Chapter 4
AI-Driven Big Data and Blockchain Convergence for Carbon Footprint Accountability in Global Supply Chains

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ABSTRACT

The urgency of climate change has heightened the need for accurate carbon accountability in global supply chains. Conventional systems suffer from fragmented data, poor interoperability, and risks of greenwashing, reducing trust and compliance. This chapter explores the convergence of Artificial Intelligence (AI), big data, and blockchain as a transformative solution. AI and big data enable emission forecasting, anomaly detection, and process optimization, while blockchain ensures immutability, transparency, and tamper-proof reporting. Case studies from Walmart and Volvo illustrate practical applications. The chapter also examines socio-economic implications, regulatory aspects, and technological barriers, while highlighting opportunities such as AI-enabled smart contracts, blockchain-based neutrality

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certifications, and predictive sustainability with digital twins. Collectively, these innovations provide a pathway to low-carbon, ethical, and transparent supply chains aligned with global sustainability and ESG goals.

INTRODUCTION

Climate change is an urgent problem that has put more pressure on the essential responsibility of carbon footprint in international supply chains. The growing complexity of the global trade and production systems is showing the inapplicability of the old systems of measurement and reporting of emissions. It has been determined that these outdated methods are characterised by fragmented information, the inconsistency of the standards and low rates of interoperability resulting in low quality sustainability reporting and undermining stakeholder confidence. This, in addition, has led to the non-observance of environmental policies, but also contributed to the probability of greenwashing whereby the companies are either overstating or overdoing their environmental performance (Y. Chen & Jin, 2023a). In a bid to make suitable adjustments to these demands, the newer digital technologies are being utilized as ground breaking tools with each passing day. Today, with the help of Artificial Intelligence (AI) and big data analytics, much more heterogeneous data can be processed, and it is possible to help the firms predict emission, identify the anomalies and optimize the processes that use a lot of energy and predict it accurately. These attributes are supplemented by blockchain with the immutable, decentralized, cannot-be-tampered-with reporting features, that provide transparency between the supply chain participants (Aarthi et al., 2025). This chapter recaps the interplay of AI, big data and blockchain and demonstrates the potential of the combination using examples. It also addresses the modern-day challenges, policy implications and future projections of the emerging low-carbon, ethical and transparent supply chains in accordance to the international sustainability objectives.

Context Of Global Warming And Carbon Footprint Responsibility

Global warming has become a burning international issue and increased temperatures and climate changes have disrupted ecosystems, human life and economies. One of the biggest emitters of Greenhouse Gas (GHG) is the supply chains of manufacturing, transportation and storage. Consequently, the responsibility of carbon footprint is a strategic issue to governments, corporations, and international bodies. Carbon management is no longer a choice but a necessity in today's world because of compliance, competitiveness, and corporate reputation. Consumers and investors