understanding the relationship between these domains helps assess the likelihood of control persistence, modification, or escalation.

Economic Implications for India's EV Sector

Multiple Indian EV manufacturers have publicly reported supply chain challenges and production adjustments. Maruti Suzuki, India's largest passenger vehicle manufacturer, delayed EV model launches by several weeks, citing magnet availability challenges.
Tata Motors reported reduced two-wheeler production in certain periods due to magnet supply constraints. Two-wheeler manufacturers, including TVS Motor and emerging companies mentioned considering production adjustments or focusing on inventory liquidation strategies.
These industry reports indicate that supply disruptions are not theoretical but are materially affecting manufacturing decisions. The specific mechanisms appear to involve:
(1) inability to source required magnets within normal lead times,
(2) emergency procurement at elevated costs, reducing profitability,
(3) Inventory depletion forces production line pauses when buffer stocks expire
When supply chains experience disruptions, some demand goes unmet. Customers unable to purchase desired EV models either delay purchases, substitute to alternative vehicle types (conventional vehicles, alternative EV models, different segments), or exit the purchase decision entirely.
The magnitude of this unmet demand—and whether it represents temporarily deferred purchases (pent-up demand that will be satisfied later) or permanently foregone purchases—affects long-term industry trajectory.
Supply disruptions create cost pressures through several mechanisms. First, scarcity premiums emerge in spot market pricing as buyers compete for available supplies.
REE spot prices (neodymium, dysprosium, and others) experienced notable increases during the period of active controls, with price movements attributed to supply expectations. Second, supply chain management becomes costlier when certainty declines: manufacturers engage in longer-distance sourcing, use expedited logistics, hold larger safety stocks, and employ supply chain specialists to navigate complexity.
These management costs, while often invisible in aggregate statistics, reduce profitability margins.
Third, inventory holding becomes more expensive when supply uncertainty is high. Manufacturers rationally accumulate inventory to protect production continuity, but this inventory ties up working capital and requires storage facilities.
For smaller manufacturers with limited financial resources, inventory expansion creates liquidity pressures.
Supply disruptions affect competitiveness differently across manufacturers. Larger companies with greater financial resources can absorb cost pressures, pursue premium pricing strategies, and invest in supply chain adaptation. Smaller manufacturers or newer market entrants may face disproportionate challenges, as they lack financial buffers and established supplier relationships.
This dynamic can shift industry structure: supply disruptions may accelerate consolidation as smaller players exit or are absorbed by larger competitors.
Additionally, supply disruptions affect export competitiveness. Indian EV manufacturers compete in global markets where other producers face fewer or different supply constraints. If Indian manufacturers absorb proportionally larger cost burdens from REE controls, their competitiveness relative to international competitors diminishes.
This effect may compress India's role in global EV markets over time, shifting India toward a domestic market supplier role rather than becoming a globally competitive exporter.
Supply constraints in EV magnets create cascading effects in supporting industries. Component suppliers to EV manufacturers face demand volatility, complicating their own planning and investment decisions. Charging infrastructure development may slow if vehicle sales decline, reducing demand for installation services. Battery recycling and circular economy initiatives may be deferred if production volumes decline below thresholds needed to justify infrastructure investments.
Employment effects extend across supply chains: manufacturers, component suppliers, logistics providers, and service sectors are all affected by demand reductions.

Geopolitical Dimensions and International Context

India and China maintain complex bilateral relations characterised by competition across multiple domains: border security, technology leadership, regional influence, and economic interdependence [56]. Recent tensions have included border disputes, trade imbalances that favour China, and competition for technological leadership. From this context, rare earth export controls can be understood as instruments within a broader competition dynamic—tools for signalling commitment to strategic objectives and demonstrating costs of non-cooperation.
India's participation in security partnerships, including QUAD (India, US, Japan, Australia), represents a deliberate choice to align with like-minded democracies on regional security issues.

From China's perspective, these alignments threaten Beijing's preferred regional order. REE controls may be partly motivated by the desire to raise costs for nations pursuing these partnerships.
The deliberate timing and targeting of restrictions—affecting India among other US-aligned nations—supports this interpretation.
Geopolitical tensions introduce uncertainty into supply calculations. When suppliers have demonstrated willingness to use supply restrictions as political instruments, buyers become uncertain about future availability.
This uncertainty affects pricing: market participants demand risk premiums reflecting non-zero probabilities of future supply interruptions.
The dynamic interaction between geopolitical signals (statements by Chinese officials, trade commentary, diplomatic incidents) and market prices creates feedback loops: geopolitical tensions drive price volatility, which affects manufacturing costs and decisions, which influence industry structure.
The bilateral India-China competition occurs within a broader US-China great power competition. The US has pursued strategies to reduce its own rare earth import dependency and to support allied nations in doing similarly.
India benefits from these US-led initiatives as a preferred strategic partner. However, India also faces risks from spillovers: if US-China tensions escalate further, China may intensify REE controls globally to increase costs for US-aligned nations, creating secondary impacts for India.

Government Policy Responses and Strategic Initiatives

The Indian government has articulated recognition of critical minerals' strategic importance through policy initiatives, including the National Critical Mineral Mission (NCMM), with announced budget allocations directed toward mining expansion, refining capacity development, magnet manufacturing facilities, recycling infrastructure, and research and development.
These investments represent an acknowledgement that private markets alone will not generate sufficient capacity given long lead times, capital intensity, and geopolitical uncertainties.
The strategic logic underlying these investments is straightforward: reducing import dependency requires expanding domestic production and processing capacity. However, capacity development requires multi-year timelines, significant capital, and technological expertise. The government interventions are designed to compress timelines and reduce private sector risk through public investment.
The existing PLI scheme for EV manufacturing has been enhanced with additional provisions designed to incentivise manufacturers to source magnets from domestic rather than imported sources.
These incentives work through economic mechanisms: manufacturers face higher after-tax returns from using domestic magnets, making domestic sourcing more attractive compared to import alternatives.
The efficacy of these incentives depends on the cost differential between domestic and imported magnets; if domestic production costs are substantially higher than imports, incentives may need to be correspondingly larger.
Government efforts to diversify supply sources include negotiation of supply agreements with Australia (Lynas Rare Earths operations), exploration of partnerships with Myanmar and Brazil, and support for joint ventures that would locate refining capacity in India but leverage international partnerships.
These diversification strategies aim to reduce China's share of India's REE supply from currently high levels (approaching 65-70% of REE inputs and 90%+ of magnet imports) to more balanced portfolios where China represents 40-50% of supply, and the remaining supply comes from multiple sources.
Diversification faces practical challenges: alternative sources may have higher costs than China, may be less reliable due to political instability in some regions, or may require technical development before reaching commercial-scale production.
However, the strategic value of reducing dependency often justifies accepting these cost and reliability trade-offs.
Government support for research into rare-earth-free magnet technologies represents a longer-term strategy for reducing REE dependency. Alternative magnet materials—including ferrite-based and other compositions—may enable EV motors with acceptable performance characteristics, reducing total REE requirements even if they cannot eliminate them.
Similarly, investment in battery chemistry research and electronic component miniaturisation may reduce the REE content of vehicles through efficiency improvements.
Recycling infrastructure development could eventually supply a meaningful portion of magnet input through recovery from end-of-life vehicles and batteries.
These technology initiatives require sustained research funding, experienced scientific and engineering personnel, and patient capital willing to accept uncertain timelines. Government investment addresses these requirements through direct funding, infrastructure provision, and partnership with academic and research institutions.

Industry and Firm-Level Responses

Major EV manufacturers have explored or initiated investments in backward integration—developing their own magnet manufacturing or refining capabilities rather than relying entirely on external suppliers.
These strategies involve substantial capital deployment but offer potential advantages: reduced reliance on external suppliers, ability to customise magnets for specific motor designs, and potential cost advantages through integrated production.
However, vertical integration requires capital investment, technical expertise, and operational complexity that smaller manufacturers may not possess.
Individual manufacturers have pursued geographic supply diversification, developing relationships with multiple suppliers across different countries rather than concentrating purchases from a single source.

This firm-level diversification complements government-level diversification strategies but operates independently: individual manufacturers can pursue these strategies without waiting for government capacity development. However, diversification may involve premium pricing or acceptance of variable quality when alternative suppliers lack the operational maturity of established suppliers.

When supply disruptions are anticipated, manufacturers increase inventory holdings to create buffers protecting production continuity.

These buffers require capital investment in inventory and storage facilities, but provide insurance against supply interruptions. The optimal buffer level depends on assumptions about disruption probability and duration—conservative manufacturers hold larger buffers, while lean operators maintain minimal buffers.

REE supply uncertainties have shifted industry norms toward more conservative inventory practices.

Some manufacturers have pursued innovation in motor and magnet design to reduce REE intensity per vehicle. This can involve redesign of magnets for improved efficiency within existing constraints, or research into motor designs that require smaller magnets or lower-grade magnets.

These innovations offer long-term competitive advantages if successfully developed, but require R&D investment and redesign timelines that limit near-term applicability.

Analysis and Discussion

The core vulnerability in India's EV sector stems from a structural gap: domestic capacity for processing REEs into magnets falls far short of anticipated demand. This gap cannot be eliminated through market forces alone, as private investors face barriers to entry (capital intensity, technical expertise, geopolitical risk) that reduce the incentive for voluntary investment. Government intervention—through direct investment, incentives, and partnership support—is necessary to close this gap.

The strategic autonomy concept refers to an economy's ability to meet essential needs through domestic or allied sources without excessive dependency on adversarial or uncertain suppliers.

For India's EV sector, achieving meaningful autonomy requires not the elimination of imports (which may be economically inefficient) but the reduction of dependency on single or potentially hostile sources.

A critical insight from the analysis is the time-sensitive nature of the challenge. Capacity development requires multi-year timelines; delays in commencing investments compress the window for building capacity before forecasted demand arrives.

This creates urgency for policy implementation: delays in government procurement, permitting, or financing extend the timeline during which India remains vulnerable to supply disruptions.

The 2025-2027 window represents a critical period for initiating capacity investments; delays beyond this period make achieving 2030 targets increasingly difficult.

Some policy responses—such as subsidising domestic magnet production or investing in alternative technologies—involve accepting higher costs relative to continued reliance on Chinese imports.

These costs reflect the price of supply chain autonomy. From a national economic perspective, the value of autonomy (protection against future disruptions, reduced geopolitical vulnerability) may justify accepting higher costs compared to baseline import dependency.

However, this trade-off exists and should be acknowledged: progress toward strategic autonomy involves cost burdens that are ultimately borne by consumers, firms, or government budgets.

This analysis operates under several important limitations. First, future geopolitical trajectories are inherently uncertain; if India-China relations improve or if China modifies control policies, the urgency and rationale for capacity investment change.

Second, technological development timelines are uncertain; alternative magnet technologies may emerge faster than anticipated or may encounter technical barriers that prevent commercialisation.

Third, international supply sources (Australia, Myanmar, Brazil) may face their own constraints or policy changes that affect reliability.

Policy Recommendations and Strategic Pathways

Immediate Priorities (2025-2026): Expedite procurement processes, permitting, and financing to commence magnet manufacturing facility construction during 2025-2026.

Early action provides maximum timeline for capacity to reach meaningful production levels by 2028-2029.

Finalise negotiations with Lynas and other international partners to establish processing facilities in India through joint ventures, enabling access to international scale and expertise while building domestic capacity.

Build government reserves of critical magnets and refined REEs during periods of relative abundance, creating buffers that can be released during supply disruptions.

Ensure PLI and other incentive mechanisms are calibrated to encourage domestic magnet use by manufacturers, reflecting the genuine cost premiums associated with domestic production.

Medium-Term Development (2027-2029): Progressively increase domestic mining, refining, and magnet manufacturing capacity toward targets that achieve meaningful supply diversification away from Chinese dominance.

Facilitate knowledge transfer from international partners in refining, magnet manufacturing, and quality control, building Indian technical capabilities that reduce future dependency on foreign expertise.

Establish research centres and pilot facilities for alternative magnet technologies, battery chemistries, and recycling processes, developing technological options for the 2030+ horizon.

Long-Term Structural Transformation (2030+): Develop India's rare earth and magnet manufacturing capabilities to supply not only domestic demand but also export demand from allied nations and global EV markets, creating economic value and strategic influence through supply provision.

Build recycling infrastructure and integrated circular supply chains where recovered magnets from end-of-life batteries supplement virgin material supply, reducing total REE demand and import dependency.

Invest in areas where India can develop technological advantages—such as rare-earth-free magnets or efficient recycling processes—that become globally competitive and reduce dependency on other nations' technologies.

CONCLUSION

China's rare earth export controls expose a fundamental vulnerability in India's electric vehicle supply chain: structural dependency on a single supplier that has demonstrated willingness to weaponise supply as a geopolitical instrument. The immediate effects are visible in production delays, cost escalations, and competitive pressures experienced by Indian EV manufacturers.

However, this crisis also presents an opportunity for strategic transformation. Government policy responses—including the National Critical Mineral Mission, enhanced PLI schemes, and international partnerships—represent appropriate recognition of both the vulnerability and the opportunity. The pathway forward requires sustained commitment to capacity development, technological innovation, and strategic partnerships over the multi-year timelines required for meaningful capacity deployment.

Success is not assured: numerous technical, financial, and political obstacles remain, and geopolitical trajectories are inherently uncertain. However, the alternative—accepting perpetual vulnerability to external supply shocks is incompatible with India's aspirations for economic autonomy and strategic influence.

India's EV transition is achievable despite current constraints. Whether this transition generates sustainable competitive advantage or merely achieves self-sufficiency in a valuable sector depends on whether India transforms this current crisis into an opportunity for technological leadership and strategic positioning.

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