Modelling insights and design choices for a credible Indian carbon market

Workshop summary report

Date: 9 March 2026
Time: 10AM–2:30PM IST
Venue: Inspire, Le Méridien, New Delhi
Organised by: IEEFA, IIT Roorkee, and Environmental Defense Fund (EDF)

About this document

This document provides a comprehensive summary of the half-day workshop held on 9 March 2026 in New Delhi, co-organised by the Institute for Energy Economics and Financial Analysis (IEEFA), the Indian Institute of Technology Roorkee (IIT Roorkee), and the Environmental Defense Fund (EDF). The workshop brought together policymakers, researchers, technical experts, and representatives from India's obligated sectors to examine modelling insights and design choices for a credible Carbon Credit Trading Scheme (CCTS).

This summary is intended for stakeholders who were unable to attend in person. It captures the key analytical findings and policy discussions held across two sessions, including modelling methodology, expert perspectives, and roundtable deliberations. Please note that this reflects the views shared during the event and is not a verbatim record.

Opening and keynote addresses

The workshop was opened with welcome remarks and framing addresses from each of the co-organising institutions, setting the context for the day's discussions.

Prof. Tarun Sharma, Associate Professor at IIT Roorkee, welcomed attendees to the workshop, noting that the project had been initiated 18 months prior to address the rapidly evolving carbon management landscape in India.

Vibhuti Garg, Director, South Asia, IEEFA, emphasised the shift from purely regulatory frameworks to analytical ones that incorporate price stability and offset integrity as central design considerations.

Hisham Mundol, Chief Advisor, EDF India, outlined three critical success factors for the CCTS:

- Price credibility: Markets must begin with enough clarity and discipline to ensure the price signal is real for investors.
- Coherence across instruments: Coordination is needed between renewable energy certificates (RECs), energy saving certificates (ESCerts), and India's Green Credit Framework to avoid double-claiming of environmental benefits.

- International strategy: A strategic decision is required on which mitigation opportunities to use for domestic decarbonisation versus for international transfer.

Dr. Christopher Costello, Chief Economist, EDF, shared global principles for environmental markets:

- Multiple objectives: Carbon markets often support broader goals such as energy security and economic growth alongside emissions reduction.
- Role of expectations: Firms' current investments are driven by their beliefs about the future longevity and price trajectory of the market.
- Purpose of models: Models should illuminate trade-offs and directional changes rather than serving as precise predictive tools.

The second session was moderated by **Dr. Saurabh Trivedi, Lead Specialist, Sustainable Finance and Carbon Markets, South Asia, IEEFA**; and the closing remarks were delivered by **Ms Shuchi Malhotra, Lead Advisor, EDF India**.

Session 1: Modelling to inform the Indian carbon market

Session 1 covered the CCTS modelling framework, sectoral abatement potential, marginal abatement cost (MAC) curve construction, compliance scenario analysis, and indicative carbon price signals. The IIT Roorkee team presented the technical CCTS model and an interactive scenario illustrator.

1.1 CCTS context

Prof. Tarun Sharma noted that the Indian Carbon Credit Trading Scheme (CCTS) is intensity-based, with compliance defined per unit of output rather than against absolute emission caps. Trading under the scheme is expected to commence in late 2026. This architecture reflects India's development context and the practical constraints of applying mandatory emission limits to a rapidly industrialising economy.

1.2 Feature presentation: Modelling architecture

Dr. Suzi Kerr (EDF) presented the methodological architecture of the model developed to inform policy decisions, drawing on international lessons from carbon market simulations and their applicability to India's baseline-and-credit architecture.

- Model purpose: Designed as a decision aid to help stakeholders understand how different design choices impact market prices and emission levels.
- Bottom-up architecture: The model uses facility-level data to capture the diversity of industrial plants within notified sectors, including cement, aluminium, and textiles.
- Models should clarify directional effects and policy trade-offs rather than produce precise numerical forecasts; this framing is especially important when baseline data quality is limited.

1.3 Marginal abatement cost modelling – detailed findings

Ankit Sharma (IIT Roorkee) presented the detailed modelling methodology and findings:

- Data sourcing: MAC data was compiled from sectoral reports, academic studies, and expert consultations.
- Visualisation tool: An interactive tool was demonstrated, allowing users to select sectors, edit baseline production data, and add abatement measures to explore scenario outcomes.
- Facility-level heterogeneity: The model captures differences between plants by assuming that lower-intensity facilities have already adopted lower-cost abatement options, producing a more realistic distribution of compliance costs.
- Model architecture: A three-part architecture consisting of inputs (baselines and MACs), processing (estimating equilibrium prices), and outputs (emission reductions and cost impacts).

1.4 Key modelling findings

Ability to generate multiple scenarios around key assumptions and conduct a comparative scenario analysis was showcased. Under one such scenario, along with the associated assumptions excluding negative cost options, and data availability constraints following assessment was discussed.

- Price discovery: In a baseline scenario excluding negative-cost options, the model identified a market-clearing price of approximately USD11.48 per credit.
- Sectoral impacts: Preliminary results showed significant emission intensity reduction potential in textiles (28%), and paper and pulp (10%).
- Production fluctuations: At the simulated price, overall production impact remained minimal, fluctuating between -0.1% and +0.1%.
- Future work: Priorities include securing accurate baseline data from Bureau of Energy Efficiency (BEE), making the model multi-year to incorporate banking behaviour, and enabling cost pass-through analysis.

1.5 Roundtable critique of the modelling framework

Following the modelling presentation, a roundtable critique was convened. Key contributions included the following:

The first discussant queried the model's ability to handle sub-sectoral process targets — for example, distinguishing between smelters and integrated aluminium operations — and raised the question of how fuel price volatility should be incorporated.

The second discussant stressed that while initial modelling helps set policy direction, it is vital to incorporate actual market data once trading begins, using real-world outcomes to calibrate future target determination.

The third discussant highlighted that the core value of carbon trading is reducing the cost of compliance. She noted that "negative cost" abatement options often face prohibitive upfront capital barriers in practice, meaning that their theoretical cost advantage may not translate into real-world uptake without complementary financial instruments.

Session 2: Market stability, design choices, and the road ahead

Session 2 opened with a presentation by **Subham Shrivastava, Climate Finance Analyst, South Asia, IEEFA**, on price stability mechanisms and future design pathways for the CCTS, followed by an invited roundtable discussion moderated by **IEEFA's Dr. Saurabh Trivedi**. Participants included

policymakers, sector representatives, technical experts, and researchers. The discussion spanned substantive themes, summarised below.

2.1 Compliance market design and price formation

Participants drew on international experience to frame expectations for the CCTS. International experience suggests that many compliance carbon markets face initial challenges, particularly in early phases where credit supply may exceed demand and price signals take time to emerge. Participants noted that these dynamics can influence the pace of behavioural change among regulated entities .

- The EU Emissions Trading System (ETS), China's national ETS, and South Korea's K-ETS were cited as cases where prices remained too low for extended periods before policy interventions introduced meaningful scarcity.
- A central theme was that carbon markets are only as effective as the political commitment and target stringency that underpin them. Price management mechanisms, however well-designed, cannot substitute credible emission constraints.
- Current reduction targets of around 2–3%, while effective for easing entities into compliance, would require to be revised upward. At this level, targets can be met through routine energy efficiency measures rather than process-level abatement, risking an oversupply of credits and a weak price signal, a dynamic also observed under the Perform, Achieve and Trade (PAT) scheme.
- Participants highlighted the importance of establishing an expected price band and medium-term trajectory, not to determine price administratively, but to give regulated entities a basis for long-run investment planning.
- Whether price management tools (price floors, ceilings, market stability reserves) should be introduced from the outset generated genuine debate:
    - Some speakers cautioned that early introduction of stability mechanisms could suppress price discovery and distort market signals.
    - Others noted the countervailing risk: If prices remain low in the early compliance cycles due to oversupply, recovery may take many years, as seen in several established systems. Early structural safeguards may therefore reduce the risk of locking in a low-price equilibrium.
- There was consensus that expectations in the first compliance cycle should remain realistic. Pursuing very high carbon prices before market institutions have matured risks generating industry resistance and undermining long-term market acceptance.
- Behavioural dynamics and market power were also flagged as modelling gaps: The top 10% of emitters account for approximately 60% of emissions, potential market power asymmetries that may not be fully reflected in standard facility-level modelling approaches. Firm investment decisions are driven by confidence in the market's long-term survival across policy cycles, not just the current carbon price. Human-actor simulations and top-down macroeconomic models were suggested as useful complements.

2.2 Lessons from the PAT scheme

India's prior market-based mechanism — the PAT scheme — was examined as a domestic reference point, with participants identifying both its achievements and structural limitations.

- PAT successfully nudged firms toward energy efficiency improvements and demonstrated that intensity-based targets are operationally feasible in the Indian industrial context. However, trading activity under PAT remained limited, as most firms met their targets through relatively modest operational changes rather than structural decarbonisation, a dynamic that the CCTS would have to manage if targets lead to an oversupply.
- Unlimited banking of ESCerts contributed to surplus accumulation, weakening price signals and reducing trading. Banking rules under the CCTS will require careful design.
- PAT primarily addressed energy intensity improvements rather than process-level emissions. Deeper decarbonisation challenges in industries such as steel and cement, where structural reductions require significant capital expenditure and technology shifts, remain largely unaddressed by earlier schemes.
- A prior simulation with human participants demonstrated a 28% reduction in compliance costs compared to non-market approaches. However, even negative-cost abatement options frequently went untaken due to high upfront capital requirements, physical space constraints, and capital lock-in.

2.3 Target setting and long-term policy signals

The discussion on target-setting centred on the tension between near-term implementation feasibility and the long-term investment signals that capital-intensive sectors require.

- Sectors such as steel, cement, and aluminium make investment decisions tied to asset lifetimes of two to four decades. Short-term or single-cycle targets offer insufficient certainty for firms to commit capital to large-scale abatement investments.
- Speakers highlighted the value of publishing long-term emission reduction trajectories or declining sectoral benchmarks, signalling the expected direction of carbon intensity requirements over a ten- to fifteen-year horizon, even if specific values are subject to periodic revision.
- There was discussion on the relative merits of sector-level versus facility-level benchmarks. Facility-level approaches based on historical emission intensities may inadvertently reward historically inefficient facilities (which receive easier targets due to higher baselines) while penalising better-performing ones. Sectoral benchmarks were proposed as a more robust and equitable alternative.
- A proposal was made for benchmarks to tighten automatically based on the volume of surplus credits in the previous compliance cycle, reducing dependence on discretionary policy decisions to maintain stringency over time.
- Benchmark stringency should increase over time in a predictable manner, creating a policy ratchet that generates credible pressure for deeper abatement without undermining short-term market stability.
- Several speakers emphasised that target-setting should be explicitly linked to India's Nationally Determined Contribution (NDC) commitments, ensuring that the CCTS contributes meaningfully to national climate goals rather than operating as a standalone industrial efficiency scheme.

2.4 Sectoral coverage and structural considerations

The composition of the sectors currently covered by the CCTS drew significant attention from participants.

- They noted and discussed that the power sector's current exclusion could limit market liquidity and the breadth of the price signal, given that electricity generation is included in major international carbon markets. Major international carbon markets — the EU ETS, China's ETS, and South Korea's K-ETS — prioritised electricity generation given its scale and the relatively accessible abatement options available. Participants also noted that excluding it could limit market liquidity and the strength of the carbon price signal.[1]
- Participants understood this exclusion to reflect India's political economy: Electricity tariffs are regulated, and carbon pricing in the power sector could result in cost pass-through to consumers and distribution companies (DISCOMs), with significant distributional implications. Inclusion also raises concerns about circular inflationary effects, as higher electricity costs ripple through all covered industrial sectors. This trade-off warrants explicit modelling before any policy decision on inclusion is made.
- Expanding sectoral coverage over successive compliance cycles was identified as important for two reasons: Improving market liquidity through more participants and larger trading volumes, and broadening the range of emission reduction options available to the market.

2.5 Coherence with overlapping instruments

A theme that cut across the discussion was the risk of policy incoherence arising from the simultaneous operation of multiple environmental market instruments.

- The CCTS operates alongside RECs and the Green Credit Framework, creating a potential risk of double-counting where the same environmental benefit is claimed under multiple schemes.
- Without clear rules on how the CCTS interacts with other carbon pricing mechanisms, the carbon price signal could become inconsistent or unreliable. Some participants called for explicit coordination rules to be established before the CCTS launches.

2.6 Integration of offsets and development of a domestic offset ecosystem

The role of offsets both within the compliance framework and as a standalone domestic instrument was a substantive focus of the roundtable.

- Integrating offsets into the compliance market too early was widely seen as a potential but temporal risk. Given that most regulated firms are currently expected to meet their emission intensity targets through relatively modest operational improvements, early offset availability would increase credit supply, dampen prices, and weaken incentives for real emission reductions.
- Offsets were therefore seen as a mechanism better suited to later compliance phases when targets have tightened, marginal abatement costs have risen, and hard-to-abate sectors face genuine compliance constraints. In that context, well-governed offsets could provide valuable flexibility.

[1] Clarificatory note: The strength of the carbon price signal depends mostly on stringency and not sectoral coverage per se.

- A more calibrated deployment would be to use offsets specifically as an incentive for hard-to-mandate sectors such as micro, small and medium enterprises (MSMEs), once the compliance market has stabilised.
- Participants emphasised that any offset system must be underpinned by robust monitoring, reporting, and verification (MRV) frameworks and methodology standards consistent with environmental integrity principles.
- A domestic offset ecosystem was seen as potentially valuable beyond its compliance function. It could catalyse emission reduction activity in uncovered sectors (agriculture, waste, smaller industrial facilities) and support the development of a domestic carbon services industry, utility for which would require deeper analysis.
- Competition from established international voluntary carbon market registries (Gold Standard, Verra) was identified as a structural challenge for nascent domestic crediting systems.
- Transaction costs in carbon credit development were flagged as a material barrier, particularly for smaller entities and MSMEs. For large-scale projects, development and verification costs are manageable; for MSME-level interventions, they can be prohibitive. Transaction costs for credit generation can reach up to USD2 per credit for smaller projects. Institutional capacity-building and cost-reducing intermediaries were seen as necessary complements to any MSME-facing offset programme.
- The importance of government-managed registries with high transparency was emphasised to ensure trust and credibility in the domestic offset system.

2.7 International carbon markets and India's Article 6 strategy

The final theme addressed India's engagement with international carbon markets, particularly through the mechanisms established under Article 6 of the Paris Agreement.

- India has initiated bilateral arrangements under Article 6.2, including a joint crediting mechanism with Japan. These arrangements offer a potential channel for international capital to support emission reduction projects within India. India can also use Article 6.4 to attract international finance for high-cost technologies that domestic carbon prices cannot yet support. Strategic authorisation of specific technology categories for international crediting could help bridge this financing gap.
- Participants stressed the importance of corresponding adjustments — the accounting mechanism that prevents double-counting of emission reductions that are both transferred internationally and counted toward India's domestic NDC targets. Without robust corresponding adjustment procedures, international linkages risk undermining India's climate accounting integrity.
- Integration with international carbon markets was identified as a source of systemic risk: If domestic credits become tradable through international financial instruments such as futures and derivatives, the CCTS could be exposed to speculative capital flows and arbitrage dynamics that domestic regulatory tools may struggle to manage, particularly in the early phases of the market before governance frameworks have been adequately stress-tested.
- The legal status of carbon credits, whether a credit constitutes property or a bundle of rights, has direct implications for how SEBI and financial intermediaries can trade and hedge them. This question needs resolution before meaningful financial market integration can occur.

- The EU Carbon Border Adjustment Mechanism (CBAM) was noted as an external policy driver that will increasingly affect the competitiveness of Indian exports, and should be factored into domestic carbon market design.
- Strong and adaptive regulatory oversight was seen as essential to ensure that international linkages support rather than distort domestic market outcomes.
- Participants also cautioned against premature financial market integration before domestic governance frameworks have been adequately stress-tested.

Overall reflections and key takeaways

Several crosscutting themes emerged across both sessions, shaping the overall direction of the discussion. **Ms Shuchi Malhotra, Lead Advisor, EDF India**, delivered the closing remarks, synthesising the key takeaways from the workshop.

Three broad insights stood out:

1. **Early design choices will shape market outcomes for multiple cycles.** There was a sense that the first compliance cycles will do more than simply "start" the market and that they will anchor expectations on price, credibility, and policy intent. If early cycles are characterised by even modest but credible price signals, the right foundations are laid for long-term market acceptance and investment decisions. Conversely, experience from other systems suggests that when markets begin with persistent oversupply and low prices, recovery can take considerable time. Even a well-designed price and supply management mechanism cannot compensate if baselines are too lenient or sectoral coverage too narrow to generate meaningful scarcity in the first place.
2. **Targets matter as much as mechanisms.** Across the discussion, there was broad agreement that market performance will be driven primarily by the level and trajectory of targets. Trading, banking, and other design features can improve efficiency, but they cannot substitute for underlying stringency. India's PAT scheme was frequently cited in this context: It delivered compliance, but with limited price discovery in cycles where targets were relatively easy to meet. CCTS design should actively aim to avoid repeating this outcome.
3. **Sequencing of flexibility mechanisms will be critical.** Participants spent considerable time on when and how to introduce flexibility mechanisms including domestic offsets, credit banking provisions, and potential international linkages under Article 6. A consistent theme was that introducing too much flexibility too early could increase credit supply and dampen price signals before the market has matured. Both domestic offsets and Article 6 linkages carry significant design risks if deployed prematurely. At the same time, these mechanisms will become important as targets tighten and harder-to-abate sectors face genuine compliance constraints. The question is less "whether" and more about "when and how".

Three additional themes worth highlighting:

Long-term signals matter for industry. Capital-intensive sectors such as steel, cement, and aluminium make investment decisions tied to asset lifetimes of two to four decades. Single-cycle policy signals offer insufficient certainty for firms to commit capital to large-scale abatement investments. Long-term emission trajectories and declining benchmark schedules, even if indicative, would materially improve the investment environment for low-carbon technologies.

Policy coherence will be important. The CCTS does not operate in isolation. Without clear coordination rules with RECs and the Green Credit Programme, the integrity of the carbon price

signal risks being diluted and the same environmental benefit could be claimed under multiple schemes. Boundary protocols should be established as a precondition for full market operation.[2]

A broader question: Trading as a means, not an end. Several participants raised the question of whether active trading should be the primary metric of success, or whether the system's core objective should be to accelerate real emission reductions. This distinction has implications for how targets, flexibility mechanisms, and market development milestones ought to be designed and evaluated over successive compliance cycles.[3]

The modelling work presented at the workshop is intended as a decision-support tool to explore how different design choices could influence price outcomes and emissions trajectories under varying assumptions. Rather than producing precise forecasts, its value lies in illuminating trade-offs and directional effects, a function that will become increasingly important as the CCTS moves from design into implementation.

Next steps and areas requiring further work

The discussion highlighted that several aspects of the CCTS design remain under active development. Participants identified the following areas as warranting further analysis, research, and policy consultation prior to full implementation:

- Determination of long-term sectoral emission reduction trajectories and declining benchmark schedules, including consideration of auto-acceleration mechanisms linked to surplus credit accumulation.
- Design and calibration of price stability mechanisms (floors, ceilings, market stability reserves) and the conditions under which they should be triggered.
- Rules governing credit banking — limits, duration, vintaging by year of issuance, and provisions to avoid surplus accumulation.
- Framework for domestic offset integration, including measurement, reporting, and verification (MRV) standards, registry governance, and phasing-in conditions, with a focus on MSME accessibility.
- Corresponding adjustment protocols for Article 6 transactions to ensure NDC accounting integrity.
- Pathway for expanding sectoral coverage, including the conditions under which power sector inclusion could be reconsidered, with explicit modelling of the inflationary trade-off.
- Institutional capacity-building for MSME participation in offset markets and the development of cost-reducing intermediaries.
- Resolution of the legal status of carbon credits to enable financial market integration and SEBI oversight.
- Coordination framework across CCTS, RECs, and the Green Credit Programme to prevent double-counting and maintain signal integrity.
- Incorporation of CBAM implications into domestic market design to protect the competitiveness of Indian industrial exports.

[2] Clarificatory note: Complex boundary protocols risk adding administrative burden and creating new opportunities for manipulation. An alternative approach would be to set more stringent CCTS targets that account for emissions reductions already delivered by overlapping policies, ensuring the scheme drives additional reductions while keeping compliance simple and enforceable.
[3] Clarificatory note: Meaningful emissions reduction is the main aim for an ETS.

- Enhancement of the IIT Roorkee modelling framework: More granular facility-level data from BEE, better sub-sectoral disaggregation, incorporation of banking behaviour, cost pass-through dynamics, and market power asymmetries.

About the organising institutions

Institute for Energy Economics and Financial Analysis (IEEFA)

IEEFA examines issues related to energy markets, trends, technologies, and policies. Its mission is to accelerate the transition to a diverse, sustainable, and profitable energy economy through independent research and analysis that informs policymakers, industry, investors, and civil society. www.ieefa.org

Environmental Defense Fund (EDF)

A global non-profit, EDF collaborates with governments, NGOs, research and academic institutions, and corporate actors to support and advance India's vision of shared, sustainable prosperity. EDF combines scientific and economic foundations with a pragmatic approach in support of India's climate ambitions. www.edf.org/place/india

Indian Institute of Technology Roorkee (IIT Roorkee)

One of India's foremost institutes of national importance, IIT Roorkee has played a vital role in providing technical expertise across all sectors of India's development, and is widely recognised for its contributions to applied research in science, technology, and engineering. www.iitr.ac.in

Annexure 1: List of participating organisations

1. NITI Aayog
2. The Council on Energy, Environment and Water (CEEW)
3. World Resources Institute (WRI), India
4. India Sustainable Growth Hub
5. Energiva Ventures
6. cKinetics Inc.
7. Institute for Financial Management and Research (IFMR)
8. The Energy and Resources Institute (TERI)
9. J-PAL, South Asia
10. Yale University
11. World Bank
12. National Council of Applied Economic Research (NCAER)
13. Centre for Social and Economic Progress (CSEP)
14. Delegation of the European Union to India
15. PricewaterhouseCoopers (PwC)

16. ReNew Power
17. Intellecap
18. Swaniti
19. Ministry of Social Justice and Empowerment
20. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)