

Hrishikesh Upadhyaya, Chandinee Goswami & Moirangthem Momocha Singh (2026). India's Emerging Carbon Market Ecosystem: Regulatory Evolution, Market Institutions and Financing Pathways. International Journal of Multidisciplinary Research & Reviews, 5(8),206-221.



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INDIA'S EMERGING CARBON MARKET ECOSYSTEM: REGULATORY EVOLUTION, MARKET INSTITUTIONS AND FINANCING PATHWAYS

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Keywords	Abstract
Carbon Finance, Carbon Market, Carbon Credit Trading Scheme, Climate Policy, Sustainable Development.	The world is now facing a great challenge due to climate change, therefore, most countries are adopting carbon markets to reduce their greenhouse gas emissions and help with the global goal of creating a sustainable environment. As India's economy is growing significantly fast and also it is considered to be strong contributor to greenhouse gas emissions, it has taken a significant step of launching its regulatory carbon market to meet the net-zero emission goals by 2070. This study assesses the national readiness regarding its carbon market. For understanding it, secondary data have been collected from Government reports, official circulars issued by regulating agencies, policy documents, research papers and global climate reports. Prior to the launch of this regulatory market, India has seen other market based frameworks like the Perform, Achieve and Trade (PAT Scheme) and Renewable Energy Certificates (RECs). This study also highlights the growing role of institutions, industries and monitoring frameworks that significantly assist in implementation of this regulatory market. Finally, the study discusses the framework and operational structure of carbon markets



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	operating in Europe and China, that helps understand the possibilities and challenges for India. Overall, India has utmost capacity to develop a successful carbon market that would facilitate clean and sustainable growth in energy, transformation of industries, and sustainable economic development.
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1. Introduction

Climate change is arguably one of the biggest global problems at present. There is growing concern about rising temperature levels, shifting weather conditions, increased occurrences of floods and droughts, all of which are evidence of the urgency to reduce greenhouse gases (GHGs) (Lashof & Ahuja, 1990; Kweku et al., 2018; Yoro & Daramola, 2020). As a result of these issues many countries around the globe have developed climate-related policies or used market-based mechanisms to encourage sustainable development and low-carbon economic growth (Dou, 2014). One of the key mechanisms to achieve this is through the use of carbon markets. They create an economic incentive for companies and organizations to lower their GHG emissions by putting a financial value on them. Companies that can succeed in lowering their emissions can generate carbon credits through trade-off agreements and then sell those credits to other companies struggling to meet their own GHG reduction goals (Siddiqui & Kushwah, 2021; Singh & Nayak, 2025). This method creates financial incentives for companies to lower their emissions cost effectively and supports environmental sustainability.

As part of India's commitment to achieve net zero GHG emissions by 2070, the government has been taking steps to assist in reaching that goal. Prior to creating a national carbon market, India had established some national market-based frameworks including the Perform, Achieve and Trade (PAT) scheme and the Renewable Energy Certificate (REC) mechanism. Both of these mechanisms were designed to incentivize companies to improve energy efficiency and develop renewable resources (Jindal et al., 2025; Singh & Nayak, 2025). Building upon those experiences, the Government of India created the National Carbon Credit Trading Scheme (CCTS) under the Energy Conservation (Amendment) Act, 2022, which was made official on 28th June 2023. The success of a carbon market relies heavily on both how well it is designed and whether there are adequate institutions ready to implement the policy. All stakeholders involved in the functioning of a carbon market (regulatory bodies, auditing and verification bodies, monitoring agencies, market administrators and trading platforms) will need to cooperate with each other to assure transparency, accountability and credibility within the carbon credit marketplace (BEE, 2023; Dey, 2026).

This paper reviews carbon financing in India, the present institutional structure, regulatory mechanisms and monitoring systems associated with carbon markets. It includes information about various international models such as the EU's ETS, China's National Carbon Market and many other countries to help understand how carbon markets can be developed effectively around the world. Furthermore, this paper assesses institutional readiness and governance structure barriers and challenges associated with India's developing carbon marketplace. Ultimately, this study seeks to



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assess India's ability to develop and maintain a successful carbon market and what institutional reforms may be needed to overcome current limitations.

2. Evolution of Carbon Finance and Carbon Markets in India

In recent years, India's engagement in climate action has transformed from participation in international carbon-trading schemes to the development of a regulatory environment in order to facilitate the exchange of carbon credits. This transformation reflects India's increasing desire to achieve balance between economic development and environmental protection. Through the Clean Development Mechanism (CDM), India became familiarized with the idea of carbon financing. The CDM was created as a provision of the Kyoto Protocol that permitted developing countries to undertake project activities that reduce greenhouse-gas emissions and generate Certified Emission Reductions (CERs) (Bohringer, 2003; Pahuja, 2023). Once generated, these credits could be acquired by developed countries to help them fulfil their requirements to reduce greenhouse-gas emissions. Due to India's vast opportunity for renewable-energy production, energy-efficiency enhancement, and waste-management practices, numerous renewable-energy-related projects such as wind, biomass, small-hydroelectric facilities and industrial energy efficiency projects were supported financially through revenues earned from selling carbon credits (Abbasi et al., 2017; Bansal et al., 2022; Gan & Voda, 2022). In response to concerns about climate change, the Government of India initiated the National Action Plan on Climate Change (NAPCC) in 2008. One of the most significant national missions included within the NAPCC is the National Mission for Enhanced Energy Efficiency.

A key component of this mission was the development of a performance-based scheme known as the Perform, Achieve and Trade (PAT) program. The PAT scheme set specific energy-saving targets for energy-intensive sectors of India such as steel, cement, thermal-power generation, fertilizer manufacturing, and aluminium smelting. While industries that met or surpassed their assigned targets were able to earn Energy-Saving Certificates (ESCerts), those who failed to meet their energy-saving objectives were required to acquire ESCerts from industries that had achieved higher levels of energy saving. The Renewable Energy Certificate (RECs) scheme was another important program implemented to promote renewable energy production. Under the REC scheme, renewable energy generators received certificates representing each megawatt-hour of electricity produced from renewable resources. The REC program assisted in creating trading mechanisms for renewable energy, promoted participant involvement in the renewable-energy marketplace, and facilitated regulatory oversight necessary to create effective trading infrastructures for carbon-market transactions. India thus experiences the CDM program, the PAT program, and the REC program that formed the foundation for India's evolving carbon market. Each of these programs facilitated the creation of administrative capability, enabled monitoring and reporting systems, permitted verification procedures, and provided trading venues (Dutta, 2015; Mondal et al., 2026). Ultimately, as India's policymakers recognized that a comprehensive carbon market would serve as a more powerful stimulus for green-house gas-reducing actions while providing support for India's long-



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term climate commitments, they began working toward its establishment. Figure 1 illustrates the evolutionary pathway of India's carbon market development.

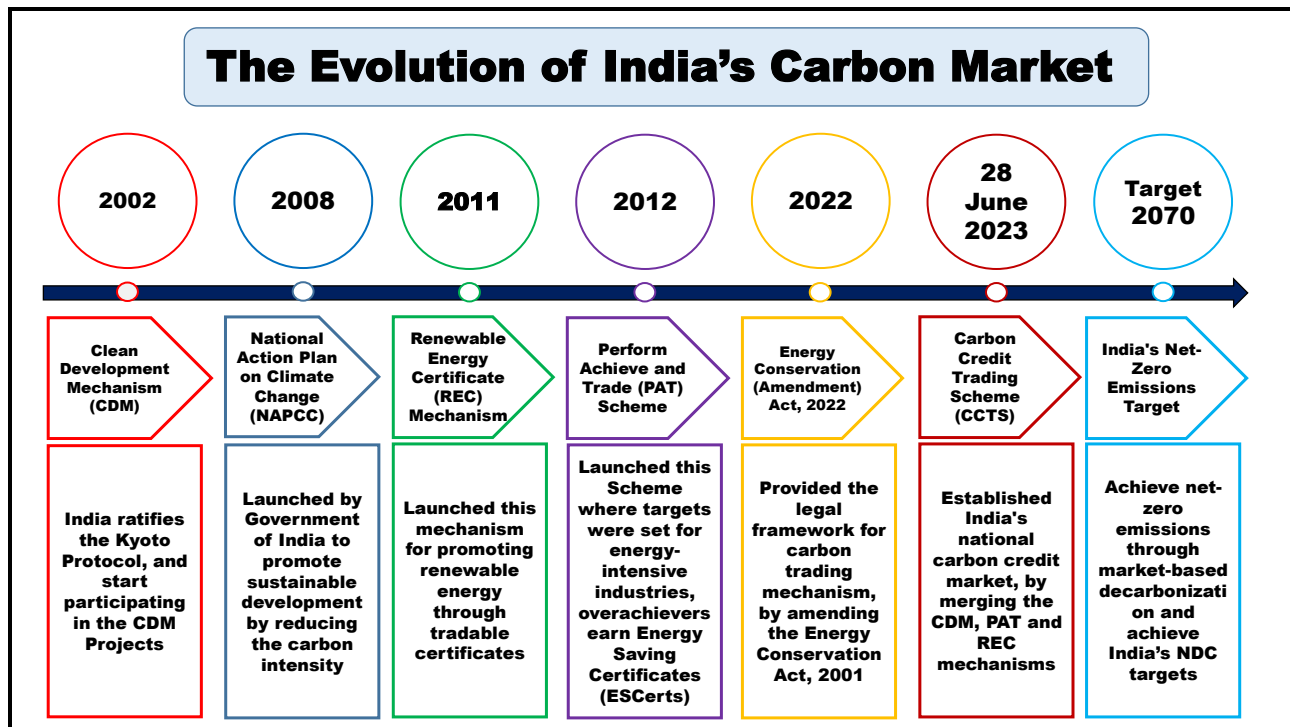


Fig. 1. Evolution of Carbon Finance and Carbon Markets in India (Source: Author's Preparation)

India's pursuit of establishing a domestic carbon market occurred when India passed the Energy Conservation (Amendment) Act of 2022. The act provided legislative authority for the creation of a Carbon Credit Trading Scheme (CCTS). The institutional structures, technical capabilities, and market infrastructures developed throughout past experiences with CDM, PAT, and REC initiatives provides essential foundations for successfully establishing and administering India's domestic carbon market (IEA, 2020).

3. Institutional Architecture of India's Emerging Carbon Market

Implementation of a functioning carbon market heavily relies upon the robustness of the institutions designed to govern it, monitor it, and regulate it. An effective design of an institutional framework will enhance the level of transparency, accountability, and market confidence in the carbon market (Gorain et al., 2021). Due to recognition of this necessity, India has created a multi-layered institutional structure to assist in the implementation of its Carbon Credit Trading Scheme (CCTS). The Bureau of Energy Efficiency (BEE) has been instrumental in creating the overall market framework, in developing operating procedures for the scheme, identifying industries subject to obligations under the CCTS, and working with all interested parties (BEE, 2023). The BEE's role in facilitating the transition from the current energy efficiency schemes to a fully developed carbon market will be very critical. The Government of India has also created a National Steering



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Committee to provide strategic direction and policy oversight. This advisory committee is charged with providing policy guidance to the Government of India, facilitating coordination among institutions involved in the development of India's carbon market, and making certain that India's carbon market supports India's overall commitment to reducing its greenhouse gas emissions and supports its sustainable development goals (ICAP, 2024).

A critical component of the emerging regulatory structure is the Central Electricity Regulatory Commission (CERC), which has been identified as the regulatory body of the market. State Designated Agencies (SDAs) and third-party verification bodies are expected to play significant roles in monitoring compliance with applicable laws and regulations, as well as validating relevant emissions data (ICAP, 2024). Reliable Monitoring Reporting Verification (MRV) systems will ensure that all carbon credits traded in a carbon market result from actual verified GHG emissions reductions (Patel et al., 2024).

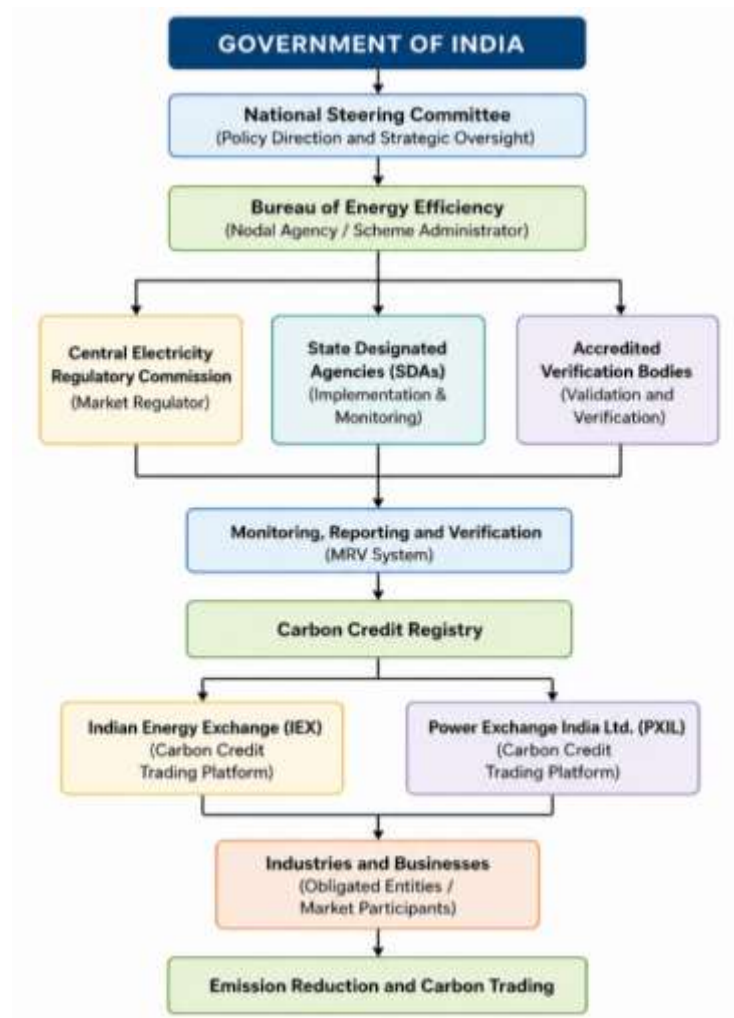


Fig. 2. Institutional Framework for the Implementation of the Carbon Credit Trading Scheme (CCTS) in India (Source: Author's Preparation)

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Figure 2 illustrates the responsibilities and relationships between key stakeholders associated with the Scheme. The framework depicts the flow of governance, monitoring, reporting, verification, registration, and trading functions that collectively support carbon market operations and facilitate GHG emissions reduction in India. Trading of carbon credits will take place on established exchanges such as the Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL). Both IEX and PXIL have prior experience with trading RECs and ESCerts. These prior experiences should allow both IEX and PXIL to execute trades involving carbon credits using their existing systems while at the same time reduce the costs associated with installing entirely new trading systems (Labatt & White, 2012). Businesses and industry associations are also major players in the institutional structure. Therefore, ongoing communication with stakeholders, public education campaigns, and capacity building programs for industry association stakeholders will be necessary to encourage participation. The presence of regulatory agencies, monitoring agencies, trading platforms, etc., that are designated specifically for this purpose demonstrate a good base for implementing a working carbon market (Wetterberg et al., 2025).

4. Governance Framework of the Indian Carbon Market

The institutional readiness of India will play a key role in its ability to successfully implement its carbon market. Prior experience with market-based approaches to addressing environmental issues such as the CDM, the PAT Scheme, and the REC mechanism provides the governmental agency and industry sectors with a "hands-on" understanding of the process of monitoring, certifying, enforcing compliance, and conducting trades related to carbon markets. Additionally, the Energy Conservation (Amendment) Act, 2022 provided the basis for a legal framework for carbon trading and therefore improved the institutional preparedness of India. Several organizations (such as BEE, CERC, GRID, IEX, PXIL, etc.) contribute to the institutional preparedness of India through their prior experience with certificate-based trading systems (Singh & Nayak, 2025).

Although India has several advantages regarding its institutional preparedness, it also contains several disadvantages. It is extremely important to establish an effective MRV (Monitoring, Reporting and Verification) system of GHG emissions reductions. Also, many small and medium-sized enterprises (SMEs) will require additional education and training in regards to carbon accounting, emissions reporting, and carbon trading. Also, it is imperative to provide complete transparency in regard to all aspects of trading (regulations, compliance requirements, verification process), etc. so that confidence will remain in the eyes of both the public and private sectors and the opportunity for problems (i.e. market manipulation, double counting), etc. will be minimized (Yeoh, 2008; Chen & Wu, 2023). Table 1 summarizes the major institutional and governance components supporting the implementation of India's Carbon Credit Trading Scheme (CCTS). It highlights the existing legal framework, institutional leadership, regulatory oversight mechanisms, monitoring, reporting and verification (MRV) systems, and market infrastructure that collectively contribute to India's readiness for carbon market implementation.



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Table 1 Key components of the governance framework of India's Carbon Market

Component	Existing Arrangement	Significance/Contribution
Legal Framework	Energy Conservation (Amendment) Act, 2022 and Carbon Credit Trading Scheme (CCTS), 2023.	Provides the legal foundation for carbon credit issuance, trading, and compliance.
Institutional Leadership	Bureau of Energy Efficiency (BEE) acts as the administrator of the CCTS.	Utilizes experience gained from PAT and REC mechanisms to support market implementation.
Market Regulation and Oversight	National Steering Committee (NSCIM) and Central Electricity Regulatory Commission (CERC).	Ensures policy coordination, regulatory oversight, and market credibility..
Monitoring Reporting and Verification System	Standardized monitoring, reporting, and independent verification procedures.	Enhances transparency and environmental integrity of carbon credits.
Market Infrastructure and Participation	Carbon registry (GRID), power exchanges (IEX/PXIL), and participation of energy-intensive industries.	Facilitates carbon credit trading and supports broader market participation.

Source: Author's preparation

5. International Lessons from the European Union and China

As India readies itself for launch of its own regulatory carbon market, knowledge about other nations or areas that have already set-up their own emissions-trading systems can assist with understanding the development process. Of all the current carbon markets, the European Union Emissions Trading System (EU ETS), and the National Carbon Market of China, offer the greatest insight into differing ways to govern a carbon market (Chen & Wu, 2023). The EU model provides a solid example of strong regulatory support and mature markets. The EU ETS was launched in 2005. It is now considered to be the largest compliance-based carbon market worldwide. The EU ETS is a cap-and-trade system. Each participant must be allocated an amount of tradable allowances equal to their level of emissions. Since the inception of the EU ETS, several major improvements to the overall governance framework have been made. The EU has provided enhanced levels of transparency and monitoring capabilities. In addition to creating long-term policies like Cross Border Adjustment Mechanism (CBAM), policy stability was another strength of the EU model. However, reforms to fix these problems have been implemented by establishing tighter regulation and improving oversight of the market place (Xu & Zhai, 2022).



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China's carbon market offers a different perspective. Unlike the European Union, China adopted a gradual approach by first introducing pilot trading schemes in selected provinces and cities before expanding to a national market (Liu et al., 2015). A phased-in approach allowed regulators to test mechanisms for regulating a carbon market, discover possible problems with implementing the carbon market and build institutional capacity before expanding the reach of the carbon market (Yu & Lo, 2014; Guo et al., 2021). Taking a step-by-step approach to establishing a nationwide carbon market helped to eliminate many of the potential pitfalls associated with developing such programs without previous experience. In addition, during the development phase, central governmental agencies were directly involved in developing the rules governing how to implement the carbon trading scheme (Yin et al., 2023). These agencies also worked closely together with other stakeholders to help implement the program. Finally, they made sure that compliance systems would be adequate enough to enforce new regulations. For India, similar mechanisms for coordinating efforts between different levels of government will be vital. Figure 3 compares the similarities as well as differences, advantages and challenges faced when implementing the EU ETS and China's National Carbon Market and illustrates the lessons applicable to the development of India's CCTS.

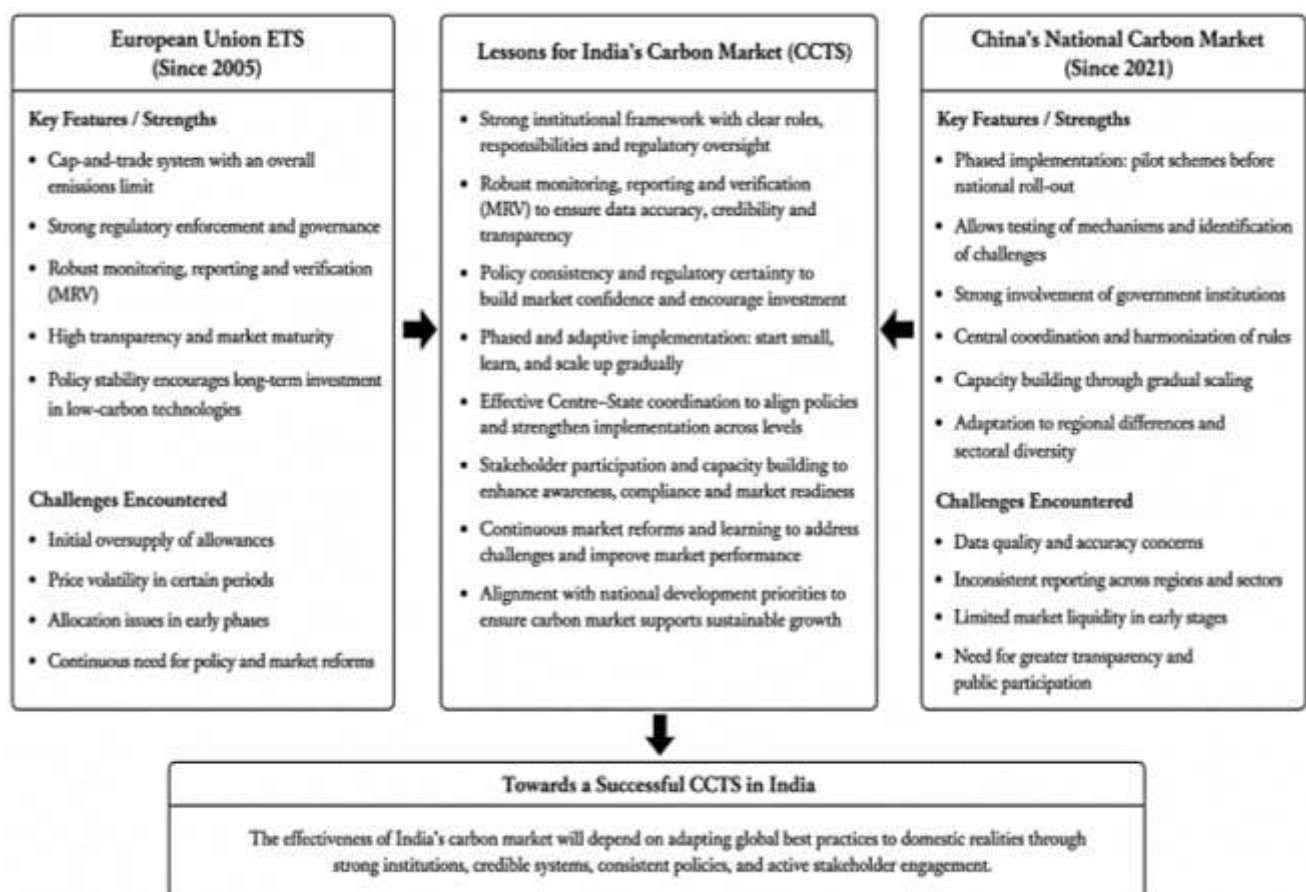


Fig. 3. Lessons from global carbon markets for development of India's emerging carbon market (Source: Author's Preparation)

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Both systems have achieved success in portions of their respective carbon markets, however, both systems have also encountered problems. The European Union experienced fluctuations in the price of carbon credits resulting from excessive allowance supplies. Similarly, China has encountered problems related to data quality, reporting consistency, and transparency in the marketplace (Liu et al., 2015; Chen & Wu, 2023). Perhaps most importantly for India, neither system offers a direct model for India to follow. There are many distinctions between India's economic structure, industrial composition, and developmental priorities compared to those of Europe and China. As a result, India's carbon market needs to grow within parameters that match India's local conditions while incorporating international best practices. Developing strong institutions, using credible monitoring systems, providing consistent policies and encouraging participant involvement appear to be much more important considerations than merely duplicating specific aspects of foreign carbon markets (Gupta & Rakshit, 2023; Lamba & Aggarwal, 2024).

6. Key Challenges to Institutional Readiness and Effective Carbon Market Governance in India

The success of India's Domestic Carbon Credit Trading Scheme (CCTS), will be determined based on how well stakeholders can address those barriers that currently inhibit India's carbon market from operating effectively (Söderholm, 2020). Some of the barriers include but are not limited to, monitoring and verification systems, institutional coordination, stakeholder readiness, market liquidity, regulatory clarity, and public trust (Vashishtha & Vashishtha, 2024; George & Rajavenkatesan, 2025). Table 2 identifies the major institutional, technical, regulatory, and governance challenges that may affect the successful implementation of India's Carbon Credit Trading Scheme (CCTS). It outlines the potential implications of these challenges for market credibility, participation, efficiency, investor confidence, and the overall effectiveness of carbon market governance in achieving India's climate and sustainable development objectives.

Table 2 Key challenges to institutional readiness and potential implications to effective carbon market governance in India

Challenge Area	Description	Potential Implications
Monitoring, Reporting and Verification (MRV) Systems	Carbon markets require accurate measurement, reporting, and verification of emissions and emission reductions. Existing systems need further strengthening through standardized methodologies, reliable databases, and robust verification procedures.	Inaccurate emissions data may undermine the credibility and environmental integrity of carbon credits.
Institutional Coordination	Multiple institutions, including ministries, regulators, state agencies, market operators, and verification bodies,	Overlapping responsibilities, administrative delays, and fragmented implementation



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	are involved in market governance.	may reduce market efficiency.
Technical Capacity and Stakeholder Readiness	Many firms, particularly small and medium enterprises, may lack expertise in carbon accounting, compliance requirements, and trading mechanisms.	Uneven participation across sectors and regions may limit market effectiveness and inclusiveness.
Policy Stability and Regulatory Certainty	Market participants require clear and predictable regulations to make long-term investments in emission reduction technologies and projects.	Regulatory uncertainty may discourage investment and weaken market confidence.
Market Liquidity and Price Discovery	Limited participation during the initial years may result in a low number of buyers and sellers within the market.	Low liquidity may lead to price volatility and weaken carbon price signals for investment decisions.
Transparency and Public Trust	Stakeholders must have confidence that carbon credits represent genuine and verifiable emission reductions.	Weak transparency and inadequate disclosure may reduce market credibility and stakeholder acceptance.
Data Quality and Verification Standards	Consistent emissions reporting and independent verification mechanisms are essential for market integrity.	Poor data quality can compromise compliance monitoring and reduce confidence in carbon credit transactions.
Gradual Expansion of Market Coverage	Expanding participation across sectors and regions requires careful planning and institutional preparedness.	Premature expansion may create implementation challenges and compliance difficulties.
Capacity Building and Awareness	Continuous training and awareness programmes are required for industries, regulators, and verification agencies.	Limited awareness may hinder active participation and compliance with market requirements.
Governance Effectiveness	The success of the carbon market depends on effective oversight, accountability, and institutional adaptability.	Weak governance may reduce the market's ability to contribute effectively to national climate goals.

Source: Author's preparation



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7. Policy Recommendations

Although India has developed a comprehensive legislative base for a domestic carbon market through the Energy Conservation (Amendment) Act 2022 and the subsequent notification of the Carbon Credit Trading Scheme (CCTS) in 2023, there still exist numerous institutional, technical and social barriers to overcome before India's carbon market becomes a viable means of reducing greenhouse gas emissions. In terms of institutional and technical capacity, the CCTS will build upon prior experience from earlier market-based mechanisms implemented by India. Prior market based mechanisms that were successfully implemented in India included the Clean Development Mechanism (CDM); the Performance, Achievement and Trade (PAT) scheme, and the Renewable Energy Certificate (REC) mechanism. The inclusion of institutions that play key roles in the governance of India's energy sector such as, the Bureau of Energy Efficiency (BEE), National Steering Committee for the Indian Carbon Market (NSCICM), Central Electricity Regulatory Commission (CERC), and power exchanges has provided a structured governance framework for implementing the carbon market (Antunes et al., 2024). Although there has been considerable advancement made in building the institutional capacity and governance structure for India's domestic carbon credit trading scheme, it is still crucial to continue to develop this capacity if India wishes to implement a robust and durable domestic carbon market (Gorain et al., 2021). To further build on the institutional capacity and governance structure of India's domestic carbon credit trading scheme, the following institutional policies could be adopted to help create a carbon market that promotes the transformation of India into an economy that supports long term decarbonisation:

- *Strengthening MRV Systems:* Developing standard methodologies, digital reporting systems and independent verification systems would allow India to accurately report GHG emissions and therefore maintain credibility of its carbon market.
- *Supporting Institutional Coordination:* By creating formalized lines of communication and defining respective responsibilities amongst various departments, agencies and organizations involved in governing India's energy sector, would enable better policy implementation and promote efficiency.
- *Encouraging Capacity Building and Technical Training:* Regular training programs, awareness campaigns and sector specific guidance materials should be created specifically to educate SME's about how they can participate in the new carbon market.
- *Ensuring Regulatory Stability and Policy Certainty:* Providing a clearly defined roadmap concerning what sectors will be covered under the CCS regime; what the compliance obligations are going to be; and what future expansions to the carbon market will entail, will help encourage investment in low carbon technologies.
- *Creating a Phase Approach:* After conducting an evaluation of each phase of implementation and assessing the potential challenges associated with each phase, expanding the number of sectors covered under the CCS regime would create a more stable environment.



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- *Fostering Transparency and Stakeholder Participation:* Making publicly available all relevant information related to the operation of the carbon market; encouraging ongoing consultations between all stakeholders; regularly publishing reports regarding compliance and trade activity would contribute to increased transparency and accountability within India's domestic carbon credit trading scheme.
- *Establishing Strong Market Structure:* Broadening participation under the CCS framework; enhancing trading mechanisms; strengthening the overall market structure; and establishing long term price stability, all will enhance the sustainability of India's domestic carbon credit trading program.

8. Conclusion

India's shift to a national carbon market, is an important component of the country's climate strategy and commitment to achieve net zero emissions by 2070. As the review illustrates, India has created a solid foundation for this initiative through the use of various mechanisms previously employed by the country, including CDM, PAT, and REC, to develop institutional capacity, and establish regulatory frameworks. In addition to building institutional capacity, and establishing regulatory frameworks, the development of the Carbon Credit Trading Scheme, also clearly shows the intent of the Indian Government to incorporate market based instruments into climate governance. However, the extent to which the new carbon market will function effectively, will ultimately be dependent on the quality of monitoring and verification processes; institutional coordination; stakeholder awareness/education/preparedness; and regulatory consistency. Both the EU and China provide lessons in that respect, in that successful carbon markets need constant policy refinement; good governance practices; and active engagement from both the public and private sectors. Although there may still exist some challenges facing India, it is believed that existing institutional arrangements provide an advantageous beginning for creating a credible and effective carbon market capable of supporting sustainable economic growth and long-term de-carbonization goals.

AUTHOR(S) CONTRIBUTION

Hrishikesh Upadhyaya: Software, data curation, writing-original draft, methodology, data analysis;

Chandinee Goswami: Data curation, methodology, visualisation;

Dr Moirangthem Momocha Singh: Investigation, validation, review and editing.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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