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**Critical Mineral Supply
Chains and Strategic
Autonomy: India in the
Emerging Energy Order**

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Critical Mineral Supply Chains and Strategic Autonomy: India in the Emerging Energy Order

Abstract

The global transition toward renewable energy systems represent a profound transformation in the structure of the international political economy. Unlike earlier energy regimes centered on fossil fuels, the emerging clean energy order is heavily dependent on critical minerals such as lithium, cobalt, nickel, rare earth elements and graphite. These minerals are indispensable for technologies including electric vehicles, battery storage systems, solar panels and wind turbines. As a result, control over critical mineral supply chains has become a defining feature of contemporary geopolitical competition.

For India, this transition presents a complex strategic dilemma. While renewable energy offers the promise of reducing dependence on imported fossil fuels and enhancing energy security, it simultaneously creates new forms of vulnerability due to reliance on global mineral supply chains that are highly concentrated and geopolitically sensitive. This paradox challenges traditional understandings of strategic autonomy, which have historically emphasised political independence and self-reliance.

This article examines India's position within the evolving global critical mineral ecosystem and argues that strategic autonomy in the 21st century must be reconceptualised as the capacity to manage interdependence through control over supply chains, technological capabilities and institutional strength. Drawing on theoretical perspectives such as dependency theory, geoeconomics and realism, the study highlights India's structural vulnerabilities and evaluates its policy responses.

The article further proposes a multi-dimensional strategy that includes diversification of supply sources, development of domestic processing industries, investment in technological innovation and participation in global governance frameworks. It concludes that India's ability to navigate the emerging energy order will depend on its success in integrating economic, technological and geopolitical strategies into a coherent framework aimed at enhancing resilience and strategic leverage

Keywords: Critical Minerals, Strategic Autonomy, Energy Geopolitics, Critical Mineral Supply Chains, India, Geoeconomics

Introduction

The transition to renewable energy is one of the most consequential developments shaping the global political economy in the 21st century. Driven by the urgency of climate change, technological advancements and shifting economic priorities, countries around the world are accelerating efforts to reduce their dependence on fossil fuels. India, as one of the fastest-growing major economies, is at the of this transformation. With rapidly rising energy demand and increasing environmental pressures, the country has committed itself to expanding renewable energy capacity and achieving long-term sustainability goals.

However, this transition is not merely a technological shift from fossil fuels to clean energy sources. It represents a deeper structural transformation that redefines the nature of energy security, economic interdependence and geopolitical competition. Renewable energy systems are fundamentally different from fossil fuel systems in that they require a wide range of critical minerals for their production and deployment. Lithium, cobalt, nickel and rare earth elements play a crucial role in enabling technologies such as batteries, electric vehicles and renewable power infrastructure.

This dependence on critical minerals introduces a new set of challenges. Unlike oil and gas, which are primarily extracted and consumed, critical minerals are embedded in complex supply chains that involve multiple stages, including exploration, extraction, processing, refining and manufacturing. These supply chains are geographically dispersed but often highly concentrated in specific countries, creating potential vulnerabilities and strategic dependencies.

For India, this creates a structural paradox. On the one hand, the shift to renewable energy reduces dependence on fossil fuel imports, which have historically been a major source of economic and strategic vulnerability. On the other hand, it increases reliance on external sources for critical minerals, thereby introducing new forms of dependency. This transformation does not eliminate geopolitical risks but rather reshapes them.

Historically, energy transitions have led to significant changes in global power structures without eliminating competition. The transition from coal to oil in the early 20th century, for example, shifted geopolitical focus to oil-rich regions but did not reduce strategic rivalries. Similarly, the current transition to renewable energy is likely to create new of power based on control over mineral resources, technological capabilities and industrial ecosystems.

In this context, the concept of strategic autonomy assumes renewed significance. Traditionally, India's strategic autonomy has been associated with its ability to maintain independence in foreign policy and avoid alignment with major powers. However, in an increasingly interconnected and technologically driven world, strategic autonomy must be redefined to include economic resilience, technological self-reliance and supply chain security.

This article argues that achieving strategic autonomy in the emerging energy order requires India to move beyond a narrow focus on resource acquisition and adopt a comprehensive approach that emphasises value chain integration, technological innovation and institutional capacity. It seeks to answer three key questions: What are the structural vulnerabilities facing India in the critical minerals domain? How do global supply chain dynamics shape India's position? And what strategies can India adopt to enhance its strategic autonomy?

Dependency Theory and Structural Constraints

Dependency theory provides an important lens for understanding the unequal distribution of benefits in global production systems. It argues that the global economy is structured in a way that perpetuates inequality between developed and developing countries. Core countries dominate high-value activities such as manufacturing and technology development, while peripheral countries are often confined to the extraction of raw materials.

In the context of critical minerals, these dynamics are particularly relevant. Countries that possess mineral resources do not necessarily derive significant economic benefits unless they also have the capacity to process and utilise those resources domestically. This results in a situation where value addition is concentrated in technologically advanced economies.

For India, which has limited reserves of certain critical minerals and limited processing capacity, the challenge is not only dependence on imports but also exclusion from high-value segments of global supply chains. Overcoming this requires deliberate efforts to build industrial capabilities and move up the value chain.

Geeconomics and Strategic Competition

Geeconomics highlights the increasing use of economic tools as instruments of geopolitical strategy. In the contemporary global order, states deploy trade policies, investment strategies and industrial policies to achieve strategic objectives.

In the critical minerals sector, geoeconomic competition is evident in efforts to secure supply chains, invest in overseas resources and promote domestic industries. Countries are increasingly viewing supply chains as strategic assets rather than purely economic mechanisms.

India's policy initiatives reflect an emerging recognition of geoeconomic dynamics. However, the scale and coordination of these efforts remain critical challenges.

Realism and Resource Geopolitics

From a realist perspective, control over critical resources has always been central to state power. The competition for critical minerals can be seen as a continuation of traditional resource geopolitics in a new form.

States seek to secure access to resources, reduce vulnerabilities, and enhance their strategic position. In this context, critical minerals are not merely economic commodities but strategic assets with significant implications for national security.

India's Structural Vulnerability in Critical Minerals

India's position in the global critical minerals landscape is characterized by a set of interrelated vulnerabilities that constrain its strategic options.

One of the most significant challenges is the limited availability of domestic reserves of key minerals such as lithium and cobalt. Although recent discoveries have generated optimism, the scale of these reserves remains insufficient to meet the country's long-term demand.

Another major issue is the high degree of concentration in global supply chains. A small number of countries dominate the extraction and processing of critical minerals and thus potential chokepoints. Any disruption whether due to geopolitical tensions, trade restrictions or market fluctuations can have significant implications for India's energy transition.

Beyond limited reserves and supply concentration, India faces additional structural constraints that deepen its dependence on external actors.

A critical issue is the lack of domestic processing and refining capabilities. Even when raw materials are accessible through imports or limited domestic extraction, India lacks sufficient infrastructure to process these minerals into usable intermediate or final products. Processing is a technologically intensive and capital-intensive stage and its absence places India at a disadvantage in capturing significant value within the supply chain system. As a result, India often imports not just raw materials but also processed components, increasing both economic costs and strategic dependence.

Closely linked to this is the problem of technological dependence. Advanced battery technologies, particularly lithium-ion cells and next-generation storage solutions are dominated by a small group of technologically advanced countries. These technologies require not only access to minerals but also sophisticated manufacturing ecosystems, intellectual property and skilled labour. India's relatively weak position in research and development limits its ability to compete in these high-value segments.

Another layer of vulnerability arises from institutional fragmentation. The governance of critical minerals in India involves multiple ministries and agencies, including those responsible for mining, energy, industry and external affairs. This often leads to coordination challenges, policy inconsistencies and delays in implementation. In a domain where global competition is intensifying rapidly, such institutional inefficiencies can significantly restrict strategic advancements.

Furthermore, financial and investment constraints pose challenges to India's ambitions. Developing mining projects abroad, establishing processing facilities and investing in advanced technologies require substantial capital. Compared to major global players, India's financial capacity to undertake large scale investments remains relatively limited, particularly in high-risk overseas ventures.

Environmental and social considerations also add complexity. Mining activities, both domestic and overseas are often associated with ecological degradation and community displacement. Balancing the need for resource security with sustainable development goals present an additional policy dilemma for India.

Taken together, these vulnerabilities highlight the multifaceted nature of India's challenge. They underscore the need for a comprehensive strategy that goes beyond securing access to raw materials and addresses deeper structural issues related to technology, institutions and industrial capacity.

Global Supply Chains and India's Position

Critical mineral supply chains are among the most intricate and strategically significant systems in the global economy. Unlike simpler commodity markets, these supply chains involve multiple stages that are geographically dispersed yet highly interconnected.

The first stage, exploration and extraction, is often located in resource-rich regions such as Africa, Latin America and Australia. These regions supply raw materials but typically capture limited economic value due to lack of downstream capabilities.

The second stage, processing and refining, is where raw minerals are transformed into usable forms. This stage is highly concentrated geographically and requires significant technological expertise, infrastructure and investment. Control over this stage provides substantial strategic leverage as it determines the availability and pricing of processed materials.

The third stage, component manufacturing involves the production of intermediate goods such as battery cells, magnets and electronic components. This stage is closely linked to technological innovation and industrial capacity.

The final stage, end-use manufacturing includes the production of electric vehicles, renewable energy systems and consumer electronics. While this stage is more widely distributed, it still depends heavily on upstream supply chain stability.

This multi-layered structure creates a hierarchical system in which countries that dominate processing and manufacturing occupy the most powerful positions. Control over these stages allows countries to influence global markets, set standards and capture a disproportionate share of value.

India's current position within this system is relatively limited. The country is primarily a consumer and downstream participant, with some involvement in low value manufacturing. Its presence in upstream extraction is minimal and its capabilities in processing and refining are underdeveloped.

This positioning has several implications., it limits India's ability to influence global supply chain dynamics and negotiate favorable terms. Secondly, it exposes the country to external shocks as disruptions in upstream or intermediate stages can have cascading effects on domestic industries. Thirdly it constrains opportunities for technological learning and industrial upgrading.

However, the evolving nature of global supply chains also creates opportunities. Increasing geopolitical tensions and concerns about supply chain resilience are prompting countries to diversify their sourcing strategies. This creates space for new entrants like India to enhance their role.

India's large domestic market is a significant advantage. As demand for electric vehicles, renewable energy and energy storage systems grows, India has the potential to attract investment and develop domestic industries. Additionally, its strategic location and growing industrial base positions it as a potential hub for supply chain diversification.

To capitalise on these opportunities, India must adopt a proactive approach that combines domestic capacity building with international engagement.

India's Strategic Response: Policy and Institutional Initiatives

Recognising the strategic importance of critical minerals, India has begun to implement a range of policy measures aimed at strengthening its position in the global supply chain.

One of the key areas of focus has been securing access to overseas mineral resources. India has engaged with resource-rich countries in regions such as Africa, Latin America and Australia to explore opportunities for investment and collaboration. These efforts are aimed at ensuring long-term access to critical minerals and reducing dependence on a limited number of suppliers.

Domestically, the government has introduced reforms to enhance exploration and mining activities. Policy changes have been designed to encourage private sector participation, streamline regulatory processes and improve transparency. These measures are intended to unlock the potential of domestic mineral resources and reduce reliance on imports.

Another important initiative is the promotion of domestic manufacturing capabilities. Programs such as production-linked incentives (PLI) aim to support industries involved in battery manufacturing, electric vehicles and renewable energy technologies. By providing financial incentives and policy support, the government seeks to create a robust industrial ecosystem.

India has also begun to emphasise the importance of technological development and innovation. Investments in research and development are being encouraged to advance battery technologies, improve energy storage solutions and explore alternative materials. However, the scale of investment remains modest compared to global leaders.

Institutionally, efforts are being made to improve policy coordination and strategic planning. The creation of dedicated frameworks and inter ministerial mechanisms reflects an increasing recognition of the need for a holistic approach to critical minerals.

Despite these initiatives, several challenges persist. Implementation gaps and funding constraints continue to limit the effectiveness of policy measures. Additionally, the rapidly evolving global landscape requires continuous adaptation and strategic foresight. India's policy response, while promising, remains in a developmental phase. To achieve meaningful progress, it is required to be scaled up and aligned with long-term strategic objectives.

Strategic Options for India: Beyond Resource Access

Structural vulnerabilities outlined above mandates India to adopt a comprehensive and forward-looking strategy that goes beyond merely securing access to raw materials. Strategic autonomy in the context of critical minerals cannot be achieved through a single policy instrument; rather, it necessitates a approach that integrates economic, technological and geopolitical considerations.

Diversification of Supply Sources

One of the most immediate priorities for India is the diversification of its sources of critical minerals. Overdependence on a limited number of supplier countries increases vulnerability to geopolitical tensions, trade disruptions and market volatility. By engaging with a broader range of resource-rich countries, India can reduce the risks associated with supply concentration.

This strategy necessitates not only establishing trade relationships but also investing in overseas mining projects and forming long-term partnerships. Regions such as Africa and Latin America offer significant potential in this regard. However, diversification efforts must be accompanied by careful risk assessment, as political instability and regulatory uncertainties in some regions can pose challenges.

In addition, India can explore participation in emerging multilateral initiatives aimed at securing critical mineral supply chains. Such engagement would enhance its ability to access resources while also contributing to global supply chain resilience.

Development of Domestic Processing and Refining Capabilities

Moving up the value chain is essential for enhancing India's strategic position. Developing domestic capabilities in processing and refining critical minerals would enable the country to capture greater economic value and reduce dependence on external actors.

This requires substantial investment in infrastructure, technology and human capital. Public-private partnerships can play a key role in mobilising resources and expertise. The government must also create a conducive policy environment that encourages investment and innovation in these sectors.

In addition to economic benefits, domestic processing capabilities would provide strategic advantages by reducing exposure to external disruptions. This is particularly important in a context where supply chains are increasingly subject to geopolitical pressures.

Technological Innovation and Research Development

Technological capability is a critical determinant of competitiveness in the critical ecosystem. India must prioritise investment in research and development to advance its capabilities in areas such as battery technology, material science and energy storage systems.

Innovation can also help reduce dependence on scarce resources by enabling the development of alternative materials and technologies. For example, research into sodium-ion batteries or other emerging technologies could provide viable substitutes for lithium-based systems.

Furthermore, strengthening collaboration between academic institutions, research organisations and industry can accelerate the pace of innovation. Building a robust innovation ecosystem will be essential for positioning India as a competitive player in the global market.

Recycling and Circular Economy Approaches

The promotion of recycling and circular economy practices offers a sustainable approach for reducing dependence on primary mineral resources. By recycling valuable materials from used products such as batteries and electronic devices, India can create a secondary supply of critical minerals.

Developing a robust recycling infrastructure requires investment in technology, regulatory frameworks and also public awareness. It also involves addressing additional challenges related to collection, sorting and processing of waste materials.

A circular economy approach not only enhances resource security but also contributes to environmental sustainability by reducing waste and minimising the ecological impact of mining activities.

Strengthening Institutional Capacity and Policy Coordination

Institutional capacity is a key enabler of effective policy implementation. India must strengthen coordination among various ministries and agencies involved in the critical minerals sector. This includes establishing clear lines of responsibility, improving information sharing and enhancing strategic planning.

The creation of specialised institutions or task forces dedicated to critical minerals could help streamline decision-making and ensure a more coherent policy approach. Additionally, capacity building at both central and state levels will be inevitable to support implementation efforts.

International Cooperation and Strategic Partnerships

In an interconnected world, no country can achieve complete in critical minerals. International cooperation is therefore essential for managing interdependence and enhancing supply chain resilience.

India can benefit from forming strategic partnerships with countries that share its interests in secure and sustainable supply chains. These partnerships can involve joint investments, technology sharing and coordinated policy actions.

Participation in global governance frameworks is also important. By engaging in international forums and standard-setting bodies, India can influence the rules and norms governing critical mineral supply chains.

Implications for Strategic Autonomy

The evolving dynamics of the global energy order necessitate a fundamental rethinking of the concept of strategic autonomy. Traditionally, strategic autonomy has been associated with and independence from external influence. However, in the context of complex global supply chains, such an approach is neither feasible nor desirable.

Instead, strategic autonomy must be understood as the capacity to manage interdependence effectively. This involves maintaining the ability to make independent decisions while being integrated into global systems of production and exchange.

In the domain of critical minerals, this means balancing domestic capacity building with international engagement. It requires developing the resilience to withstand external shocks, the flexibility to adapt to changing circumstances and the capability to influence global supply chain dynamics to avoid shocks from geopolitical situation such as ongoing conflict in Middle East.

Control over supply chains, technological capabilities and institutional strength are key determinants of strategic autonomy in the contemporary era. Countries that can integrate these elements into a coherent strategy are better positioned to secure their interests.

For India, this implies a shift from a reactive to a proactive approach. Rather than responding to external developments, India must actively shape the environment in which it operates. This includes anticipating future trends, investing in emerging technologies and building strategic partnerships.

Moreover, strategic autonomy must be viewed as a dynamic concept that evolves over time. As the global landscape changes, India's strategies must adapt accordingly. Continuous

learning, innovation and policy experimentation will be essential for maintaining relevance and effectiveness.

Conclusion

The global transition to renewable energy is reshaping the foundations of the international political economy. Critical minerals have emerged as a central element of this transformation, redefining the nature of energy security and geopolitical competition.

For India, this transition presents both opportunities and challenges. While renewable energy offers a pathway to sustainability and reduced dependence on fossil fuels, it also introduces new vulnerabilities associated with mineral supply chains. These vulnerabilities are rooted in structural factors such as limited domestic reserves, technological dependence and marginal participation in high-value segments of global supply chains.

Addressing these challenges requires a comprehensive and integrated strategy. India must move beyond a narrow focus on resource acquisition and invest in building capabilities across the entire value chain. This includes developing domestic processing industries, promoting technological innovation and strengthening institutional capacity.

At the same time, international cooperation remains essential. By engaging with global partners and participating in governance frameworks, India can enhance its ability to manage interdependence and secure its interests.

Ultimately, strategic autonomy in the 21st century is not about isolation but about resilient integration. It is the ability to navigate a complex and interconnected world while preserving the capacity for independent decision-making.

If India succeeds in aligning its economic, technological and geopolitical strategies, it can emerge as a significant player in the evolving energy order. Failure to do so, however, may result in new forms of dependency that undermine its aspirations.

The challenge, therefore, is not merely to adapt to the changing global landscape but to actively shape it in ways that advance national interests and contribute to a more stable and sustainable international system.

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