Adapting to Global Carbon Policies: Economic Impact of Carbon Border Adjustment Mechanism on Indian Businesses

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OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada.
ISSN 1923-6654 (print) ISSN 1923-6662 (online) www.oidaijsd.com
Also available at https://www.ssrn.com/index.cfm/en/oida-intl-journal-sustainable-dev/

Abstract: This paper analyses the impact of global carbon policies through the lens of the European Union's Carbon Border Adjustment Mechanism (CBAM) and its implications for Indian industries, particularly in carbon-intensive sectors such as steel, cement, and aluminium. Imposition of carbon tariffs on imported goods has placed an additional economic pressure on Indian exporters, potentially undermining their trade competitiveness. This study examines the economic effects of CBAM, focusing on the tax burden and its impact on Indian businesses. Furthermore, it explores emissions reduction strategies, such as investing in cleaner technologies and improving energy efficiency. The paper also underscores the importance of developing a robust domestic carbon market in India to align industries with global carbon regulations and enhance their resilience in the face of evolving international climate commitments.

Key words: Carbon Border Adjustment Mechanism (CBAM), carbon emissions, carbon pricing, energy, industries

Carbon Pricing

Carbon pricing is a market-based strategy designed to reduce greenhouse gas (GHG) emissions by assigning a monetary value to the release of carbon dioxide (CO_2) and other GHGs. By placing a cost on carbon emissions, it makes emitting GHGs more expensive, encouraging businesses and consumers to adopt cleaner, more sustainable practices (World Bank, 2021; OECD, 2019). The goal is to reflect the true environmental cost of emissions, creating a financial incentive for industries to innovate and reduce their carbon footprint (Basu et.al, 2024; OECD, 2019).

Mechanisms of Carbon Pricing

There are two primary approaches to carbon pricing:

1. **Carbon Taxes**: A government-imposed tax is levied on every ton of CO_2 emitted, directly charging the polluter for their emissions (OECD, 2019). This tax is generally fixed, meaning companies must either adjust their operations to reduce emissions or bear the financial burden of the tax. The carbon tax provides a clear price signal, pushing industries to integrate emission reduction strategies into their business models (EY & Shakti Sustainable Energy Foundation, 2018).
2. **Emissions Trading Systems (ETS)**: Commonly known as cap-and-trade, ETS establishes a cap on the total emissions allowed across certain industries or sectors. Companies receive allowances that permit a specific amount of emissions. These allowances can be traded in a carbon market, enabling firms that exceed their emission limits to buy additional allowances, while those that emit less can sell their surplus allowances (European Commission, 2020).

Importance of Carbon Pricing

Carbon pricing plays a critical role in addressing climate change by internalizing the environmental costs of emissions. The core benefits include:

- **Internalizing Environmental Costs**: Without carbon pricing, the broader social and environmental costs of carbon emissions, such as climate change, health issues, and ecosystem degradation, are not accounted for in market transactions (World Bank, 2021; OECD, 2019).
- **Market Efficiency**: By attaching a financial cost to emissions, carbon pricing allows market forces to determine the most efficient pathways to reduce pollution (OECD, 2019).
- **Encouraging Innovation**: The financial burden created by carbon pricing motivates businesses to invest in cleaner technologies, improve energy efficiency, and adopt low-carbon processes (World Bank, 2021).
- **Revenue Generation for Governments**: Carbon pricing mechanisms, such as carbon taxes and the auctioning of allowances in an ETS, can generate significant revenue for governments. These funds can be reinvested in renewable energy projects and climate mitigation efforts (European Commission, 2020).

Challenges of Implementing Carbon Pricing

Despite its benefits, implementing carbon pricing systems is not without challenges. Issues such as ensuring fair competition, preventing carbon leakage, and addressing the economic impact on fossil fuel-dependent industries have complicated the adoption and effectiveness of carbon pricing in many regions (OECD, 2019). India and European Union (EU) present two different approaches and subsequent results of Carbon Tax implementation.

Case 1: Carbon Tax in India

India's attempt at carbon pricing through a coal tax, introduced in 2010, exemplifies some of the challenges of implementing carbon pricing in a developing economy. The tax, initially set at INR 50/ MT coal, was aimed at reducing India's reliance on coal, which generates around 70% of the country's electricity (EY & Shakti Sustainable Energy Foundation, 2018). This initiative was unsuccessful due to following reasons for failure:

1. **Low Tax Rate**: The tax rate was not high enough to significantly influence coal consumption. Industries reliant on coal continued their operations without any significant changes (EY & Shakti Sustainable Energy Foundation, 2018).
2. **Revenue Misallocation**: A large portion of the tax revenue was diverted to other government projects unrelated to climate action (Qutubuddin, 2023).
3. **Huge Dependence on Coal**: India's energy sector is deeply reliant on coal, making it difficult to transition to cleaner alternatives (EY & Shakti Sustainable Energy Foundation, 2018)
4. **Economic Pressures**: India's developmental priorities made it politically difficult to raise carbon taxes without slowing economic growth. Economic growth took a precedence over environmental considerations (Qutubuddin, 2023).

The European Union (EU) Emissions Trading System (EU ETS)

The EU ETS, launched in 2005, is the world's largest carbon market and serves as the EU's flagship climate policy (European Commission, 2020). Covering more than 10,000 facilities across Europe, the EU ETS plays a central role in reducing GHG emissions. The mechanism operates under a cap-and-trade model, where a limit is set on the total amount of emissions permitted from sectors covered by the system. The cap decreases annually, ensuring a gradual reduction in overall emissions. Companies receive a certain number of emission allowances, either through free allocation (for industries vulnerable to international competition) or auctioning. Each allowance permits the emission of one ton of CO_2. Firms can buy or sell these allowances on the carbon market, depending on whether they exceed or fall short of their allowed emissions. At the end of each year, companies must surrender enough allowances to cover their emissions. If they fail to do so, they face hefty financial penalties, creating a powerful incentive for companies to stay within their allocated limits.

The EU ETS has been instrumental in reducing emissions across Europe. Since its inception, emissions from sectors covered by the system have decreased by nearly 40%. The price of carbon allowances, driven by market demand, has steadily risen, reaching over Euro 80/tonne in recent years, as shown in Figure 1. This rise has made emitting carbon increasingly expensive, pushing companies to adopt greener technologies and reduce their emissions (European Commission, 2022). Key reasons for the success of the EU ETS include:

1. **Cap-and-Trade Efficiency**: The system's gradually tightening cap on emissions ensures that total emissions decrease over time, while the trading mechanism allows companies to find the most cost-effective ways to reduce their emissions (European Commission, 2020).
2. **Market Flexibility**: The dynamic nature of the carbon market, with fluctuating prices based on supply and demand, allows companies to adapt their emission reduction strategies to market conditions, leading to more efficient outcomes (European Commission, 2020; Carbon Trust, n.d.).
3. **Global Impact**: The EU ETS has expanded its influence by linking with other carbon trading schemes, such as Switzerland's ETS, creating a broader market for emissions trading and amplifying its impact globally.

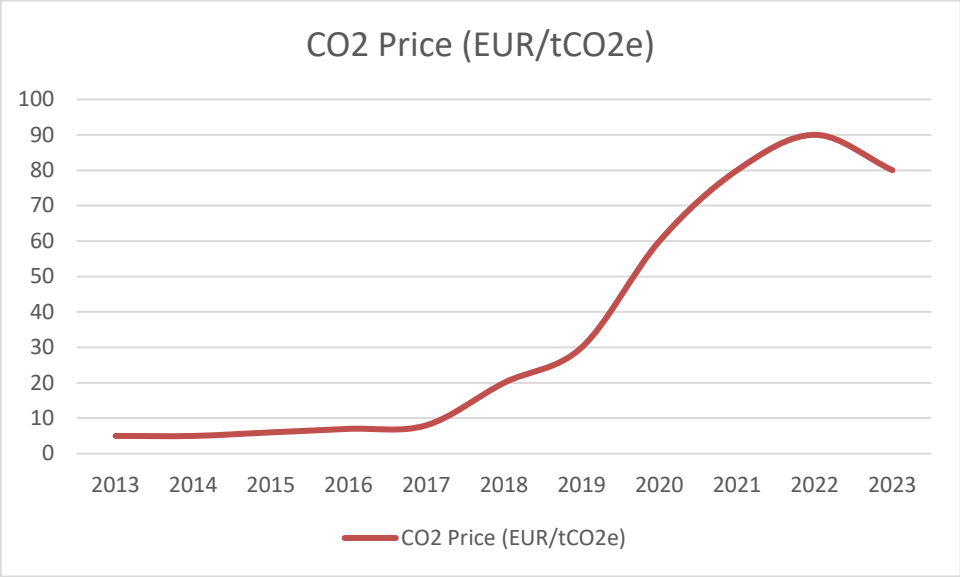

Figure 1: CO2 Pricing in EU ETS (Source: Trading Economics)

Carbon Border Adjustment Mechanism (CBAM)

The Carbon Border Adjustment Mechanism (CBAM) is a significant regulatory measure introduced by the European Union to address the issue of carbon leakage and ensure fair competition for EU industries subjected to the ETS. The underlying principle of CBAM is to impose a carbon price on imports of certain goods from countries that do not have comparable carbon pricing systems. By doing so, the EU seeks to prevent the relocation of industries to regions with lax environmental regulations while also protecting the competitiveness of European manufacturers in global markets.

Initially, CBAM targets highly carbon-intensive sectors such as steel, cement, aluminium, fertilizers, and electricity. These industries are not only critical to Europe's economy but also among the largest sources of greenhouse gas emissions globally. The mechanism applies a carbon price on imports of these goods based on the carbon content embedded in their production processes. This pricing ensures that foreign producers, whose countries lack stringent carbon pricing policies, are charged at the EU carbon price level, thereby levelling the playing field between EU manufacturers and their non-EU competitors (European Commission, 2022).

CBAM is being implemented in phases, beginning with a transitional period from 2023 to 2025 (Figure 2). During this phase, importers will have reporting obligations related to the carbon content of goods but will not yet be required to pay a financial adjustment. This phase is critical for gathering data, establishing administrative procedures, and allowing businesses time to adapt to the upcoming requirements. From 2026 onwards, importers will have to purchase CBAM certificates that correspond to the carbon price that would have been paid if the goods had been produced under the EU ETS (European Commission, 2020).

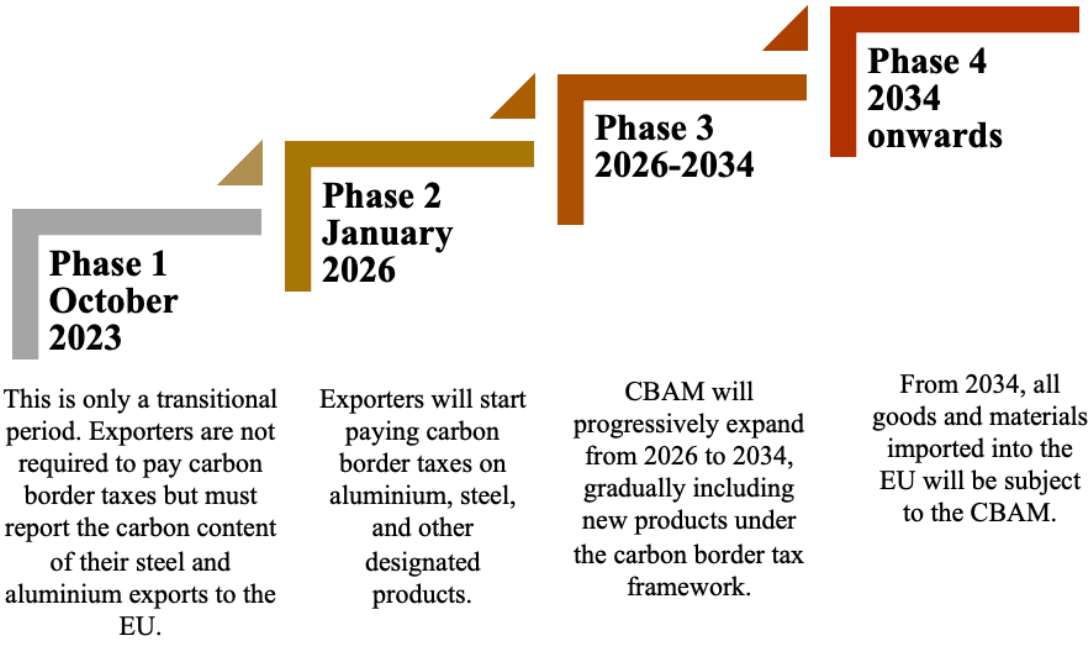

Figure 2: Implementation plan of CBAM (Source: European Commission 2022)

Addressing Carbon Leakage

One of the key motivations for CBAM is to tackle carbon leakage, which occurs when businesses relocate production to countries with weaker or no carbon pricing regulations, thereby undermining the EU's climate goals (World Bank, 2021). Without CBAM, energy-intensive sectors like steel, cement, and aluminium are particularly vulnerable, as the high costs associated with the EU ETS make their products less competitive in international markets (OECD, 2019). As a result, European manufacturers have increasingly faced competition from countries with less stringent environmental policies, leading to a decline in market share and, in some cases, the offshoring of production. By implementing CBAM, the EU ensures that imports from these countries reflect the same carbon costs faced by European producers, thus incentivizing foreign industries to adopt more sustainable practices.

Criticisms of CBAM

Despite its well-intentioned goals of reducing carbon leakage and promoting global climate action, CBAM has faced several criticisms, particularly from developing countries and trade partners:

1. **Protectionism Allegations**: One of the primary criticisms of CBAM is that it could be perceived as a tool of protectionism. Critics argue that the mechanism unfairly targets developing countries, such as India, which are still heavily reliant on fossil fuels to sustain their economic growth. These countries may view CBAM as a way for the EU to protect its industries under the guise of climate action while placing additional financial burdens on nations that are already grappling with development challenges (Srivastava, 2022; Tiwari, 2024; World Bank, 2021). This perception is exacerbated by the fact that many developing countries have not yet had the same opportunities or resources to transition to low-carbon economies.
2. **Trade Disputes**: CBAM has the potential to trigger trade tensions between the EU and its trading partners, particularly those most affected by the carbon tariffs. Countries that rely on exports to the EU might view the mechanism as an unjust trade barrier. This could lead to disputes at international trade forums, such as the World Trade Organization (WTO), where affected countries might challenge CBAM's compliance with free trade principles (Gupta et al., 2024; Tiwari, 2024). Nations like China and India have already expressed concerns about how the mechanism might impact their export competitiveness, potentially leading to retaliatory trade measures.

3. **Implementation Challenges**: The practical implementation of CBAM presents significant challenges, particularly when it comes to accurately measuring the carbon emissions associated with the production of imported goods. Since different countries have varying methodologies and capacities for tracking emissions, ensuring consistent and reliable data across borders could become a complex administrative burden for both importers and exporters. This complexity may further exacerbate costs for businesses in developing nations, which may lack the resources to comply with stringent reporting and verification requirements (Sharma & Gupta, 2021; World Bank, 2021).
4. **Inequity in Transition**: A further criticism of CBAM is its failure to adequately account for the varying capacities of different countries to transition to low-carbon economies. Developing nations, which are often more dependent on fossil fuels and face higher barriers to adopting cleaner technologies, may find it disproportionately difficult to meet CBAM's standards. Critics argue that the mechanism does not provide sufficient support or flexibility for these countries, placing undue pressure on their industries and economies (Gupta et al., 2024; Tiwari, 2024). This inequity in the global transition to a low-carbon economy raises concerns about fairness and the potential for exacerbating existing economic inequalities between developed and developing nations.

Impact of CBAM on India

India has consistently emphasized its commitment to mitigating climate change. The country's approach to carbon pricing and emission reductions has evolved significantly over the past few decades. As a signatory of the Paris Agreement in 2015, India committed to reducing the emissions intensity of its GDP by 33-35% by 2030, compared to 2005 levels.

Although India has not implemented a direct carbon tax or cap-and-trade system at the national level, the country has introduced several indirect mechanisms such as the Perform, Achieve, and Trade (PAT) scheme, targeting energy efficiency in specific industries and Renewable Purchase Obligations on distribution companies and conventional power consumers. These early frameworks reflect India's efforts to balance economic growth with environmental sustainability. Despite these initiatives, carbon pricing remains a sensitive topic due to the country's developmental priorities and socio-economic challenges. The introduction of CBAM adds a layer of complexity, pressuring India to accelerate its carbon market developments and low-carbon transitions. The introduction of CBAM could significantly impact foreign direct investment (FDI) in carbon-intensive industries in India. As the European Union tightens its carbon regulations, FDI may shift from sectors like steel, aluminium, and cement, which will face additional taxes when exporting to Europe under the CBAM framework.

Based on the literature review and dicussions with Indian industry leaders, the authors expect the primary impact of CBAM for Indian businesses to be as below:

1. **Increased Costs for Exporters**: Indian industries exporting to the EU may face higher costs due to the additional carbon price imposed on imports. This could affect the competitiveness of Indian goods in European markets (Sharma & Gupta, 2021).
2. **Need for Compliance**: To maintain market access, Indian companies must invest in cleaner technologies and practices to comply with EU standards. This may require significant capital investment and technological innovation (Gupta et al., 2024).
3. **Economic Impact**: Sectors that heavily rely on carbon-intensive processes, such as steel and cement, might experience reduced profitability due to the carbon costs associated with CBAM (Best, 2023; Mondaq, 2024).
4. **Potential for Job Losses**: As industries adjust to the new pricing mechanism, there may be job losses in sectors unable to adapt quickly enough or those that cannot absorb the additional costs (Best, 2023; Mondaq, 2024).
5. **Opportunities for Green Technology**: The pressure to reduce emissions could lead to increased investments in renewable energy and energy-efficient technologies, potentially benefiting India's long-term energy strategy (Gupta et al., 2024).

CBAM and Direct Foreign Investment (FDI) in India

The potential decline in FDI could hinder the growth of these industries unless India makes concerted efforts to align its climate policies with global standards. Conversely, this may also present opportunities for investments in low-carbon technologies and renewable energy sectors, as foreign investors increasingly seek to finance cleaner industries. India's ability to attract such investments will hinge on its policy response to CBAM and its broader climate commitments. India exports mainly iron & steel, aluminium, cement, and fertiliser to EU. Goods exported to EU only constitute 9.9% of total exported goods from India.

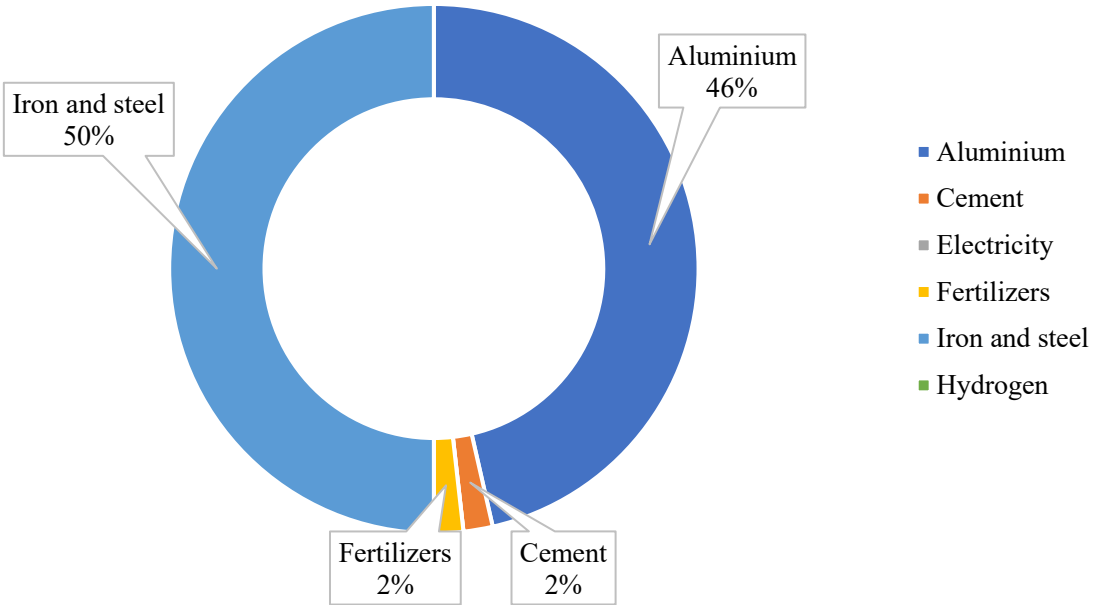

Figure 3: Share of goods covered under CBAM exported from India to EU in 2022-23 (Source: Dev & Goswami, 2024; Ministry of Commerce 2024)

Implementation of CBAM shall result in direct additional tax burden of 23%-27% as estimated below.

Table 1: Estimated tax burden on CBAM goods (Source: Dev & Goswami, 2024; European Commission, 2022; Ministry of Commerce, 2024)

Weight of CBAM covered goods (tonnes)	**2021-22**	**2022-23**	**2023-24**
Aluminium	6,85,237	7,41,423	3,73,320
Fertilisers	213	315	499
Iron and steel	51,31,790	37,32,842	47,01,786
Total weight (tonnes)	58,17,240	44,74,580	50,75,605
Value of CBAM covered goods (million USD)			
Aluminium	2,257	2,234	1,046
Fertilisers	-	1	2
Iron and steel	7,026	5,179	5,321
Total value (million USD)	9,283	7,414	6,369
Emissions of CBAM covered goods (tCO2e)			
Aluminium	72,55,611	78,28,244	39,40,043

Fertilisers	335	547	939
Iron and steel	1,29,88,685	95,96,989	1,20,72,123
Total emissions (tCO2e)	2,02,44,631	1,74,25,780	1,60,13,105
CBAM cost at Euro 100/tonne	2,02,44,63,100	1,74,25,78,000	1,60,13,10,500
CBAM cost (million Euro)	2,024	1,743	1,601
CBAM cost (million USD)	2,146	1,847	1,697
Additional tax burden	23%	25%	27%

Green Hydrogen

While India is not currently exporting green hydrogen to the EU, the country has been making significant strides in the green hydrogen sector, positioning itself as a potential global hub for hydrogen production. With the global pivot towards clean energy, European markets represent an attractive opportunity for Indian green hydrogen producers. However, there are critical challenges stemming from the misalignment between India's domestic standards for green hydrogen and the more stringent requirements set by the European Union (EU). This divergence threatens the competitiveness of Indian green hydrogen in international markets (Bridge to India, 2023).

The EU has set comprehensive standards for green hydrogen production to ensure that the hydrogen imported or produced within the region contributes to their net-zero emissions goals. Among these standards, three key requirements stand out:

1. **Additionality**: This mandates that the renewable energy used for hydrogen production must be new, additional capacity, rather than repurposed from existing renewable projects (European Commission, 2022).
2. **Temporal and Geographical Correlation**: The EU requires that the renewable energy used to produce hydrogen must be temporally and geographically linked to the green hydrogen production site. This means that the renewable energy should come from nearby facilities and should be generated around the same time as hydrogen production (European Commission, 2022).
3. **Well-to-Gate Emissions**: Perhaps the most critical of the EU's green hydrogen regulations is the limit on total emissions throughout the lifecycle of hydrogen production. The EU caps well-to-gate emissions (which include the entire hydrogen production process from raw material extraction to the final product) at 3.4 kg CO2e per kg of hydrogen (Mingolla et.a., 2024).

In contrast, India's green hydrogen standard focuses primarily on the emissions from the direct production process, requiring that green hydrogen must have no more than 2 kg CO2e per kg of hydrogen during production. However, it does not factor in other emissions throughout the value chain, nor does it require alignment with additionality or temporal/geographical correlation (Ministry of Power, Government of India, 2023). This gap in regulatory stringency may pose several issues:

- **Limited Market Access**: Indian producers who meet domestic standards may find that their products do not qualify for sale in the EU, limiting their ability to export green hydrogen to one of the largest clean energy markets in the world (IRENA, 2023).
- **Perceived Quality Discrepancy**: The lack of alignment with global standards could create a perception that Indian green hydrogen is of lower quality or sustainability. This could further diminish the marketability of Indian hydrogen on the international stage (IRENA, 2022).
- **Competitiveness in Global Trade**: As other nations, such as Australia or Chile, align their green hydrogen production processes with EU requirements, Indian producers may find themselves at a competitive disadvantage. Failure to meet these international benchmarks will make Indian hydrogen less attractive to global buyers, reducing its competitiveness in what is set to be a fiercely contested market (Mingolla, et. al., 2021).

To secure a foothold in the European market, India must take proactive measures to align its green hydrogen standards with global norms. This would not only involve revising the carbon emission thresholds but also addressing the additionality and correlation requirements laid out by the EU. By upgrading domestic standards, Indian producers can

better position themselves to compete on the international stage and capitalize on the growing demand for clean energy solutions in Europe and beyond.

Recommendations

Given the potential impacts of CBAM on Indian industries, particularly export-oriented sectors such as steel, aluminium, and cement, it is essential for these sectors to adopt proactive strategies to mitigate the risks and capitalize on the opportunities presented by global carbon markets. Key recommendations include:

1. **Investment in Renewable Energy:** A low-hanging fruit for reducing carbon emissions is investing in renewable energy sources such as solar and wind power. India has abundant renewable energy potential, and industries can leverage this to reduce their carbon footprint. Large industrial players should integrate renewable energy into their operations through Power Purchase Agreements (PPAs) or by investing in their own renewable energy projects. This would not only help companies meet global standards but also shield them from rising fossil fuel costs.
2. **Focus on Energy Efficiency:** Improving energy efficiency is another cost-effective strategy that can provide immediate benefits. Implementing energy-saving technologies, upgrading machinery, and optimizing production processes can significantly reduce energy consumption and carbon emissions. India's Perform, Achieve, and Trade (PAT) scheme already promotes energy efficiency in energy-intensive industries, and companies should make full use of these incentives to enhance their competitiveness in global markets.
3. **Electrification of Industrial Processes:** Indian industries should accelerate the electrification of industrial processes to reduce their reliance on fossil fuels. By transitioning to electric systems powered by renewable energy, industries can substantially cut down their emissions. This could be particularly useful for sectors such as steel and cement, where current production methods are heavily dependent on coal and other fossil fuels.
4. **Explore Carbon Capture, Utilization, and Storage (CCUS) Technologies:** For sectors where decarbonization is challenging, such as cement and steel, investing in Carbon Capture, Utilization, and Storage (CCUS) technologies offers a promising solution. These technologies capture CO_2 emissions from industrial processes and either store them underground or use them in other products, reducing the overall emissions from production. While the technology is still in its early stages, it holds significant potential for industries looking to mitigate their carbon impact.
5. **Deploy India’s Carbon Market:** India should expedite the deployment of its domestic carbon market. A well-functioning carbon market can help industries adapt to global carbon pricing mechanisms, including CBAM, by gradually exposing them to carbon costs and encouraging emission reductions. A national carbon market would provide a structured environment for companies to buy and sell carbon credits, incentivizing low-carbon innovation and aligning domestic policies with global standards. This could also prepare Indian exporters to compete more effectively in markets with stringent carbon regulations.

Conclusion

As global carbon markets evolve and the European Union implements the CBAM, Indian industries will face new challenges in maintaining their competitiveness in the international market. The CBAM adds a significant cost burden on carbon-intensive exports to the EU, and industries that do not adapt to these changes risk losing market share and profitability. However, these challenges also present opportunities for India to transition towards a more sustainable economy. By investing in renewable energy, improving energy efficiency, electrifying industrial processes, and exploring advanced technologies such as CCUS, Indian companies can reduce their emissions and enhance their global standing.

Moreover, by developing its own carbon market, India can not only prepare its industries for international regulations but also create a robust domestic mechanism to reduce emissions and stimulate green growth. With the right policy frameworks and industrial strategies, India can turn the challenge of CBAM into an opportunity for long-term sustainability and global leadership in clean energy.

These proactive measures will not only safeguard India's industries against the immediate impacts of CBAM but also position the country as a key player in the global low-carbon economy, ensuring its industries thrive in an increasingly carbon-constrained world.

References

1. Basu-Das, S., Duggal, V. K., Foster-McGregor, N., Jiang, Y., Kang, J. W., Kim, K., & Pradhananga, M. (2024). Carbon pricing as a key policy for climate change mitigation. In *Asia–Pacific Climate Report 5153*.
2. Best, F. (2023). The EU Carbon Border Adjustment Mechanism and its Influence on Imports from India.
3. Bridge to India. (2023, September 19). *Indian green hydrogen standards will need to catch up*. https://bridgetoindia.com/indian-green-hydrogen-standards-will-need-to-catch-up/ (Accessed October 2024)
4. Carbon Trust. (n.d.). CBAM: What it means for businesses across Europe. https://www.carbontrust.com/en-eu/our-work-and-impact/guides-reports-and-tools/cbam-what-it-means-for-businesses-across-europe (Accessed October 2024)
5. Chandra, T. (2021). Pricing carbon: Trade-offs and opportunities for India. In Mitra, A. (Ed.), *Reconciling India's Climate and Industrial Targets: A Policy Roadmap*
6. Dev, T., & Goswami, A. (2024). Carbon Border Adjustment Mechanism (CBAM): *The Global South's response to a changing trade regime in the era of climate change.*
7. Emeka-Okoli, S., Otonnah, C. A., Nwankwo, T. C., & Nwankwo, E. E. (2024). Review of carbon pricing mechanisms: Effectiveness and policy implications. *International Journal of Applied Research in Social Sciences, 6*(3), 337–347.
8. European Commission. (2020). What is the EU ETS? https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en (Accessed October 2024)
9. European Commission. (2022). A hydrogen strategy for a climate-neutral Europe. https://ec.europa.eu/energy/topics/energy-systems-integration/hydrogen_en (Accessed October 2024)
10. European Commission. (n.d.). Carbon Border Adjustment Mechanism (CBAM). https://trade.ec.europa.eu/access-to-markets/en/news/carbon-border-adjustment-mechanism-cbam (Accessed October 2024)
11. EY, & Shakti Sustainable Energy Foundation. (2018). *Discussion paper on carbon tax structure for India* [Report]. EY. https://shaktifoundation.in/wp-content/uploads/2018/07/Discussion-Paper-on-Carbon-Tax-Structure-for-India-Full-Report.pdf
12. Gupta, A., Pandey, R., & Sapatnekar, S. (2024). *Potential implications of the EU's Carbon Border Adjustment Mechanism*. National Institute of Public Finance and Policy.
13. IEA (2021). *Global hydrogen review 2021*. https://www.iea.org/reports/global-hydrogen-review-2021 (Accessed October 2024)
14. IRENA. (2024). *Global trade in green hydrogen derivatives: Trends in regulation, standardisation and certification.* IRENA, Abu Dhabi.
15. Ministry of Commerce and Industry. (n.d.). Trade statistics. Government of India. https://www.commerce.gov.in/trade-statistics/ (Accessed October 2024)
16. Ministry of Power, Government of India. (2023). Green hydrogen/green ammonia policy. https://powermin.gov.in/en/content/green-hydrogen (Accessed October 2024)
17. Mingolla, S., Gabrielli, P., Manzotti, A., Robson, M. J., Rouwenhorst, K., Ciucci, F., & Lu, Z. (2024). Effects of emissions caps on the costs and feasibility of low-carbon hydrogen in the European ammonia industry. *Nature communications*, *15*(1), 3753.
18. Mondaq. (2023, February 21). The new EU carbon border tax: Key points for consideration of Indian exporters to EU. https://www.mondaq.com/india/climate-change/1301642/the-new-eu-carbon-border-tax-key-points-for-consideration-of-indian-exporters-to-eu (Accessed October 2024)
19. Nedumpara, J. J., & Pradeep, S. (2021). Implementing carbon tax: From rhetoric to reality. *Indian Journal of International Law*, *59*, 139-171.
20. Qutubuddin, M. K. (2023, April 12). How India's carbon tax implementation could set a precedent for G20 countries. *Earth.Org*. https://earth.org/india-carbon-tax/ (Accessed October 2024)
21. Sharma, V., & Gupta, K. (2021). Implications of Carbon Border Adjustment Mechanism: a case of India's exports to European Union. *Journal of Resources, Energy and Development*, *18*(1-2), 55-76.
22. Sontakke, U., & Jaju, S. (2021, November). Green hydrogen economy and opportunities for India. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1206, No. 1, p. 012005). IOP Publishing.
23. Srivastava, P. (2022). Looking Out, Looking In: How India can Respond to a Carbon Border Adjustment Mechanism on the Principles of Justice and Equity in the Net-Zero Transition.
24. Tiwari, A., Anand, M., Mansharamani, M., Sehgal, U., (2024, August 12). Carbon Border Adjustment Mechanism and its Impact in India. Azb. https://www.azbpartners.com/bank/carbon-border-adjustment-mechanism-and-its-impact-in-india/

25. Trading Economics. (n.d.). Carbon. *Trading Economics.* https://tradingeconomics.com/commodity/carbon (Accessed October 2024)
26. World Bank. (2021). *State and trends of carbon pricing 2021*. World Bank Group. https://openknowledge.worldbank.org/handle/10986/35620 (Accessed October 2024)