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Article

Challenges of Net-Zero Supply Chain Management in Emerging Economies: A Review and Future Research Agenda

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Abstract: Net-zero supply chain management has gained prominence as firms extend decarbonization efforts beyond organizational boundaries. However, much of the existing literature is grounded in assumptions derived from developed economies, limiting its applicability to emerging economy contexts. This paper presents a narrative review of the challenges associated with net-zero supply chain management in emerging economies, with the objective of synthesizing fragmented insights and identifying future research directions and managerial implications. Drawing on prior research in operations, sustainability, and supply chain governance, the review organizes key challenges into three interrelated domains: structural and institutional constraints, operational and supply chain design limitations, and measurement, governance, and coordination failures. The analysis highlights how infrastructure deficits, capital constraints, supplier capability gaps, and data limitations collectively complicate the implementation of standardized net-zero pathways. Building on this synthesis, the paper outlines context-sensitive research agendas that emphasize differentiated transition pathways, dynamic trade-offs, and hybrid governance mechanisms. The study also offers pragmatic managerial implications, emphasizing phased implementation, capability development, and collaborative supplier engagement. Overall, the paper contributes to a more context-aware understanding of net-zero supply chain management and underscores the need to align decarbonization ambitions with institutional and operational realities in emerging economies.

Keywords: Net-zero supply chains; emerging economies; supply chain decarbonization; sustainability governance; Scope 3 emissions; narrative review.

INTRODUCTION

The transition toward net-zero emissions has emerged as a defining strategic challenge for firms and supply chains worldwide. Increasing regulatory pressure, investor scrutiny, and stakeholder expectations have pushed organizations to move beyond firm-level carbon reductions toward supply chain–wide decarbonization efforts[1]. As a result, net-zero supply chain management has become a central theme in operations and sustainability research. However, much of the existing literature rests on assumptions derived from developed economies—assumptions that presuppose institutional capacity, infrastructure readiness, and supplier formalization that are often absent in emerging markets[2].

Emerging economies present a fundamentally different—and often underestimated—context for net-zero supply chain management. Supply chains in these regions are frequently characterized by fragmented supplier bases, infrastructure deficits, weak regulatory enforcement, and persistent cost pressures[3]. These conditions complicate the adoption of standardized net-zero pathways and limit the transferability of practices developed in advanced markets[4]. Despite their growing contribution to global emissions and their central role in global production networks, emerging economies remain underrepresented in conceptual syntheses of net-zero supply chain challenges.

The purpose of this narrative review is to synthesize the key challenges associated with net-zero supply

chain management in emerging economies and to identify future research directions and managerial implications[4]. Rather than offering an exhaustive systematic review, the paper adopts a conceptual synthesis approach to structure fragmented insights and surface unresolved tensions. By doing so, it reframes net-zero supply chain management as a context-sensitive, multi-level challenge rather than a universally applicable managerial solution[5].

2. Conceptual Foundations of Net-Zero Supply Chain Management

Net-zero supply chain management refers to the coordinated design and governance of supply chain activities such that net greenhouse gas emissions across all relevant scopes are reduced to zero or near zero over a defined time horizon. Unlike carbon-neutral approaches that often rely heavily on offsets, net-zero strategies emphasize absolute emission reductions across Scope 1, Scope 2, and, critically, Scope 3 emissions[6]. For most firms, Scope 3 emissions originating from upstream suppliers and downstream logistics constitute the largest share of their carbon footprint.

From a supply chain perspective, net-zero ambitions introduce systemic interdependencies. Emission reductions at one node often require investments or behavioral changes at another, frequently beyond the focal firm's direct control. These interdependencies are particularly pronounced in emerging economies, where supply chains are dominated by small and medium-sized enterprises with limited financial and technological capabilities. Data availability is also uneven, and standardized emissions reporting practices remain the exception rather than the norm[7].

Conceptually, this review treats net-zero supply chain management in emerging economies less as a technical optimization problem and more as a governance and capability-building challenge embedded within broader institutional constraints. This framing provides the foundation for the thematic synthesis developed in the following section.

3. CHALLENGES OF NET-ZERO SUPPLY CHAIN MANAGEMENT IN EMERGING ECONOMIES

3.1 Structural and Institutional Challenges

A central barrier to net-zero supply chain management in emerging economies arises from structural and institutional conditions. Regulatory frameworks governing carbon emissions are often underdeveloped, inconsistently enforced, or subject to frequent policy changes. In practice, such regulatory uncertainty weakens incentives for long-term decarbonization investments and reinforces managerial preferences for short-term cost competitiveness[8].

Infrastructure limitations further constrain decarbonization efforts. Limited access to reliable renewable energy, inefficient transportation networks, and underdeveloped digital infrastructure reduce firms' ability to lower emissions even when strategic intent exists. In many emerging economies, production clusters remain locked into carbon-intensive energy systems, making supply chain–level decarbonization dependent on systemic transitions that individual firms cannot easily influence[9].

The prevalence of informality and fragmented supplier networks presents additional complications. Many upstream suppliers operate outside formal regulatory oversight, lack standardized documentation, and engage minimally with sustainability initiatives. These characteristics directly undermine traceability, making the imposition and monitoring of net-zero commitments across multiple tiers both costly and unreliable[10].

3.2 Operational and Supply Chain Design Challenges

Operational realities in emerging economies generate persistent trade-offs between cost efficiency, resilience, and decarbonization. Thin margins and intense price competition limit firms' capacity to absorb the costs associated with low-carbon technologies or process redesign[11]. Unlike firms in developed markets, companies in emerging economies frequently operate under capital constraints that render the long payback periods of many decarbonization investments commercially unattractive[12].

Supplier capability gaps further complicate implementation. Many suppliers lack the technical expertise, skilled labor, or managerial systems required to measure and reduce emissions. Consequently, lead firms often encounter resistance or symbolic compliance when cascading net-zero requirements upstream. These difficulties intensify beyond Tier 1 suppliers, where visibility and influence decline sharply[13].

Logistics and network design decisions also pose challenges. Strategies such as nearshoring, modal shifts, or network reconfiguration may conflict with cost and service-level priorities in emerging markets, where infrastructure alternatives are limited. As a result, operational feasibility frequently constrains both the scope and pace of net-zero initiatives[14].

3.3 Measurement, Governance, and Coordination Challenges

Reliable emissions measurement is a prerequisite for net-zero supply chain management, yet it remains particularly problematic in emerging economies[15]. Data availability is uneven, data quality varies widely, and standardized measurement frameworks are rarely adopted across supplier networks. As a result, baseline emissions remain uncertain, weakening both target-setting exercises and the credibility of subsequent performance evaluations[15].

Governance challenges stem from misaligned incentives between global buyers and local suppliers[3]. While multinational firms face mounting pressure to commit publicly to net-zero targets, their suppliers often perceive these commitments as cost burdens rather than strategic opportunities. Without complementary incentive structures, such as financial support or technical assistance, compliance is likely to remain superficial[16].

Coordination across multiple supply chain tiers represents a further obstacle. Many emerging economy supply chains rely on transactional governance mechanisms and weak relational ties, limiting information sharing and joint problem-solving[17]. These coordination failures reduce the effectiveness of supply chain–wide decarbonization efforts and contribute to uneven progress across tiers.

4. Future Research Agendas

The challenges identified above point to several promising avenues for future research. First, there is a clear need for context-sensitive conceptual frameworks that explicitly incorporate institutional, infrastructural, and economic constraints in emerging economies. Such frameworks would move the literature beyond universal net-zero roadmaps toward differentiated transition pathways that better reflect contextual constraints.

Second, future research should examine dynamic trade-offs between decarbonization, cost efficiency, and supply chain resilience in resource-constrained environments. Longitudinal designs, comparative case studies, and simulation-based approaches could provide insights into how these trade-offs evolve over time and under different policy or market conditions.

Third, governance mechanisms for engaging multi-tier suppliers warrant closer examination. Future studies could explore hybrid governance models that combine contractual enforcement with relational and capability-building mechanisms, particularly in contexts characterized by low supplier maturity[18]. Finally, the role of digital technologies in enabling net-zero supply chains under infrastructure constraints remains underexplored. Rather than assuming advanced digital readiness, research should investigate incremental and frugal digital solutions that are feasible in emerging economy settings.

5. Managerial Implications

For practitioners operating in emerging economies, the findings of this review suggest that net-zero supply chain management should be approached as a phased and adaptive process. In many cases, managers may need to prioritize the development of basic measurement and data capabilities before committing publicly to aggressive emission targets. Premature commitments risk undermining credibility and straining supplier relationships[19].

Lead firms play a critical enabling role. Rather than relying solely on compliance-based mechanisms, managers should consider collaborative approaches that include technical assistance, shared investments, and incentive alignment. In several contexts, improvements in operational efficiency and reliability may be necessary before substantive decarbonization becomes feasible[20].

Managers should also recognize the limits of firm-level control. Addressing structural barriers may require engagement with policymakers, industry associations, and infrastructure providers to support broader system-level transitions.

6. CONCLUSION

This narrative review demonstrates that net-zero supply chain management in emerging economies is shaped by a distinct set of structural, operational, and governance challenges. These challenges constrain the applicability of standardized net-zero models and highlight the need for context-aware approaches. By synthesizing existing insights and articulating future research directions, this paper contributes to a more grounded understanding of supply chain decarbonization in emerging markets. While limited by its conceptual scope, the review underscores the importance of aligning net-zero ambitions with institutional realities and managerial capabilities.

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