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Navigating Dual Carbon Pressures: Impacts of China's National ETS and the EU CBAM on the Cement and Aluminum Sectors

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Abstract. As global climate change intensifies, countries around the world are adopting measures to reduce greenhouse gas emissions. With the European Union's Carbon Border Adjustment Mechanism (CBAM) scheduled for full implementation in 2026, China's energy-intensive industries-particularly cement and aluminum-will face significant challenges under the dual pressure of domestic and international carbon-pricing mechanisms. This study examines the impacts of China's Emissions Trading System (ETS) and the EU's CBAM on the cement and aluminum sectors. Exploring this issue helps clarify how these mechanisms influence firms' operating costs, competitiveness, and low-carbon transitions, while also offering policy and strategic responses to advance global green and low-carbon development. Since 2004, China has gradually built a comprehensive emissions-trading framework, evolving from its participation in the Clean Development Mechanism to regional pilot programs and ultimately to a unified national market. Existing research indicates that carbon markets can effectively reduce abatement costs through market mechanisms. However, the suitability of different allowance-allocation methods-such as historical emissions-based allocation and benchmark-based allocation-varies across industries like cement and aluminum, making industry-specific optimization essential. Meanwhile, the introduction of the EU's CBAM provides new perspectives for global carbon governance but also affects China's cement and aluminum industries in terms of export costs, market competitiveness, and pathways for industrial transformation. Confronted with dual domestic and international pressures, China's cement and aluminum sectors must enhance their competitiveness through technological innovation, energy-structure optimization, and improved carbon data management, thereby transforming challenges into opportunities for upgrading and transition.

Keywords: Carbon Border Adjustment Mechanism (CBAM), China's Emissions Trading System (ETS), cement, aluminum

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1. Introduction

Climate change is one of the most pressing global challenges of our time. Excessive greenhouse gas emissions have driven rising global temperatures, sea-level rise, and more frequent extreme weather events, posing severe threats to human survival and development. In response, the international community reached the Paris Agreement, committing to limiting the increase in global average temperature to well below 2°C above pre-industrial levels, while pursuing efforts to limit it to 1.5°C. In September 2020, during the General Debate of the 75th Session of the United Nations General Assembly, President Xi Jinping announced that China would enhance its Nationally Determined Contributions (NDCs), implement more ambitious policies and measures, aim to peak carbon dioxide emissions before 2030, and achieve carbon neutrality by 2060.

Europe has long been a pioneer in climate policy innovation, consistently leading the world in regulatory design and market-based experimentation, and offering valuable models for global sustainable development. In 2022, the European Union became the first jurisdiction globally to introduce the Carbon Border Adjustment Mechanism (CBAM). The mechanism entered its transitional phase in October 2023 and is scheduled for full implementation in January 2026. The core objectives of CBAM are to prevent carbon leakage, promote global emissions reductions, enhance the integrity of the EU carbon market, and preserve the competitiveness of domestic industries. Its implementation is expected to significantly raise compliance costs of China's export products, elevating the financial burden on firms. The impact will be particularly pronounced for exporters of energy-intensive products-such as steel, cement, and aluminum-because these sectors fall squarely within CBAM's primary scope of taxation.

In March 2025, China's Ministry of Ecology and Environment released the Work Plan for Including the Steel, Cement, and Aluminum Smelting Industries in the National Carbon Emissions Trading Market, officially expanding the national ETS coverage to these sectors. As an institutional arrangement that leverages market mechanisms to address climate change and promote green and low-carbon development, the carbon market strengthens emissions control and supports progress toward the "dual-carbon" goals. According to the Work Plan, carbon emissions regulated by the power sector-which is already included in the ETS-account for approximately 40% of China's total CO_2 emissions. With the addition of steel, cement, and aluminum smelting, an estimated 1,500 key emitters will enter the system, raising the ETS coverage to more than 60% of national emissions. As major high-emission industries, the steel, cement, and aluminum sectors are characterized by substantial emissions volumes, high emissions intensity, and strong carbon lock-in effects. Including these industries in the national ETS will not only facilitate progress toward national carbon targets but also help eliminate outdated production capacity and promote innovation and application of low-carbon technologies, steering these sectors toward low-carbon competitiveness.

This study focuses on the cement and aluminum industries, examining in depth the impacts of China's ETS and the CBAM on these sectors, and proposing corresponding strategic responses. The structure of this paper is as follows: Section 2 provides an overview of the design and implementation of China's ETS, with particular attention to allowance-allocation mechanisms in the cement and aluminum industries; Section 3 explains the operation of the EU's CBAM and analyzes its implications for Chinese exporters; Section 4 outlines firm-level and policy-level strategies for coping with dual domestic and international pressures. The paper concludes by offering policy recommendations and reflecting on the future trajectory of global carbon governance.

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2. Understanding China's national emissions trading system

2.1. Overview of the national ETS

2.1.1. Historical development and institutional evolution

The development of China's carbon market has unfolded in three stages. The first stage was the policy preparation phase, marked by the issuance of the Measures for the Operation and Management of Clean Development Mechanism Projects in October 2005. The second stage was the regional pilot phase. In October 2011, the General Office of the National Development and Reform Commission released the Notice on Launching the Carbon Emissions Trading Pilot announcing that seven provinces and municipalities-including Beijing and Shenzhen-would take the lead in piloting carbon-market transactions. The third stage was the development of the national carbon market. In July 2021, the national ETS was officially launched, with key emitters in the power-generation sector included in the first batch-signifying China's transition from regional pilots to a unified national market [1,2]. In May 2024, the Interim Regulations on the Administration of Carbon Emissions Trading came into effect, formally establishing the institutional framework of the ETS. In March 2025, the Ministry of Ecology and Environment issued the Work Plan for Including the Steel, Cement, and Aluminum Smelting Industries in the National Carbon Emissions Trading Market, marking the first expansion of sectoral coverage and the official start of its implementation.

2.1.2. Basic concepts of the emissions trading system

Carbon emissions refer to greenhouse gas emissions generated by activities such as the combustion of fossil fuels (including coal, oil, and natural gas) and industrial production processes, as well as emissions associated with the use of purchased electricity and heat. A carbon emission allowance is the quota allocated to an emitting entity, permitting a certain volume of emissions within a designated period. Emissions trading is a market-based mechanism designed to control and reduce greenhouse gas emissions and promote green, low-carbon development. As a key policy instrument for achieving carbon peaking and carbon neutrality, an ETS operates by setting a cap on total emissions and dividing that cap into discrete units of emission allowances, which are then allocated or auctioned to enterprises, as shown in Figure 1. Through this system, carbon emissions are priced via market mechanisms, effectively converting greenhouse gas emissions into part of a company's operating costs. Government agencies or designated institutions determine the maximum amount of emissions allowed within a specific region or industry over a given period. This total is divided into a certain number of allowances and distributed to relevant firms or entities [3]. If a firm's actual emissions fall below its allocated allowances, it may sell the surplus to firms that exceed their limits. Conversely, if a firm emits more than its allowances permit, it must purchase additional allowances to ensure compliance. This mechanism encourages firms with low abatement costs to reduce emissions as much as possible, while those with higher abatement costs may opt to purchase allowances-achieving overall emission-reduction targets at the lowest possible cost across the entire market.

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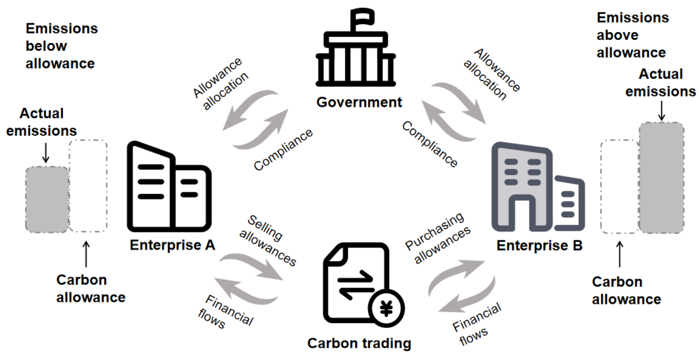

Figure 1. Emissions trading mechanism

2.2. Allowance allocation: historical method vs. benchmark method

The allocation of carbon allowances in China's ETS is primarily based on free allocation, with two main methods used to calculate free quotas: the historical method and the benchmark method. The historical method allocates allowances according to an enterprise's past emissions levels, whereas the benchmark method determines allowances based on the product-level emission intensity characteristic of the relevant industry [4]. A comparison of the two approaches is presented in Table 1.

Table 1. Comparison of two allocation methods

Item	Historical Method (Grandfathering)	Benchmark Method
Definition	Allocates allowances based on an enterprise's historical carbon emissions during a defined period.	Allocates allowances based on product-level emission intensity data for the relevant industry.
Advantages	Simple accounting and easy to implement; facilitates calculation of total industry-wide emissions reductions.	Promotes fairer industry-level allocation; incentivizes firms to improve production efficiency and reduce emissions; enhances firms' motivation for low-carbon production.
Disadvantages	Low-emission firms receive fewer allowances, while high-emission firms receive more, reducing overall abatement efficiency.	May exert excessive short-term pressure on high-emission firms, risking "forced over-adjustment" ,which could hinder steady industry-wide improvement.
Incentive Effect	Weak (encourages maintaining the status quo)	Strong (encourages technological upgrading)
Fairness	Protects inefficient firms; new entrants lack historical data, making fair allocation difficult.	Rewards efficient firms; allocation linked directly to current output, adapting automatically to economic fluctuations and reflecting real emission needs.
Data Requirements	Easy in early stages	Requires precise, high-quality data
Main Applicable Scenarios	More appropriate in the early stage of carbon-market development, when data foundations are weak and industry conditions vary significantly.	Suitable for mature carbon markets with strong data foundations; particularly effective for standardized industrial sectors such as power, cement, and steel.

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2.3. Sector-specific benchmarks: cement and aluminum

2.3.1. Cement sector

The production of cement as shown in figure 2 involves three major stages: raw material extraction and grinding, clinker calcination, and cement grinding. The associated carbon emissions arise from three main sources: (1) fuel combustion emissions, (2) process emissions, and (3) electricity-related indirect emissions. Fuel combustion emissions stem from the burning of coal, waste materials, and other fuels. Process emissions come from the release of CO_2 during limestone calcination at high temperatures. Electricity-related indirect emissions originate from power consumption across mechanical processes such as cooling, grinding, and homogenization. The approximate shares of each emission source are: 35% fuel combustion, 60% process emissions, and 5% electricity-related indirect emissions [5].

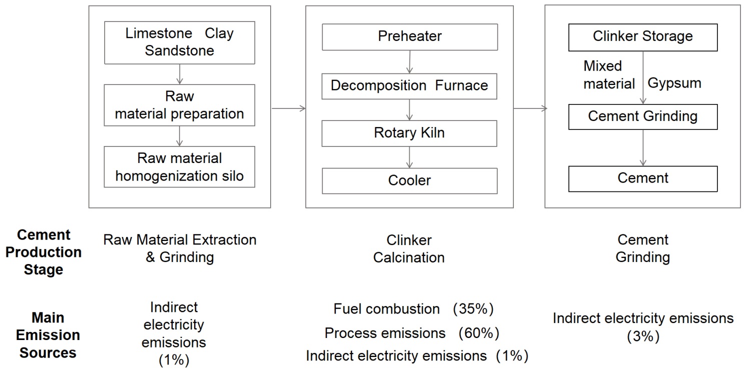

Figure 2. Stages of cement production

The benchmark method for the cement industry is based on product-level carbon intensity metrics, which establish unified benchmark values for allowance allocation. Its core mechanism is quantifying emission-reduction requirements through standardized “carbon intensity per unit of product”, thereby promoting energy-efficiency improvements and low-carbon transformation across the sector. Benchmark setting relies on key parameters such as clinker output and energy-consumption levels, covering major emission sources including fuel combustion, process emissions, and electricity-related indirect emissions. Since different kiln technologies vary significantly in energy efficiency, differentiated benchmarks are used: New dry-process kilns, which represent mainstream advanced technology, receive benchmarks that incorporate factors such as waste-heat recovery and alternative fuel use. Enterprises can earn lower benchmark intensities through technological optimization. Shaft kilns and other outdated technologies face stricter benchmarks due to higher energy consumption and carbon intensity. Such enterprises must undergo technological upgrades (e.g., transition to new dry-process kilns) or reduce output to meet benchmark requirements; otherwise, they incur high costs from purchasing additional allowances. Benchmarking thus provides dynamic incentives: allocation is linked to current output and adjusts automatically with production changes. It also encourages adoption of alternative fuels, green energy, and other low-carbon technologies, enabling firms to reduce actual emission intensity and narrow potential allowance deficits [6].

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2.3.2. Aluminum smelting sector

The aluminum industry comprises primary aluminum production, recycled aluminum, aluminum processing, and manufacturing. Among these, primary aluminum (electrolytic aluminum) production is the most energy-intensive, accounting for over 70% of total energy consumption in the aluminum sector [7]. The benchmark method for aluminum is based on sector-wide energy-consumption and carbon-emission data. It sets a “carbon-intensity benchmark per ton of electrolytic aluminum” , with the goal of enhancing energy efficiency, promoting clean-energy substitution, and driving technological innovation.

Current benchmark values are approximately 13,300 kWh per ton of aluminum [8]. Because China’s electrolytic aluminum producers differ significantly in their electricity sources, benchmarking produces a “reward the efficient, penalize the inefficient” effect: Hydropower-based aluminum producers in regions such as Yunnan and Sichuan have much lower actual emissions due to clean electricity. Their carbon intensity is typically below the benchmark, allowing them to sell surplus allowances and generate revenue. Coal-powered aluminum producers in regions such as Shandong and Xinjiang must strictly control electricity consumption per ton of aluminum. If actual electricity use exceeds the benchmark, they must purchase additional allowances to cover the excess [9]. The benchmark system also promotes structural upgrading by encouraging: broader adoption of clean-energy pathways (e.g., expanding hydropower-based production), technological innovation (e.g., development of inert-anode technology), and continuous process optimization. Together, these measures guide aluminum enterprises toward proactive, long-term emission reductions.

2.4. Challenges and implications

2.4.1. Difficulties in data monitoring (underdeveloped MRV system)

As a core component of carbon-trading implementation, the MRV mechanism refers to the processes of quantifying carbon emissions and ensuring data quality. It encompasses three sub-processes-monitoring, reporting, and verification-and involves regulatory authorities, emission-controlled enterprises, and third-party verification agencies. The purpose of the MRV system is to ensure that the carbon emission data reported by enterprises are accurate, complete, consistent, and transparent, thereby providing a reliable basis for quota allocation, trading, and compliance. At present, the cement and aluminum industries still face several issues within their MRV systems, including the lack of unified carbon-accounting standards, insufficient accuracy of monitoring equipment, and underdeveloped verification and regulatory frameworks. These problems hinder the allocation of carbon quotas and the fulfillment of compliance obligations [10].

2.4.2. Rising corporate compliance costs

Given the ongoing imperfections of the MRV system, enterprises must invest substantial resources to build comprehensive monitoring, reporting, and verification capabilities to ensure data accuracy. This includes installing metering equipment, establishing data-management systems, and hiring third-party verification agencies-all of which increase managerial and operational costs. Within the carbon-emissions trading framework, emission-controlled enterprises may also need to purchase additional allowances due to quota constraints or bear penalties for failing to meet compliance requirements, further raising their production costs.

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2.4.3. Shifts in industry competition patterns

In regions where cement is included in the carbon market, local enterprises may raise product prices due to increasing carbon-related costs. In contrast, regions where cement is not covered by the carbon market maintain relatively lower prices and stronger competitiveness, potentially enabling them to capture additional market share. This may further exacerbate regional imbalances in industrial development. China's electrolytic aluminum production is gradually shifting toward provinces rich in hydropower resources, such as Yunnan and Sichuan. These "hydropower-based aluminum" enterprises benefit from inherently lower carbon costs and thus enjoy a natural competitive advantage in the carbon market. Conversely, "thermal-power-based aluminum" enterprises in regions such as Shandong and Xinjiang face growing operational pressure and even potential "survival crises".

3. The dual squeeze: comparative analysis and enterprise responses

3.1. The CBAM mechanism

CBAM is a trade-policy instrument launched to address "carbon leakage"-a phenomenon in which stringent carbon policies drive high-emission industries to relocate to regions with looser carbon constraints. By imposing carbon tariffs on imported carbon-intensive products, CBAM aims to equalize carbon costs between EU and non-EU producers and thereby promote a global shift toward low-carbon development.

In its initial phase, CBAM covers six sectors: steel, aluminum, cement, fertilizers, electricity, and hydrogen. The period from October 2023 to December 2025 serves as the transitional phase during which stakeholders are only required to submit emissions reports and are not obliged to pay carbon tariffs. Starting 1 January 2026, the mechanism will be fully implemented. Importers will need to purchase CBAM certificates to offset the embedded carbon emissions of imported products, and the certificate price will be directly linked to the carbon price under the EU Emissions Trading System (EU ETS). The emissions accounting boundary includes both direct and indirect emissions from production, though indirect emissions remain exempt from charges during the transition period.

3.2. Impacts of CBAM on the cement and aluminum industries

The impacts of CBAM on the cement and aluminum sectors are primarily reflected in three dimensions: export costs, market competition, and industrial transformation.

3.2.1. Increased export costs

Assume that a Chinese cement company exports cement at approximately RMB 400/ton, with a production cost of about RMB 187/ton, and an emissions intensity of roughly 0.8 tCO_2 per ton of cement.

Assume also that a Chinese aluminum company exports aluminum at around RMB 24,000/ton, with a production cost of RMB 11,000/ton. Producing one ton of electrolytic aluminum generates around 13 tCO_2 when powered by the coal-based national grid.

Given that the carbon price in China is about RMB 60/tCO_2 and the EU carbon price is roughly EUR 80/tCO_2 (exchange rate ≈ 1:8), the cost differences can be calculated as follows.

Without CBMA, the profit of cement/aluminum of a Chinese manufacturer can be calculate by the following equations.

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$$C_{Carbon} = I_{carbon} \times P_{carbon} \quad (1)$$

Where, C_{carbon} is the cost of carbon emission for cement/aluminum, RMB/ton; I_{carbon} is the carbon emission intensity during the production process, t $CO_{2\text{-eq}}$/ton; P_{carbon} is the carbon trading price in China, RMB/ton $CO_{2\text{-eq}}$.

The total cost of cement/aluminum production is calculated by the following equation.

$$C_{total} = C_{production} + C_{carbon} \quad (2)$$

Where, C_{total} is the total cost of cement/aluminum production, RMB/ton; $C_{production}$ is costs excluding carbon cost, RMB/ton.

The profit from exporting is calculated by the following equation.

$$P = R - C_{total} \quad (3)$$

Where, P is the profit from exporting, RMB/ton; R is the revenue from exporting, RMB/ton.

After the implementation of the CBAM mechanism, the profit of exporting can be calculated by the following equations.

$$C_{Carbon-CBAM} = I_{carbon} \times P_{carbon-CBAM} \times E \quad (4)$$

Where, $C_{carbon\text{-}CBAM}$ is the cost of carbon emission for cement/aluminum under CBAM mechanism, RMB/ton; $P_{carbon\text{-}CBAM}$ is the price of carbon in EU, €/ton $CO_{2\text{-eq}}$; E is the exchange rate between Euro and RMB, RMB/Euro.

The total cost of cement/aluminum production under CBAM mechanism is calculated by the following equation.

$$C_{total-CBAM} = C_{production} + C_{carbon-CBAM} \quad (5)$$

Where, $C_{total\text{-}CBAM}$ is the total cost of cement/aluminum production under CBAM mechanism, RMB/ton.

The profit from exporting is calculated by the following equation.

$$P_{CBAM} = R - C_{total-CBAM} \quad (6)$$

Where, P_{CBAM} is the profit from exporting under CBAM mechanism, RMB/ton; R is the revenue from exporting, RMB/ton.

The comparison of profits without CBAM and with CBAM mechanism is shown in Table 2 and 3.

Table 2. Comparison of cement enterprise costs before and after CBAM implementation

Items	Without CBAM mechanism	With CBAM mechanism
RMB/ton Cement	400	400
Ccarbon(RMB/ton)	48	512
Ctotal(RMB/ton)	235	699
Profit(RMB/ton)	165	-299

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Table 3. Comparison of aluminum enterprise costs before and after CBAM implementation

Items	Without CBAM mechanism	With CBAM mechanism
RMB/ton aluminum	24000	24000
Ccarbon(RMB/ton)	780	8320
Ctotal(RMB/ton)	11780	19320
Profit(RMB/ton)	12220	4680

Thus, if an aluminum exporter relies on coal-based electricity and ships products to the EU market, the overall cost is projected to rise to RMB 19,320/ton-an increase of RMB 7,540 per ton compared with the pre-CBAM scenario. Net profit would fall to RMB 4,680/ton, which is only 38% of the previous level. For cement enterprises exporting to the EU, total costs would rise to RMB 699/ton after CBAM implementation, representing an increase of RMB 464 per ton-equivalent to a 97% surge-eliminating any remaining profit margin.

3.2.2. Intensified market competition

Following CBAM implementation, EU importers are highly likely to prioritize low-carbon aluminum products (such as hydropower-based aluminum from Norway). Chinese aluminum companies that fail to achieve low-carbon transformation risk losing export market share. Similarly, the price competitiveness of Chinese cement in the EU market will be significantly weakened by CBAM-related charges [11].

3.2.3. Pressure for industrial transformation

Chinese aluminum producers must accelerate the shift of production capacity to hydropower-rich regions such as Yunnan and Sichuan, or invest in building their own photovoltaic and wind power facilities to reduce reliance on externally purchased coal-based electricity. At the same time, enterprises need to actively develop low-carbon technologies such as inert anodes and next-generation electrolysis cells to support industrial upgrading. For Chinese cement producers, rapid decarbonization through energy substitution (e.g., using green electricity) is difficult. Instead, they must rely on carbon capture and utilization (CCUS) technologies or adopt alternative raw materials to decrease limestone consumption. However, the short-term costs of deploying such technologies remain high.

In summary, once CBAM is formally implemented in 2026, the cement and aluminum industries will face a dual squeeze: the internal pressure imposed by China's domestic ETS and the external pressure resulting from CBAM. The internal pressure reflects a "pressure to survive and develop" , requiring enterprises to reduce costs and maintain compliance to avoid being eliminated. The external pressure represents a "pressure to participate or withdraw", compelling enterprises to evaluate whether they can remain competitive in the EU market and retain their share.

4. Policy implications

Confronted with the dual pressures of China's Emissions Trading System (ETS) and the European Union's Carbon Border Adjustment Mechanism (CBAM), China's cement and aluminum industries must adopt a systematic and multi-level set of strategies to transform these challenges into

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opportunities for industrial upgrading. The following recommendations outline the necessary pathways for enterprise-level, industry-level, and government-level responses.

4.1. Strengthening core enterprise capabilities

4.1.1. Promoting technological innovation and process upgrading

Enterprises should actively advance technological innovation to reduce carbon emissions per unit of output. Cement enterprises may substitute biomass fuels and solid waste for coal to reduce combustion-related emissions. They should also increase investment in waste heat and pressure recovery technologies to improve energy efficiency. Aluminum enterprises can optimize electrolytic cell operation to lower the anode effect coefficient and reduce emissions of perfluorocarbons and other non-CO_2 greenhouse gases. In addition, they should accelerate R&D on inert anode technologies and vigorously develop the recycled aluminum sector.

4.1.2. Establishing a robust carbon data management system

Enterprises should build internationally recognized monitoring, reporting, and verification (MRV) systems to ensure the accuracy, transparency, and traceability of carbon emissions data. Strengthening carbon data management capabilities-through professional teams or external experts-is essential for coping with the complexity of CBAM compliance and reporting requirements. Modern information technologies should be leveraged to achieve real-time monitoring, dynamic updates, and transparent disclosure of carbon emissions data.

4.1.3. Optimizing the energy structure

Increasing the share of green energy is critical for reducing greenhouse gas emissions. Enterprises may promote low-carbon transformation by installing on-site photovoltaic projects, purchasing hydropower or wind power, and relocating production capacity to regions such as Yunnan and Sichuan where renewable energy resources are abundant.

4.2. Enhancing industry-wide synergies

4.2.1. Developing standards and guidelines

Industry associations, leading enterprises, and research institutions should collaborate to establish unified standards for carbon footprint accounting. Based on industry-specific production processes, clear pathways for energy conservation and emission reduction should be developed, along with best-practice cases to guide enterprises in technological upgrading and management optimization. A dynamic mechanism for updating standards should be established to revise relevant guidelines regularly in response to policy changes, technological progress, and evolving industry needs. This will enhance the sector’s ability to respond to external policy challenges such as carbon tariffs.

4.2.2. Building platforms for communication and knowledge sharing

Stakeholders-including enterprises, research institutions, and industry associations-should jointly establish information-sharing databases integrating green technology cases, emission reduction data, and policy interpretations. Technical exchange forums, policy briefings, and carbon accounting

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training sessions should be organized to strengthen cooperation along the entire industry chain and promote the formation of a collaborative low-carbon development ecosystem.

4.2.3. Strengthening participation in international climate governance

Domestic enterprises should be encouraged to engage in international standard-setting processes in order to promote fair global carbon reduction rules. Efforts should be made to advocate for favorable arrangements such as mutual recognition of carbon pricing between China and the EU to avoid double taxation and ensure a fair competitive environment for Chinese industries in global markets.

4.3. Creating an enabling policy environment

4.3.1. Improving the domestic carbon market system

Carbon allowances should be allocated in a scientifically sound and equitable manner, with allocation schemes designed to balance fairness and incentives for emission reduction in the cement and aluminum industries. China should gradually introduce more trading products and diversify trading mechanisms to ensure that carbon prices better reflect actual abatement costs, thereby improving market liquidity and efficiency [12].

4.3.2. Strengthening carbon data regulation

The integration of MRV mechanisms with blockchain technologies should be promoted to ensure the authenticity and credibility of carbon emissions data. This will provide reliable support in potential data-related disputes arising under the CBAM framework.

4.3.3. Deepening international cooperation on low-carbon development

China should maintain close dialogue with the EU on key aspects of CBAM-such as benchmark setting and exemption clauses-and work toward establishing a mutually recognized bilateral carbon accounting system. In parallel, China should strengthen cooperation with emerging economies such as Russia and Brazil, and leverage frameworks like the Belt and Road Initiative to advance the construction of a “Green Silk Road”.

5. Conclusion

At present, China’s ETS and the European Union’s CBAM exert dual pressures on China’s cement and aluminum industries. The internal pressure stems from the domestic ETS, while the external pressure originates from the EU’s CBAM. This study provides an in-depth analysis of how both mechanisms influence enterprise operations and broader industry development, and proposes a set of systemic response strategies. Enterprises should enhance their competitiveness through technological innovation, energy structure optimization, and robust carbon data management. At the industry level, coordinated efforts are needed to develop unified standards and guidelines. At the policy level, the government must continue to refine the regulatory environment to enable effective carbon market functioning. As China’s carbon market further matures and CBAM moves toward full implementation, the cement and aluminum industries must accelerate technological upgrading and deepen international cooperation. By doing so, they can strengthen their position in global carbon governance while exploring more pathways toward green and low-carbon development.

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