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Carbon Border Adjustment Mechanism and Nigeria's Manufacturing Sector: Perspective from the EU for Bilateral Industrial Competitiveness

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Perspective

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Abstract

The Carbon Border Adjustment Mechanism (CBAM) introduced by the European Union marks a critical shift in global climate governance by embedding carbon pricing within international trade. This study analyses the implications of CBAM for Nigeria's manufacturing sector, particularly its effects on trade competitiveness and sustainable industrial development. Utilising a Multi-Regional Input–Output (MRIO) approach, the analysis investigates carbon intensity across production systems and evaluates exposure to carbon-related trade regulations. The findings suggest that Nigeria's dependence on fossil fuel-based energy and its limited capacity for carbon measurement, reporting, and verification (MRV) significantly heighten compliance costs, thus constraining export competitiveness in EU markets. These dynamics pose a risk of reinforcing existing structural inequalities in global trade unless adaptive measures are enacted. The study highlights the necessity of strategic policy alignment, including investments in low-carbon technologies, institutional strengthening, and enhanced regulatory frameworks, to facilitate a just and sustainable industrial transition. The results contribute to ongoing debates regarding climate policy, trade equity, and sustainable development in the context of EU–Africa economic relations.

1. Introduction

The increasing impact of climate change is prompting countries to reassess strategies for industrial growth, economic security, and social development. As greenhouse gas emissions rise, governments and international organizations are intensifying efforts to promote decarbonisation and sustainable production. A significant initiative in this context is the EU's Carbon Border Adjustment Mechanism (CBAM), introduced under the European Green Deal. This policy seeks to mitigate the risk of carbon leakage and encourage trade in environmentally sustainable products (European Commission, 2023).

CBAM applies to sectors such as iron and steel, aluminium, cement, fertilisers, electricity, hydrogen, and other industries that produce significant carbon emissions. These sectors face a high risk of carbon leakage and compete internationally (European Commission, 2024). CBAM’s goal is to add carbon-related costs to imports based on their emissions, similar to the charges EU producers face under the Emissions Trading System (EU-ETS) Böhringer et al. (2022) note that this policy complements existing measures.

The EU’s Carbon Border Adjustment Mechanism (CBAM) is expected to significantly impact Nigeria’s manufacturing sector, as many industries rely on fossil fuels and carbon-intensive production methods. CBAM imposes a carbon cost on imports into the EU to reduce global emissions and prevent carbon leakage (International Energy Agency [IEA], 2024). Although Nigeria has not implemented CBAM, it has enacted policies such as the Climate Change Act 2021 and the Energy Transition Plan to promote a cleaner industry, renewable energy, and sustainable practices.

Nigeria encounters significant challenges in meeting CBAM requirements, including inadequate emissions reporting and limited access to green financing. As a key partner in the EU-AU relationship due to its large population and economy, Nigeria’s production sector remains heavily dependent on fossil

fuels, a situation that requires urgent attention. Consequently, industries such as fertilisers, aluminium, iron and steel, chemicals, and industrial processing are particularly vulnerable to CBAM compliance obligations and carbon price fluctuations. Although crude oil and LNG constitute the majority of Nigerian exports to the EU, recent trends show increasing importance of CBAM-sensitive sectors. Over the past decade, exports of industrial inputs, machinery, iron and steel, fertilisers, and aluminium to the EU have expanded (Eurostat 2025; UN COMTRADE 2025). CBAM poses a substantial risk to the competitiveness of Nigeria's manufacturing sector, its export market access, job stability, and capacity for technological adaptation.

The absence of an effective domestic carbon pricing system and inadequate measurement, reporting, and verification (MRV) mechanisms for industrial emissions present significant challenges for Nigeria. During the CBAM transition phase, exporters are required to submit verified emissions data for their products (European Commission, 2024). Failure to provide such data results in the application of default carbon values, thereby increasing compliance costs and diminishing export competitiveness. Consequently, CBAM functions not only as a climate policy instrument but also as a non-tariff trade barrier for countries with insufficient environmental regulations.

This study examines the effects of the EU's CBAM on Nigeria's manufacturing sector and proposes strategies to enhance industrial competitiveness between the EU and Nigeria. While CBAM presents challenges, it also incentivises industrial modernisation, the adoption of renewable energy, improved energy efficiency, and technological advancement. For Nigeria, accelerating climate reforms, strengthening decarbonization strategies, and investing in cleaner manufacturing technologies are recommended.

This paper investigates the impact of the EU's Carbon Border Adjustment Mechanism (CBAM) on Nigeria's manufacturing sector, addressing the gap in Nigeria-specific research. CBAM is an EU border measure rather than a policy to be domesticated by exporting countries such as Nigeria; it operates through trade. Consequently, Nigerian exporters to the EU must comply with emissions reporting requirements and incur carbon-related costs to remain competitive.

2. Research Methods

A comprehensive analysis of CBAM spillover effects on Nigerian manufacturing necessitates a multi-method framework that combines bilateral trade-flow analysis with embodied-carbon accounting. Given the structural reliance of Nigeria's industrial sector on carbon-intensive production and its export-focused orientation toward EU markets (Oyelami, 2021; Shin, 2014), the methodology must address both direct compliance costs and indirect impacts on competitiveness across supply chains. The study focuses on four energy-intensive manufacturing sectors, iron, steel, cement, and aluminum, which represent the main channels of Nigeria's manufacturing exports to the European Union and are most immediately affected by CBAM compliance requirements (Clarke, 2005; Abiodun et al., 2021).

This research uses Multi-Regional Input-Output (MRIO) analytical frameworks to track the carbon content of intermediate and final goods along complex global value chains. The methodological specification follows the consumption-based accounting approach, wherein the carbon footprint of trade is calculated as:

$$C_{embodied} = \mathbf{L} \cdot \mathbf{F} \cdot \mathbf{y}$$

where $\mathbf{L}$ represents the Leontief inverse matrix capturing economy-wide production linkages, $\mathbf{F}$ denotes the diagonalized vector of sectoral carbon intensities, and $\mathbf{y}$ indicates final demand vectors distinguishing EU consumption from domestic absorption (Valodka et al., Meng atal., 2018).

3. Nigeria’s Manufacturing Sector and CBAM

The manufacturing sector in Nigeria has been contributing to industrial production, employment generation, export development, and value addition across a number of industries. The structural bottlenecks still constrain manufacturing performance (World Bank, 2023). Nigeria's energy architecture is vulnerable. Nigeria’s power generation is predominantly dependent on fossil fuels, especially natural gas and thermal power systems (International Energy Agency, 2023). Heavy dependence on fossil fuels and other carbon-intensive inputs in many manufacturing industries substantially increases their carbon intensities, especially in energy-intensive sectors such as fertilisers, aluminium, iron and steel, cement, and chemicals.

Accordingly, the application of the CBAM on 01 January 2026 imposes enormous adjustment pressures on Nigerian exporters. The transition phase from October 2023 will require exporters to declare embedded emissions for goods entering the EU market. Companies that fail to establish credible emissions reporting systems will be assigned default emissions values, which will significantly raise compliance costs. CBAM will affect the export prices of countries that do not include a price on carbon and whose production processes result in greenhouse gas emissions without a price on carbon. The implication is that it will have the greatest impact on the sectors directly affected. If Nigerian companies in the fertiliser, aluminium, iron and steel sectors fail to meet environmental reporting obligations, they could face higher export costs and reduced competitiveness or market access.

3.1 Structural Weaknesses and Technological Possibilities of the Nigerian Manufacturing Sector.

Nigeria’s manufacturing sector faces ongoing problems with unstable electricity, poor transport infrastructure, and outdated technology. These issues make it hard to reduce carbon emissions. Because the national grid is unreliable, many manufacturers rely on diesel generators, thereby increasing the carbon footprint of their production processes beyond what is technically necessary. As a result, their reported emissions exceed global standards. These challenges are built into the system, not caused by individual behaviour, so meeting CBAM requirements will require major technological

upgrades and significant investment in the power grid. Limited access to financing and a lack of strong industrial policies for clean technology make these problems even harder to solve.

The informal sector plays a significant role in Nigeria's manufacturing value chains, making it difficult to monitor emissions and meet CBAM reporting requirements. Many people work in informal iron, steel, and aluminium businesses, but these companies are not covered by official environmental monitoring. They also lack the tools and systems needed to track carbon content. This makes it hard to follow materials through the supply chain and prevents formal exporters from verifying the carbon footprint of raw materials from informal producers. Because of these information gaps, Nigerian manufacturers are at a disadvantage compared to global suppliers who have formal systems for tracking and reporting emissions. This increases the risk that higher default carbon values will be applied under CBAM rules.

3.2. Nigeria-EU Trade Relations

The trade relationship between the European Union and Nigeria is structurally asymmetric, thereby increasing the vulnerability of Nigeria's manufacturing sector to the Carbon Border Adjustment Mechanism (CBAM). Historically, Nigeria has primarily exported commodities such as crude oil and raw materials, while importing manufactured goods that compete with domestic production. Within this context, Nigeria's manufacturing exports to the EU, though limited in value, are concentrated in carbon-intensive sectors targeted by the CBAM, including iron, steel, cement, and aluminium. The Economic Partnership Agreement (EPA) between Nigeria and the EU, designed to facilitate market access, also subjects Nigerian manufacturers to stringent EU standards that may function as non-tariff barriers, particularly when combined with carbon border adjustments.

Quantitative analysis of Nigeria-EU trade flows demonstrates that Nigeria's manufacturing exports lack diversification, with energy-intensive products comprising a disproportionately large share of non-oil exports to Europe. This concentration increases dependence on the EU market, as Nigerian manufacturers have limited alternative export destinations for these carbon-intensive goods.

The implementation of the Carbon Border Adjustment Mechanism (CBAM) is likely to exacerbate Nigeria's trade imbalance by imposing additional compliance costs on a limited range of export categories. Furthermore, the CBAM may induce trade diversion, redirecting Nigerian manufacturing exports to alternative markets. Since Nigeria does not have a comprehensive domestic carbon pricing system, CBAM-related liabilities cannot be offset against domestic environmental taxes. Consequently, Nigerian exporters face a dual regulatory burden relative to competitors in regions with established emissions trading systems.

3.3 EU Imports from Nigeria and CBAM-Relevant Trade Flows

The European Union, one of Nigeria's biggest trading partners, worth over US$20.2 billion in 2025, has experienced volatility in EU imports from Nigeria over the past decade due to oil price fluctuations, exchange rate volatility, the COVID-19 pandemic, and changing geopolitical conditions. The European

Union (EU), one of Nigeria's biggest trading partners, is projected to hit over US$20.2 billion in 2025. The instability in EU imports from Nigeria over the past decade has been largely driven by fluctuations in oil prices, exchange rates, COVID-19 pressures and changing geopolitical developments. Nigeria-EU trade relations are increasingly dominated by carbon-intensive manufactured export data. Nevertheless, crude oil is losing its dominance, with CBAM-sensitive products like fertilizers, aluminum, and industrial metals growing in importance.

Table 1
EU Imports from Nigeria (2015–2025)

Year	EU Imports from Nigeria	Major Nigerian Exports	CBAM-Relevant Sectors
2015	US$18–20 billion	Crude oil, LNG, agriculture	Minimal exposure
2016	US$14–16 billion	Oil exports declined	Limited industrial exports
2017	US$20–22 billion	Energy export recovery	Iron & steel emerging
2018	US$24–26 billion	Mineral fuels dominant	Aluminum and fertilizers increased
2019	US$23–25 billion	Oil, fertilizers, chemicals	Iron, steel, aluminum
2020	US$13–15 billion	COVID-19 disruptions	Manufacturing weakened
2021	US$18–20 billion	Post-pandemic recovery	Fertilizer and metals expanded
2022	US$28–30 billion	Energy exports surged	Increased CBAM-sensitive imports
2023	US$22–24 billion	Oil, fertilizers, industrial inputs	Aluminum and steel exposure rose
2024	US$19–21 billion	Diversification efforts	CBAM reporting intensified
2025	US$20.2 billion	Oil, fertilizers, machinery	Direct CBAM exposure increased

Source: Eurostat (2025**); UN COMTRADE (2025);** Trading Economics (2025**).**

3.2 Sector-Specific Impacts of CBAM

Table 2
Sector-Specific Impacts of CBAM on Nigeria's Manufacturing Sector

Sector	CBAM Impact	Compliance Strategies	Policy Measures
Steel and Aluminum	High	Energy efficiency and cleaner technologies	EU technical support and climate finance
Cement and Fertilizers	High	Carbon accounting and emissions reduction	Domestic carbon pricing mechanisms
Electricity	Moderate to High	Renewable energy integration	Green infrastructure investment
Author's Compilation			

The steel, aluminium, and fertiliser sectors are at increased risk due to CBAM, given their energy-intensive production processes and heavy reliance on fossil fuels. Conformity would probably require substantial investment in energy efficiency, renewables, and emissions-reduction or removal technologies. Exporters that do not upgrade technologically and install reliable emissions-reporting systems will lose competitiveness when the EU implements regulations against them.

4. Policy Implications for Industrial Competitiveness and Green Transition

The EU Carbon Border Adjustment Mechanism (CBAM) has significant implications for Nigeria's industrial competitiveness, trade performance, and green transition pathway.

5. Policy Recommendations

Several policy measures are necessary to mitigate the adverse impacts of CBAM and strengthen Nigeria's industrial competitiveness.

6. Conclusion

The European Union's Carbon Border Adjustment Mechanism (CBAM) is an important step in climate and trade policy. It aims to stop carbon leakage and encourage global decarbonization. Nigeria's manufacturing sector faces major challenges, especially because it relies on fossil fuels, lacks robust carbon accounting, and has limited technological capacity. These issues are even more serious in energy-intensive industries such as steel, aluminium, and fertilisers.

CBAM could help drive green change in the industry by encouraging the use of renewable energy, supporting upgrades, and strengthening environmental regulations. How well CBAM works in Nigeria will depend on local reforms and support from other countries.

This study examines the European Union's Carbon Border Adjustment Mechanism (CBAM) and its implications for Nigeria's manufacturing sector. With CBAM changing trade rules, entering large markets will depend more on the carbon content of exported goods. This means that exports to the European Union will rely more on the sustainability of production processes.

To stay competitive in the European Union market, Nigerian manufacturers need to use energy more efficiently, switch to cleaner technologies, and improve carbon reporting. Policymakers should help by investing in renewable energy, improving monitoring, and making policies that support low-carbon production.

In short, CBAM is not just a trade challenge but also a chance to drive industrial change. Although it may put more pressure on sectors that use large amounts of carbon, it also offers Nigeria an opportunity to build a stronger, more competitive manufacturing sector for the future

Declarations

7.1 Ethics, Consent to Participate, and Consent to Publish declarations

Ethics, consent to participate, and consent to publish declarations: not applicable.

7.2 Funding

Declaration

There was no funding for this research.

Author Contribution

K.S. and G. contributed equally to the development of this manuscript. Both authors were involved in the conceptualization of the study and conducted the comprehensive literature review. They performed the data analysis and interpretation, and jointly drafted and revised the manuscript. All authors contributed to the critical review and refinement of the paper, ensuring coherence and rigor across all sections from the introduction to the conclusion. All authors have read and approved the final version of the manuscript.

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Figures

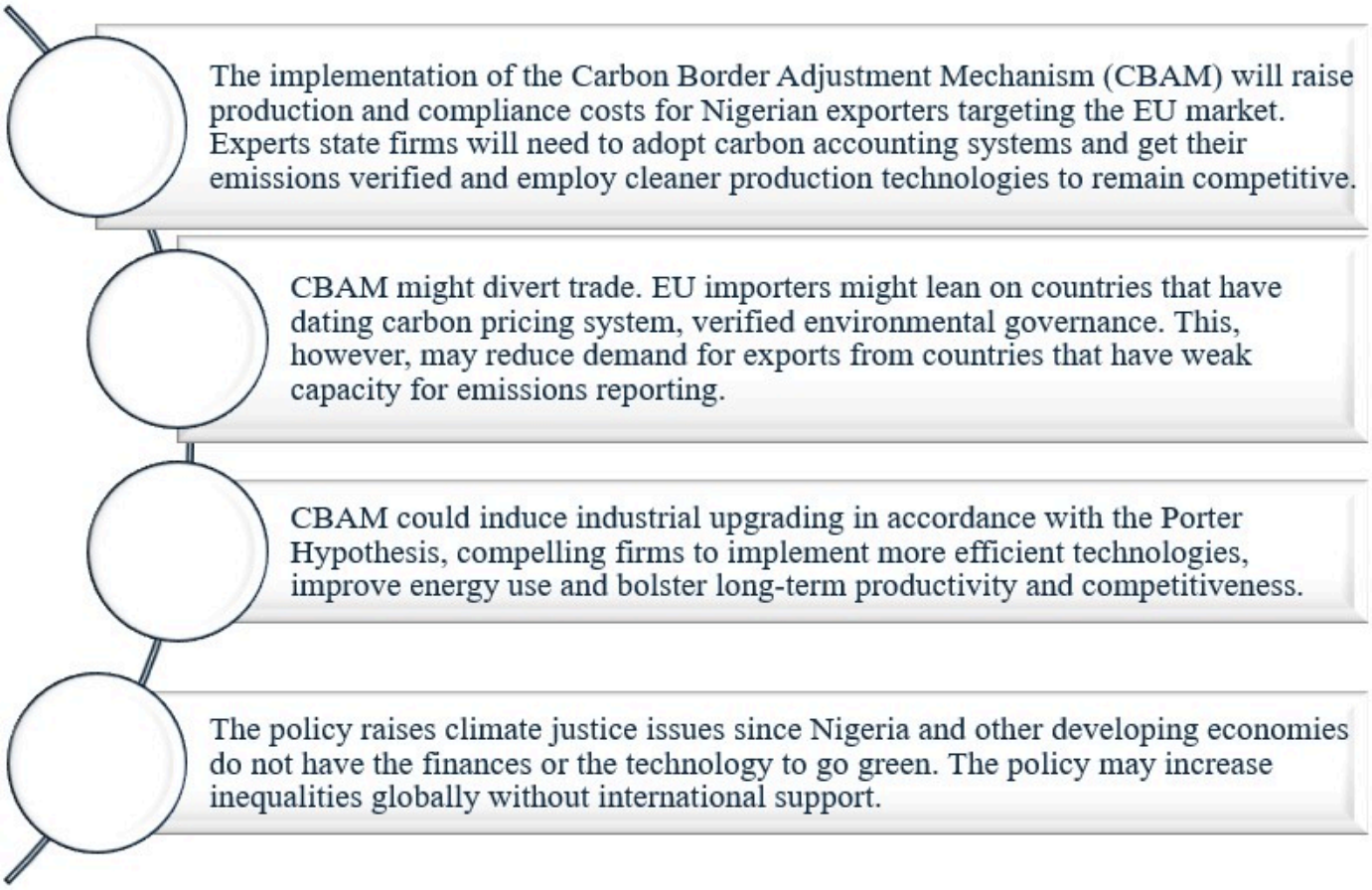


Figure 1

Unnumbered image in the **Policy Implications for Industrial Competitiveness and Green Transition** section.

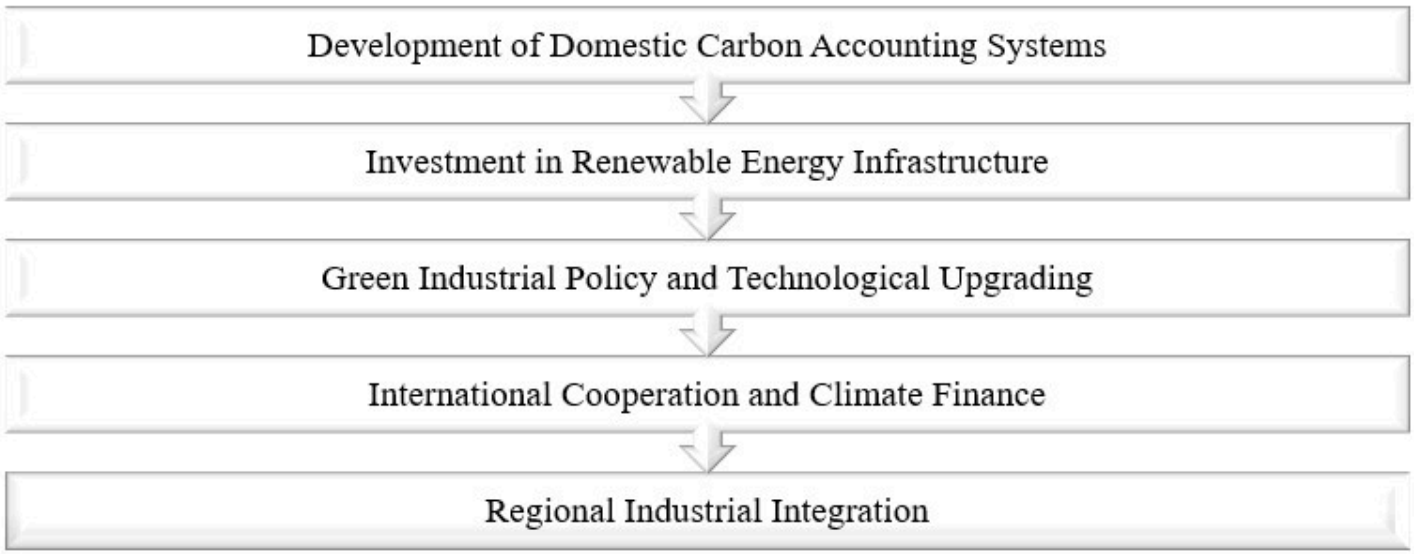


Figure 2

Unnumbered image in the **Policy Recommendations** section.

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