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Strengthening India's carbon market

The case for a stability mechanism in India's CCTS

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Key findings

India's forthcoming Carbon Credit Trading Scheme (CCTS), could face supply-demand imbalances and subdued price signals. This is an operational reality observed in several Emissions Trading Systems (ETSs) globally during their initial phases. Recognising this at the outset presents an opportunity to apply lessons from past experience and embed proactive institutional mechanisms that can help ensure the CCTS delivers lasting incentives for decarbonisation.

Lessons from other ETSs show that markets lacking Price or Supply Adjustment Mechanisms (PSAMs) suffer prolonged periods of low prices, investment inertia, and ultimately require costly, politically contentious reforms. In contrast, systems that integrate stability tools early on sustain stronger and more credible carbon prices.

This report recommends a stability mechanism tailored to India's CCTS that comprises three elements: a consignment auction system for transparent, rule-based credit interventions; a vintage-based credit classification to limit the impact of older surplus credits on future prices; and an existing price corridor to guide interventions when carbon prices deviate from expected levels.

Mechanisms like consignment auctions, vintage rules, and price corridors can operate within the mandates of regulators. Introducing them early can build familiarity with the approach and facilitate smoother market evolution.

Executive summary

The challenge: Ensuring market credibility from day one

India's Carbon Credit Trading Scheme (CCTS) represents a transformative shift in the country's climate policy architecture. Set to commence compliance in 2026, the CCTS adopts a baseline-and-credit system with facility-level intensity targets, allowing emissions to scale with economic growth while rewarding firms that outperform their benchmarks. This design offers considerable flexibility for a rapidly industrialising economy and marks a strong step in India's decarbonisation journey, while also highlighting the importance of proactive measures in maintaining long-term market balance.

One of the key design considerations for the CCTS should be managing potential supply-demand imbalances. Unlike cap-and-trade systems, which have fixed emissions limits, the CCTS generates credits based on performance against intensity targets. When combined with moderate initial benchmarks, unlimited banking provisions and the front-loading of low-cost abatement opportunities, this architecture may have potential for surplus credit accumulation. Such oversupply can suppress carbon prices below levels necessary to drive meaningful decarbonisation investments.

This concern is informed by India's experience with the Perform, Achieve and Trade (PAT) scheme. PAT was a pioneering step in market-based climate policy and created the institutional foundation for emissions trading in India. However, despite significant issuance of Energy Saving Certificates, trading volumes remained modest, underscoring how early design choices shape price formation.

International evidence: The cost of delayed intervention

Global carbon market experience provides compelling evidence that market stability mechanisms are essential. The EU's Emissions Trading System (ETS) operated for 14 years before implementing its Market Stability Reserve (MSR), during which time carbon prices languished between €3 and €7 per tonne – insufficient to drive low-carbon investment. A study by Climate Strategies[1] found that nearly two-thirds of the efficiency losses from the EU ETS's early years could have been avoided with earlier intervention. Similarly, in Canada, Alberta's Technology Innovation and Emissions Reduction system accumulated more than 53 million surplus credits by 2023, pushing market prices 40% below the official fund price. Australia's Safeguard Mechanism operated for seven years with effectively zero carbon price signal before major reforms in 2023 finally introduced meaningful scarcity. In contrast, California's cap-and-trade system, which implemented comprehensive stability measures from the outset, has maintained consistently stronger price signals.

The pattern is clear: markets that postpone stability mechanisms typically face significant challenges requiring disruptive corrections. Delayed intervention allows oversupply to become structural,

[1] Neuhoff, Karsten, W. Acworth, R. Betz, D. Burtraw, J. Cludius, H. Fell, C. Hepburn et al. "Is a Market Stability Reserve likely to improve the functioning of the EU ETS." No. VIII). Climate Strategies (2015).

weakens investment incentives, and necessitates more substantial reforms than would have been required otherwise. The political economy of these corrections is invariably more contentious than preventive measures embedded from the outset.

The solution: Price or supply adjustment mechanisms as market anchors

Price or Supply Adjustment Mechanisms (PSAMs) should ideally provide a transparent, rule-based, fiscally prudent and administratively efficient means of maintaining market balance without significantly altering the fundamental architecture of the CCTS. Rather than relying on ad hoc interventions or fiscally inefficient methods of buying back credits to modulate supply, PSAMs use predefined quantitative triggers to adjust credit supply when thresholds are reached. They act as stabilisers, containing both persistent oversupply and extreme scarcity, anchoring market expectations, and preserving space for genuine price discovery. PSAMs are necessary even in a system with well-aligned targets and allocations. Real-world markets inevitably face external shocks, regulatory uncertainty, overlapping policies, and liquidity constraints, all of which can destabilise prices for extended periods. By buffering against these imperfections, PSAMs ensure that carbon prices remain credible and predictable, sustaining the long-term investment signals required for decarbonisation.

While PSAMs have a rationale for implementation, a practical question remains: how can regulators effectively intervene to adjust credit supply within the Indian CCTS's unique market framework? The EU ETS's MSR demonstrates one approach, but its reliance on complex quantitative algorithms and comprehensive historical datasets may not suit India's upcoming CCTS infrastructure in the initial stages. Instead, the proposed framework integrates three complementary mechanisms – consignment auctions, vintage-based credit classification, and price corridors – specifically designed to operate within India's current institutional capabilities and gradually evolving data.

First, a consignment auction system can create the operational infrastructure necessary for supply interventions. Since the CCTS issues credits only after verified performance, unlike cap-and-trade systems with regular government auctions, a consignment mechanism allows firms to voluntarily submit earned credits to a government-managed platform. This preserves property/emissions rights while enabling price discovery, and provides regulators a transparent channel for rule-based interventions.

Second, a vintage-based credit classification system – elements of which are already present in the CCTS design including a tag for each Carbon Credit Certificate (CCC) with its issuance year, and limit compliance eligibility to recent vintages. This approach serves as a soft cap on banking accumulation, preventing long-dated surpluses from destabilising future price signals while maintaining intertemporal flexibility for firms. Older credits would either expire or face progressive devaluation according to predetermined schedules, ensuring banking serves its intended purpose of smoothing compliance costs rather than enabling indefinite speculation.

Importantly, vintaging should not be perceived as a mechanism to reclaim legitimately earned credits but as a standard governance feature of ETSs. By setting transparent, time-bound compliance windows, vintaging preserves ownership while ensuring that credits reflect timely abatement. This safeguards the value of credits and maintains a level playing field by preventing large legacy surpluses from weakening incentives for newer or smaller participants.

Third, a price corridor framework can guide PSAM interventions without imposing rigid price controls. Building on the CCTS's existing price collar, this mechanism can trigger credit withholding when prices fall below the lower bound, and reserve releases when prices exceed the upper threshold. The corridor can be updated periodically to reflect evolving marginal abatement costs, inflation and India's long-term decarbonisation trajectory.

The strategic imperative: Acting with foresight

The timing of PSAM implementation is as critical as its design. Timely adoption in the lifecycle of the ETS offers four distinct advantages. First, it enables proactive market management that can prevent the reactive corrections that have challenged other carbon markets, where accumulated imbalances required disruptive and politically contested reforms. Second, it helps maintain market balance during the formative years when market norms and expectations are being established, preventing structural oversupply from becoming entrenched. Third, it builds predictability into the system, enabling confident long-term investment decisions by signalling how the market will respond to various conditions. Fourth, it allows for gradual calibration, beginning with modest parameters that can evolve with market maturity rather than requiring dramatic interventions when imbalances become severe.

The institutional feasibility of a timely PSAM implementation in India is stronger than might initially appear. Each proposed mechanism – consignment auctions, vintage rules and price corridors – can operate within existing regulatory mandates and can be scaled with institutional capacity. The Bureau of Energy Efficiency has the technical foundation for credit tracking and auction management, while the Central Electricity Regulatory Commission has oversight capabilities. Embedding these mechanisms at the appropriate time avoids the political resistance that typically accompanies retrospective market reforms.

Building credibility through design

India's CCTS is more than an environmental policy – it is a strategic climate policy instrument for aligning domestic industrial development with global low-carbon norms. Its success will be measured not just by compliance rates or administrative efficiency, but by its ability to generate credible, sustained price signals that direct capital towards clean technologies and operational improvements. This requires moving beyond the assumption that markets will naturally self-correct, and instead, recognising that effective carbon pricing depends on careful institutional design and active stewardship.

Integrating PSAMs at the onset of the CCTS would signal that India views carbon markets as a lasting part of its economic architecture, not a transitional experiment. Acting with foresight would position the CCTS as a global exemplar, balancing flexibility with discipline, supporting industrial competitiveness while driving decarbonisation, and maintaining credibility across economic and political cycles. The window for such proactive design is open, but it may not remain so indefinitely. Policymakers can learn from other markets' experiences and incorporate insights in the CCTS design.

Ultimately, credibility and fairness must go hand in hand. Designing a fiscally prudent and administratively efficient PSAM not only preserves credit values through predictable rules but also ensures that the benefits of carbon pricing are distributed evenly across participants. By embedding such measures early, India can build a market that is both stable and equitable.

Introduction

Key questions for India's carbon market design

As India prepares to operationalise its Carbon Credit Trading Scheme (CCTS) with compliance obligations in 2026, the initial phase of emissions monitoring and reporting – through mandatory monitoring plans and early data submissions – is already underway. This staggered rollout follows international best practice, enabling institutional capacity-building, familiarising obligated entities with the system, and generating early insights to support both regulatory refinement and market preparedness.

While all Emissions Trading Systems (ETSs) evolve through market forces and regulatory refinement, experience from established carbon markets worldwide shows that early implementation of well-designed stability mechanisms can significantly improve market functioning. Although Price or Supply Adjustment Mechanisms (PSAMs) are valuable for all types of ETSs – whether cap-and-trade or baseline-and-credit – their design must be tailored to each market's unique characteristics.

PSAMs are institutional tools designed to help carbon markets remain aligned with their environmental, economic and investment objectives. Their core function is to maintain credible price signals, ensure credit supply reflects actual abatement ambition, and anchor market expectations through transparent, rule-based interventions. Unlike ad hoc regulatory fixes, PSAMs operate within the market's architecture, adjusting supply through predefined, quantitative actions such as withholding, releasing or retiring credits based on clear triggers. These triggers can be price-based, quantity-based or hybrid, allowing regulators to respond flexibly to evolving market conditions without undermining credibility.

This paper addresses three key questions:

- **Why does India's CCTS require a PSAM?** We examine the structural factors that can lead to market imbalances in ETSs, with particular attention to India's specific design features.
- **What design options are most suitable for India?** We propose a high-level PSAM mechanism, integrated with complementary design elements, tailored to India's institutional capacity and market structure.
- **When should such mechanisms be implemented?** We discuss the advantages of timely implementation.

By addressing these questions, this paper aims to inform the development of India's CCTS at this critical juncture when foundational design choices will shape the market's ability to deliver on both environmental and economic objectives.

Overview of India's CCTS

India's CCTS, officially notified but not yet operational, represents a major advancement in climate policy that aims to drive industrial decarbonisation while supporting economic growth. As India's forthcoming ETS, the CCTS will adopt a baseline-and-credit approach with intensity-based targets.

What are ETSs?

ETSs aim to leverage market-based incentives to achieve cost-effective emissions reductions through tradable allowances or credits rather than uniform command and control approaches that rely on regulator-imposed standards. Instead of mandating specific technologies or imposing uniform standards, ETSs define an aggregate constraint on emissions through either a cap or an intensity-based baseline, allocate allowances or credits (freely or by auction), allow regulated entities to trade credits, monitor emissions and enforce compliance. This design incentivises firms to identify and implement the least-cost mitigation options, wherever and whenever they occur, thereby improving allocative efficiency, fostering innovation, and enabling greater compliance flexibility than conventional regulatory tools. Drawing on the Coasean insight that well-defined, enforceable and tradable property rights can lead to efficient outcomes even under externalities,[2] ETSs transform emissions from an unpriced societal cost into a managed liability. This approach reduces the information burden on regulators, who need only establish boundary conditions while allowing the market to discover cost-effective solutions.

Industrial modernisation and co-benefits

Beyond climate mitigation, the CCTS serves as an instrument of industrial modernisation. By tying rewards to performance, it incentivises firms to improve operational efficiency, adopt cleaner technologies, and strengthen data management systems. These upgrades not only reduce emissions intensity but also enhance competitiveness and resource productivity. In India, where accelerating industrial development is a strategic priority, this alignment between emissions performance and broader economic efficiency offers a compelling rationale for adopting emissions trading.

ETSs enable adaptive policy architecture through mechanisms such as intertemporal compliance provisions and market-based design, which are valuable for managing uncertainty during long-term transitions and where rigid command-based policies may struggle to accommodate evolving information, technologies, and sectoral dynamics.

Alignment with India's climate commitments

The CCTS is designed to serve as one of the main components of India's mitigation strategy in energy-intensive sectors. By assigning intensity-based targets to covered entities, and creating a

[2] Journal of Law and Economics. The Problem of Social Cost. Coase, R. H. 1960. Volume 3(1), Page-1-44.

framework for trading excess reductions, the scheme aligns domestic mitigation efforts with India's Nationally Determined Contributions (NDCs) under the Paris Agreement. In doing so, it aims to reduce emissions intensity in line with national targets while preserving space for economic growth and structural transformation.

The CCTS also strengthens India's position within the evolving international climate and trade landscape. As mechanisms such as the EU's Carbon Border Adjustment Mechanism (CBAM) become operational, exporting sectors are likely to face growing scrutiny of embedded emissions in their products. A credible domestic carbon market can enable India to demonstrate environmental equivalence, and assert claims for CBAM exemption, while potentially opening pathways for Article 6.2 co-operation[3] and climate finance.

In this broader context, India's CCTS is more than just an environmental policy. It is a strategic instrument for aligning domestic development with global low-carbon norms, enhancing industrial competitiveness, and building institutions for climate and economic resilience. The scheme's implementation timeline is highlighted below (Figure 1).

Figure 1: India's CCTS implementation timeline

Source: IEEFA. Note: ACVA = Accredited Carbon Verification Agency

Key design features of the CCTS

Baseline-and-credit system

India's CCTS is structured as a **baseline-and-credit system** wherein each obligated entity is assigned a facility-specific greenhouse gas (GHG) emissions intensity target. If the entity's verified emissions intensity in a compliance year is lower than its assigned target, it earns **Carbon Credit Certificates (CCCs)** proportional to the overperformance and output volume. Conversely, if its

[3] It enables countries to engage in voluntary bilateral or multilateral cooperation through the transfer of internationally transferred mitigation outcomes (ITMOs), allowing emission reductions achieved in one country to count toward another's NDC.

emissions intensity exceeds the target, the entity must surrender CCCs to cover the shortfall (Figure 2).

Figure 2: How a baseline-and-credit system works

While India's baseline-and-credit architecture resembles output-based allocation (OBA) approaches used in California and New Zealand, it differs in timing rather than structure. In these systems, firms effectively receive an implicit entitlement to emit up to a certain emissions intensity per unit of output without cost. The compliance obligation is determined retrospectively, based on actual performance relative to this threshold. In California and New Zealand, allowances are allocated based on expected output and later adjusted when actual output is recorded, much like India's CCTS where credits will be issued post the actual performance is validated. However, a key operational difference is that Indian firms can only trade credits after verification whereas OBA systems often allow trading earlier.

The CCTS, by design, lacks an economy-wide emissions ceiling, allowing credit supply to adjust with economic growth while preserving environmental integrity through stringent, differentiated baselines. Thus, while both approaches modulate carbon cost exposure to protect competitiveness and reward efficiency, India's CCTS issues credits only for emissions below the target, and requires surrender for emissions above it, rather than allocating allowances in advance. However, the economic logic is similar to systems used in California and New Zealand.

This emissions-intensity-based approach reflects a core design choice: to drive mitigation through performance-linked incentives while maintaining economic flexibility. Unlike cap-and-trade systems, intensity-based cap systems allow aggregate emissions to rise with output, but reward firms that decarbonise faster than their peers. This makes these systems particularly suited to fast-growing, industrialising economies where high output volatility can make rigid caps economically risky, amplifying carbon price uncertainty and undermining predictable investment signals for decarbonisation.

A distinguishing feature of India's design is the granularity of its target-setting framework. **Targets are assigned at the facility level**, not just sector or subsector level, thereby capturing firm-specific differences in emissions intensity, process design and technological maturity. This granularity is particularly relevant in sectors with high intrasectoral heterogeneity, such as between integrated and mini steel plants or among refineries with differing configurations, where a uniform benchmark could create inequities or distort competition. By tailoring targets at the facility level, the system can better reflect actual abatement potential, reduce excessive credit transfers, and mitigate political resistance that can arise when policy design leads to abrupt shifts in costs across firms. The design, thus, balances efficiency and distributional considerations.

The **target-setting methodology**, as outlined in the official procedure document,[4] builds on a structured trajectory framework. The Bureau of Energy Efficiency (BEE), with oversight from the National Steering Committee, develops **sectoral emissions intensity trajectories** aligned with India's decarbonisation commitments. These trajectories incorporate multiple inputs: expected sectoral mitigation potential, technology availability, associated costs and the extent of energy efficiency or fuel switching possible. Importantly, it has been indicated that **only technologies with technology readiness level greater than 7,** representing mature, deployable technologies, are considered for incorporation into benchmark construction. This ensures targets are both ambitious and grounded in operational feasibility. Following the sectoral trajectory, **facility-specific targets** are determined based on the relative emissions intensity of each unit within its subsector. This benchmarking logic avoids one-size-fits-all stringency (which could impose disproportionate burdens on certain facilities due to structural or process-level differences) and provides a transparent rationale for differentiation. The trajectory is fixed for a multi-year "compliance cycle" (currently three years), but annual targets are notified for each compliance year within the cycle. This phased tightening approach provides regulatory certainty while allowing firms to plan investments accordingly.

Intensity-based system

This architecture reflects a deliberate balancing of climate ambition, economic flexibility and administrative pragmatism, aligning with India's developmental priorities and institutional capacities while preserving key economic incentives for decarbonisation.

Unlike cap-and-trade systems, this system allows emissions to scale with production, thereby embedding flexibility within the structure of the market itself. By linking obligations to output rather than absolute levels, the scheme avoids the risk of unintentionally penalising economic expansion.

Intensity-based systems also offer a pragmatic response to a deeper knowledge challenge: in many sectors and geographies, especially in a country like India, the "socially optimal" or technologically feasible absolute emissions level is not clearly known beforehand. Fixed caps require regulators to forecast total emissions precisely, which can be especially difficult in settings with diverse industrial processes, evolving technologies and limited data. While intensity targets do not eliminate uncertainty in abatement costs or emissions intensity, they reduce the need to predict total output or

[4] Bureau of Energy Efficiency (BEE). Detailed Procedure for Compliance Mechanism under CCTS. July 2024.

the scale of economic expansion. This makes them more flexible and politically feasible in fast-growing, heterogeneous economies. Intensity targets impose a directional constraint, driving continuous improvement per unit of output while preserving space for growth.

While systems such as the CCTS do not set a hard cap on absolute emissions, they do imply a notional emissions ceiling based on the level of output and the assigned intensity target. This makes intensity-based target systems inherently flexible: as output rises, allowable emissions rise proportionally, maintaining compliance feasibility during economic expansion. Yet, this flexibility is limited. By tightening benchmarks over time, regulators can control aggregate emissions outcomes while avoiding the rigidity of fixed quantity caps. In this sense, intensity-based ETSs reflect a bounded rationality approach to regulation, allowing emissions governance to proceed under uncertainty, while retaining the ability to steer long-term outcomes through the scheduled tightening of intensity benchmarks.

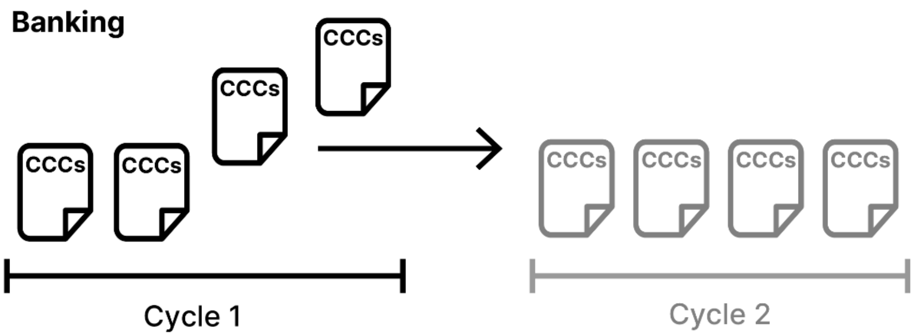
Intensity-based systems suit India's diverse industrial landscape by leveraging differences in firms' abatement costs while encouraging cost-effective reductions. Facilities that emit less per unit of output than their benchmark earn tradable CCCs, while those that exceed the benchmark must buy credits or invest in abatement. This ensures emissions reductions happen where they are cheapest, preserving efficiency. It also aligns with India's facility-level monitoring, reporting and verification (MRV) systems, which are typically better equipped to monitor intensity metrics than absolute emissions, especially in complex, multi-output plants.

India's implementation of this model through a three-year "trajectory period" introduces a phased tightening of sector-specific intensity targets, grounded in observed performance, technology diffusion and cost considerations. This enables the system to adapt as new information becomes available while maintaining a clear forward signal. Firms that outperform these dynamic benchmarks generate CCCs while underperforming entities must procure them from the market, creating both flexibility and accountability.

Intertemporal flexibility provisions

The CCTS incorporates intertemporal flexibility through credit banking (Figure 3), allowing entities to carry forward surplus CCCs from one compliance cycle to the next. This feature introduces flexibility into what is otherwise a rigid annual compliance obligation and is widely seen as a foundational element of ETSs globally.

Figure 3: Banking of CCCs



Banking credits serves multiple purposes:

- It allows firms to smooth their compliance costs over time, reducing exposure to short-term volatility in emissions, production or credit prices. In years where abatement is cheaper, or operational changes lead to improved performance against targets, entities can over-comply and bank surplus credits. These can be used later when compliance is more costly or when emissions intensity performance falls short of targets.
- Banking also enables firms to act on superior knowledge of near-term abatement opportunities, such as emerging technologies or falling mitigation costs, potentially allowing the market to deliver faster emissions reductions than regulators anticipate. This yields short-term climate benefits while maintaining long-run compliance flexibility.
- The flexibility offered by banking contributes to market stability. It helps avoid sharp swings in credit demand and prices between compliance periods. By enabling firms to act based on forward-looking expectations, banking can facilitate early investments in low-carbon technologies. In this sense, it enhances the dynamic efficiency of the system – firms are incentivised not just to comply at minimum cost in a given year, but to optimise across time.

The CCTS's design does not impose a formal expiry date or devaluation rule on banked credits. While this approach offers maximum flexibility, it can also result in higher early credit accumulation due to generous benchmarks or low mitigation costs that could influence demand. Without limits, indefinite banking can lead to a build-up of surplus credits that suppress market prices in later periods unless benchmarks are adjusted. This could affect marginal abatement incentives and weaken the market's alignment with India's broader decarbonisation trajectory. If India later decides to transition to an auction-based system, excess credit accumulation could lower future credit prices and reduce demand for newly auctioned units. This, in turn, can undermine the fiscal rationale for auctioning by lowering potential government revenues. (We discuss this in detail later in the report.)

Balancing the market: The case for a PSAM in the CCTS

Carbon markets as regulatory constructs

India's CCTS, like all emissions trading systems, is not a market in the classical sense. It is a policy instrument constructed to control emissions through regulatory definitions of supply, demand and compliance. Every aspect of the market is shaped by institutional design, making the balance between supply and demand a result of policy parameters rather than emerging from organic scarcity or production costs as in conventional markets.

In terms of carbon credits, the key distinction between regulatory supply and market supply is often overlooked.

- Regulatory supply refers to the total carbon credits that could theoretically be issued under the scheme. This upper bound is determined by the stringency of emissions benchmarks, baseline-setting methodology, actual output levels and observed mitigation performance.
- Market supply, by contrast, reflects the subset of these credits that are actively offered for trade in the market. Especially in the early phases of a scheme, market supply may remain thin, even when regulatory supply is abundant.

This difference becomes central to discussions on supply responsiveness. One might assume that if mitigation is inexpensive and firms outperform their targets, credit supply will increase, and prices will adjust accordingly. However, this is rarely immediate or automatic. When carbon prices are low and future policy signals are unclear, firms often prefer to bank credits rather than sell them. As a result, what looks like supply responsiveness at the generation level does not translate into immediate market liquidity or price correction. This is a **rational strategy**: selling into a depressed market would further weaken prices. In theory, widespread banking could help rebalance the market by absorbing credits. But this mechanism depends on firms' confidence in future scarcity and stronger price signals. If those expectations are weak or uncertain, even extensive banking may fail to restore meaningful price levels. In such cases, structural oversupply often caused by generous initial benchmarks or unexpected drops in demand can persist across compliance cycles, dampening the carbon price signal and delaying deeper decarbonisation. In this context, a PSAM is needed to sustain credible price signals.

These conceptual dynamics, where credit supply appears abundant on paper but limited in trade, are especially relevant. India's CCTS, with its baseline-and-credit structure, shares important features with OBA systems. In these systems, credit generation is endogenous: it scales with output, and depends on how individual facilities perform against their intensity targets. However, this endogeneity does not necessarily stabilise the market. If initial targets are lenient, as is often the case to encourage market uptake, even modest operational changes or low-cost interventions by firms can generate large volumes of credits. These "low-hanging" technology-driven reductions are often front-loaded, and their credits may be banked in large volumes, creating a persistent surplus.

Over time, such accumulation can lead to design-induced imbalances, with banked credits far exceeding near-term mitigation needs. This surplus remains only if firms anticipate future stringency or higher prices; otherwise, it may be liquidated, further depressing prices. Such structural oversupply is not corrected by output cycles or marginal price signals, as it originates in the system's governance architecture.

Although India's CCTS includes a price collar to prevent extreme price fluctuations, this instrument alone cannot address structural oversupply. The floor price provides a safety net, but does not create real scarcity. Experience from PAT demonstrates that prices can remain anchored to administrative floors when surplus credits are abundant, highlighting the importance of complementary supply management mechanisms for maintaining investment incentives.

> **Without real scarcity in the market, prices may remain anchored to the floor.**

The challenge may get amplified by using periodic market clearing price (MCP) auctions instead of continuous trading in the CCTS.[5] Because price discovery happens intermittently, the market reacts slowly to evolving imbalances. If large surpluses enter the auction at once, even a floor price may not prevent the perception of market weakness. Instead, it could delay investment or trigger regulatory intervention, especially since sellers may be rationed if demand at the floor is insufficient, leaving some credits unsold.

The CCTS is a regulatory instrument designed to meet multiple public goals. While its core mandate is to drive measurable emissions reductions, its success also depends on how efficiently and equitably those reductions are delivered. A well-functioning market must enable a cost-effective and dynamic transition to a cleaner, more competitive industrial sector. That requires careful attention not only to how credits are created, but also to how they circulate. Distinguishing theoretical supply from actual market availability is therefore critical to building a credible and resilient system.

Defining problematic credit accumulation

Credit accumulation and banking represent rational compliance behaviour, as firms often exceed required reductions to hedge against future uncertainty, tightening targets and potential cost spikes. The CCTS's banking provisions enhance this strategy by allowing firms to bank credits across

[5] The details of the MCP mechanism are yet to be finalised.

compliance cycles. This helps firms manage production volatility while contributing to market stability.

Yet, when early credit surpluses grow faster than future compliance demand, banking may tip into structural oversupply. This risk is amplified if initial targets are relatively accommodating or when early-stage abatement is cheap and abundant. What begins as rational firm-level hedging can result in structural oversupply that suppresses price signals, delays deeper decarbonisation, and undermines the carbon market's core function.

Oversupply in this sense is not just a temporary market fluctuation but a structural imbalance. It erodes the scarcity that gives ETSs environmental and economic power. When credit availability exceeds what is necessary for compliance over a sustained period, it weakens incentives for clean investment, delaying or shelving strategic decarbonisation decisions.

> **When credit availability persistently exceeds compliance needs, prices remain too low to trigger the capital-intensive abatement required for long-term transition. This weakens clean investment incentives, and reinforces expectations of low prices, causing firms to delay or forgo strategic decarbonisation decisions.**

One common pattern across multiple global ETSs is the tendency to initially set generous targets to ease market transition, and safeguard economic growth. This is not due to lack of ambition or willingness but to avoid administrative challenges with serious consequences, and facilitate the ETS rollout for firms. However, such flexibility in targets has historically not been rapidly reversed, and has led to systematic oversupply, a risk heightened by sector-specific dynamics.

That said, decarbonisation does not always follow a linear progression up the marginal abatement cost curve. Some firms may adopt capital-intensive options – such as electrification – early, especially where enabling infrastructure exists. Deeper reductions, however, will require expensive and less mature technologies such as green hydrogen or CCUS.[6] While rising carbon prices can help unlock these, ETS prices do not increase automatically as low-cost options are exhausted. In reality, price trajectories reflect, to some extent, not only economic principles (e.g. the Hotelling

[6] While CCUS is often cited as a decarbonisation option, its track record remains limited, with high costs, scalability challenges, and frequent project underperformance raising concerns about its viability as a core mitigation pathway. Refer to IEEFA's analysis on CCUS - https://ieefa.org/ccs.

rule[7]) but also political expectations. Often, it is weak confidence in future policy stringency, not cost curves, that keeps prices suppressed.

If firms mitigate faster than expected in the early years, targets are likely to be too generous, and the generation of surplus CCCs from the early uptake of cost-effective measures may lead to market oversupply. This could suppress carbon prices and undermine the long-term goals of the CCTS, particularly if investors believe the low prices will last.

> **While banking provides flexibility, the CCTS faces a risk of structural oversupply when early-phase "low-hanging fruit" reductions generate credit surpluses faster than the market requires for compliance, which may lead to price suppression that undermines long-term decarbonisation objectives.**

When intensity-based targets are insufficiently stringent relative to achievable performance levels, most entities can reduce emissions intensity below their targets. While rising output increases the total volume of credits generated, it also expands future credit demand. What matters here is not the accumulation of credits alone, but whether they exceed what will be required under tighter targets in future. If those targets are not tightened quickly, or if market participants doubt they will be, prices remain low, delaying investment in transformative decarbonisation. This pattern, observed across several ETSs, highlights the importance of credible and timely tightening of baselines to anchor expectations and maintain price integrity.

The implications of indefinite banking

The CCTS faces a potential challenge due to its lack of temporal restrictions. As outlined in Section 10 of the Detailed Procedure for Compliance Mechanism under the Indian Carbon Market,[8] obligated entities may indefinitely carry forward surplus CCCs from one compliance year to meet future obligations. However, if credit surpluses accumulate early without clear signals of tightening, prices may remain artificially low, only to rise abruptly when surpluses are exhausted. This dynamic can destabilise market liquidity and erode confidence in long-term investment signals.

[7] The Hotelling rule suggests that the price of a scarce resource (like carbon allowances) should rise over time at the rate of interest, reflecting growing scarcity.
[8] BEE. Detailed Procedure for Compliance Mechanism under the Indian Carbon Market. July 2024. Page 38.

Firms may meet future obligations by drawing down past surpluses rather than investing in new abatement. This weakens price signals and delays transformation, undermining the system's intended role to support a gradual, investment-driven decarbonisation pathway with rising and credible price signals. The larger the legacy bank, the more persistent this drag becomes, as seen in New Zealand's case (discussed later).

> **Banking brings forward reductions: Firms that expect tighter targets later have an incentive to cut early and store surplus credits. The difficulty arises when generous initial benchmarks create more credits than future targets can absorb.**

While benchmark tightening is the logical path forward in an intensity-based system, a large legacy surplus may require exceptionally sharp tightening just to neutralise past 'overallocation', before any meaningful price signal can emerge to support India's decarbonisation and industrial efficiency goals. However, such "super-tightening" is politically difficult, and risks resistance from industry, making it an unreliable lever to restore market scarcity. This is where a PSAM becomes essential. Rather than relying on politically costly, one-time corrections, a PSAM offers a dynamic, rule-based approach to adjust supply in response to observed imbalances, restoring scarcity, supporting price credibility and building trust in the system's long-term stability. We explore the rationale and design of a PSAM further in the report.

Root causes of market imbalance

Having examined the risks of market imbalance within the CCTS, particularly the dynamics of oversupply, weak price signals and delayed mitigation, it is essential to explore the underlying drivers. Understanding the root causes of these imbalances at a structural level is critical to designing effective corrective mechanisms, such as PSAMs, and ensuring the long-term credibility of the market.

Benchmark-setting challenges

One of the foundational drivers of market imbalance in the early phases of ETSs is the challenge of setting appropriate emissions intensity benchmarks. The core issue is not information asymmetry per se, but a pervasive uncertainty; regulators must make decisions under conditions of limited knowledge about firms' true abatement costs and reduction potential. This uncertainty is particularly acute when an ETS is introduced early in a country's decarbonisation journey.

India’s initial target-setting under the CCTS reflects this broader challenge. The reduction targets assigned for the first CCTS compliance year (2025-26) are modest, typically ranging from 2-3%. These deepen marginally in the second year. This phased design suggests a strategic calibration: easing entities into the new system with manageable initial obligations, followed by a controlled escalation in ambition once institutions and compliance frameworks gain maturity.

This pattern reflects a well-documented design tendency across global ETS implementations. Regulators – aware of the political and economic risks associated with overestimating feasible reductions – often opt for conservative benchmarks in the early years. These are justified as transitional measures intended to facilitate market entry, avoid disruptive compliance costs, and allow for institutional learning. India’s approach mirrors that of its global precedents: ETSs in the EU, South Korea and China all encountered early-phase credit surpluses due to initial overallocations and lenient baselines, but without a safety net to create scarcity.

If early benchmarks are not aligned with actual mitigation potential, large volumes of credits may be generated with limited real abatement, a risk that may unfold as the CCTS progresses. In the absence of a complementary supply adjustment mechanism, these early surpluses accumulate, and risk depressing credit prices.

Technical constraints could also pose a challenge. While India’s CCTS benefited from facility-level audits during target-setting, moving beyond reliance on PAT data, robust benchmark development still requires high-resolution, harmonised emissions and output data across diverse installations. Emissions factor calculations can be complex due to variations in fuel composition, measurement practices and plant configurations. Still, consistency can be maintained if the same methodology underpins both baseline setting and compliance. However, forecasting output, process shifts and technology adoption – especially in trade-exposed or fast-evolving sectors – remain uncertain and difficult to standardise. This reduces precision in future compliance cycles, affecting the accuracy of initial targets and the pace at which they can be tightened, and leading to risks of early overallocation and future inertia.

Political economy of a technical scheme

Beyond technical uncertainty lies a deeper political logic embedded in the architecture of market-based regulation. To ensure the legitimacy and longevity of a market-based scheme such as the CCTS, policymakers must engage closely with industry. This is a necessary step, but one that introduces powerful incentives to negotiate rather than impose stringency, particularly in sectors exposed to global competition. In these interactions, regulated entities are not passive recipients of policy, but active participants in shaping it. Their contributions, often framed around investment constraints, cost volatility and competitiveness risks, tend to overemphasise potential burdens while underrepresenting mitigation potential. The tendency to present information that favours a lighter regulatory approach is often rooted in constraints such as limited available data, an inclination towards risk aversion in reporting, and a focus on immediate cost implications. When independent verification is difficult, the cumulative effect is a body of input that may inadvertently favour leniency.

In such systems, informational asymmetries are not just gaps, they are structural features that shape the regulatory design itself.

> **Initial benchmark-setting inevitably tilts towards leniency due to uncertainty, caution and political economy constraints, making automatic supply adjustment mechanisms essential to counteract structural oversupply.**

Ultimately, these dynamics – regulatory caution, data limitations and political economy pressures – lead to lenient benchmarks. While this may help stabilise the launch of the CCTS, it also underscores the importance of embedding rule-based mechanisms to adjust supply after implementation. Without such mechanisms, even well-intentioned conservatism at the outset can create long-lasting price suppression, and affect the environmental and economic credibility of the carbon market.

Lessons from PAT

India's PAT scheme[9] offers a decade of valuable regulatory experience on how a baseline-and-credit market behaves under real-world conditions of data constraints, industrial heterogeneity and regulatory complexity. While the PAT mechanism successfully established a foundational framework for intensity-based trading, it also highlighted important lessons that can inform the design and evolution of the CCTS.

First, conservative benchmarks enabled most facilities to over-comply on account of readily available efficiency measures, generating substantial Energy Saving Certificates (ESCerts) and demonstrating the importance of benchmark stringency for sustained price signals. Second, market architecture proved inadequate without liquidity support. While the "Perform" and "Achieve" components of the PAT functioned, "Trade" consistently underperformed. Trading volumes remained subdued because entities successfully met or surpassed their energy efficiency targets, leaving fewer deficits to trade and more banked surpluses. BEE's annual auctions provided limited price discovery due to market thinness.[10]

Third, in certain years, the monetary penalty for non-compliance did not always correspond closely with prevailing market expectations of ESCert prices. This sometimes resulted in a situation where

[9] The scheme is a market-based mechanism to improve industrial energy efficiency by assigning energy intensity targets to large energy-consuming entities and allowing trading of ESCerts among over- and under-performers. Refer to https://beeindia.gov.in/en/programmes/perform-achieve-and-trade-pat for details.
[10] Bhandari, Divita, and Gireesh Shrimali. "The perform, achieve and trade scheme in India: An effectiveness analysis." *Renewable and Sustainable Energy Reviews* 81 (2018): 1286-1295.

firms found it financially comparable, or in some cases preferable, to pay the penalty rather than fully engage with the market. Such dynamics may have moderated the overall environmental effectiveness of the scheme. For the CCTS to be effective, it will require a penalty regime that is consistently higher than desired credit prices, adjusted for inflation, and supported by public disclosure of non-compliance.

> **PAT succeeded administratively but underperformed as a market mechanism; CCTS must avoid similar pitfalls through proactive design.**

Fourth, and often overlooked, PAT did not incorporate a revenue-generation mechanism. The system prioritised flexibility for industry and was designed around free allocation and compliance trading. Thus, there was no fiscal dividend that could be reinvested in industrial decarbonisation, technological innovation or support for vulnerable firms, workers or consumers. The CCTS, in its current form, also does not envisage a revenue generation component. Models such as the EU ETS demonstrate how auctioning credits can provide considerable revenues, exceeding €32 billion in 2023 alone. This revenue can be earmarked to fund clean technology, support micro, small and medium enterprises (MSMEs), or cushion cost impacts on vulnerable sectors. Embedding this revenue link can improve the scheme's legitimacy, and broaden political support over time.

These lessons demonstrate the CCTS must build upon PAT's foundational experience through dynamic benchmarks, robust trading infrastructure, credible enforcement and strategic auction mechanisms to create a system that is both effective and politically sustainable.

Addressing market imbalance: Available approaches

Source-level solutions

The most direct approach to prevent market imbalance is to address credit oversupply at its source through three primary solutions: enhanced benchmark stringency, dynamic benchmark updating mechanisms, and long-term trajectory frameworks. While well-calibrated intensity targets should theoretically align credit supply with climate ambition, this calibration faces significant practical constraints.

Enhanced initial benchmark stringency: The first solution involves setting more ambitious benchmarks within the early cycles. This would prevent undesirable surplus accumulation, establish credible price signals, and drive timely low-carbon investments before institutional inertia takes hold, which makes future tightening politically harder. These stringent targets also strengthen India's position in global policy frameworks, including border carbon adjustments while supporting NDC alignment. However, regulators must navigate information uncertainties about abatement costs across India’s diverse industrial landscape. Without adequate flexibility mechanisms, excessively strict targets could trigger non-compliance or opposition from vulnerable sectors, underscoring the need for safety nets.

Dynamic benchmark-updating mechanism: The second solution addresses the limitations of static benchmark setting through dynamic updating mechanisms. A more sustainable approach is to embed transparent, rule-based processes to update benchmarks over time. Internationally, systems such as the EU ETS, Korea’s K-ETS, and Alberta’s TIER programme embed automatic adjustments in their allocation processes. In India, such dynamic, rule-based adjustment could help correct early overallocations without the political challenge of full recalibration.

Long-term trajectory frameworks: Third, the above should be complemented by publishing long-term benchmark trajectories, developed using consistent modelling approaches, to guide investment decisions and align expectations. Such mechanisms enable gradual tightening as new data emerges and industrial capacity evolves, turning what might otherwise be a political negotiation into a predictable institutional process. This helps firms plan long-term investments with greater confidence, and reduces regulatory uncertainty.

However, implementation constraints limit the effectiveness of sophisticated benchmark frameworks. They remain inherently retrospective, and cannot address existing surpluses. Their effectiveness depends on data quality and comparability across diverse firms, potentially challenging during initial phases, given sectoral diversity and evolving MRV capacity. Political economy pressures also persist – policymakers should consider how the allocation architecture might evolve as the market matures (Box 1).

Box 1: Rethinking allocation architecture – beyond benchmarking in a maturing market

While benchmark-based allocation is a practical and politically acceptable starting point for the CCTS, it may not provide a strong foundation for long-term market credibility. Benchmarking allows credit allocation to scale with output, which helps protect industrial competitiveness and facilitates uptake. However, over-reliance on this method risks embedding a system in which firms adjust to performance benchmarks, but do not face a strong, transparent carbon price that drives deep and sustained abatement.

As the CCTS matures, India must consider evolving beyond benchmarking as the sole allocation tool. One limitation is that free allocation through benchmarks, while shielding firms from abrupt compliance costs, does not create robust price signals across the economy. It also concentrates incentives in the hands of incumbent firms, while free allocation shields firms from abrupt compliance costs.

It also narrows the reach of carbon pricing, limiting incentives for broader decarbonisation actions, such as reducing the use of carbon-intensive materials, since downstream users face no carbon cost signal. Over time, this weakens both the efficiency and fairness of the transition, particularly if costs are transferred to less protected groups. Moreover, benchmark-based allocation is less effective in sectors with diffuse or hard-to-define output metrics, such as transport, non-industrial fossil-fuel use and electricity production, which will become increasingly relevant as the CCTS's compliance sector coverage expands. These sectors may require different allocation approaches altogether, and cannot be governed indefinitely by intensity benchmarks calibrated for heavy industry (although in India, sectors such as electricity may still face cost pass-through constraints due to tariff cross-subsidies and persistent distribution losses).

Given these limitations, especially as the CCTS expands beyond heavy industry, auctioning offers several advantages. It introduces price transparency, creates a more level playing field for new entrants, and generates fiscal revenues that can be strategically recycled – for example, to support industrial transition, cushion impact on vulnerable communities, or fund innovation in clean technologies. It also provides the operational backbone for deploying market stability mechanisms such as PSAMs, reserve releases or consignment auctions.

Importantly, India would not be alone in considering this transition. China, which initially adopted benchmark-based allocation for its ETS, announced in May 2025 that it would introduce allowance auctions as part of its medium-term reforms. The move is intended to strengthen price signals, improve fairness and prepare the ground for absolute caps.

India does not need to abandon benchmarking immediately. A phased or blended model, combining benchmarked allocation in exposed sectors with pilot auctions in less vulnerable ones, could offer a practical transition path. But to safeguard the long-term integrity and flexibility of the CCTS, it is essential not to hardwire benchmarking as a permanent feature. Doing so would constrain the market's evolution and limit the government's ability to manage supply, support ambition or align with emerging global carbon trade norms.

Source-level solutions shape credit supply structure, and reinforce carbon price credibility, but their gradual nature demands complementary mechanisms that respond more dynamically to emerging imbalances.

Structuring banking limitations and vintages as a solution

Complementary mechanisms such as constraining the accumulation and use of banked credits provide a direct approach to managing structural market imbalance. In intensity-based systems such as India's CCTS, unconstrained banking may shift the regulatory framework from a flow-based system to a stock-based one, which could influence market dynamics and potentially suppress carbon prices over time.

The core concern is not credit banking, but its interaction with generous early allocations. Unlimited banking allows firms to carry forward large credit volumes indefinitely, weakening regulators' ability to control period-specific emissions.

Other common measures, such as banning banking in initial phases or imposing fixed credit expiry dates, can create unintended volatility. As expiration nears, firms may rush to use or sell credits, triggering price swings. In thin markets, credits from legitimate early abatement may expire unused, undermining market trust, and penalising early movers.

> **Unchecked banking, when combined with overallocation, transforms emissions control from periodic regulation to a cumulative stockpile problem, suppressing carbon prices, and delaying abatement for years.**

To address these risks while preserving market flexibility, this report proposes the adoption of a vintage-based credit control framework in India's CCTS. The detailed design and operational mechanisms of this vintaging system are discussed comprehensively in the PSAM design section later, which outlines how temporal limits on credit use can balance business flexibility with regulatory control over market scarcity.

Ultimately, the goal is to balance the economic benefits of banking against the risks of unchecked credit accumulation. Vintages allow policymakers to preserve temporal flexibility while restoring the connection between market prices and actual decarbonisation needs. If implemented carefully, they could serve as a powerful complement to other supply-side instruments.

Role of a PSAM in India's CCTS

This report proposes a high-level PSAM architecture based on vintage-lifetime limits, and strategic credit reserve mechanisms that adjust supply over time to prevent oversupply, maintain price credibility, and preserve flexibility within India's intensity-based system.

PSAMs are not a substitute for well-aligned target setting or appropriately scaled credit allocation but are important complements to other market design features. Even in a market with well-aligned settings, significant price movements may occur due to macroeconomic shocks, policy uncertainty or rapid shifts in abatement costs. While PSAMs moderate extreme price volatility, they do not eliminate market fluctuations, which are important for price discovery. Their role is to prevent prolonged price collapses or spikes that would distort incentives, destabilise investment decisions, and provoke political backlash.

Even if the CCTS were to achieve perfectly calibrated benchmarks and allocation, a PSAM would still be necessary. Real-world markets are subject to external shocks such as swings in global fuel prices, recessions, or faster-than-expected deployment of new technologies, any of which can destabilise prices for prolonged periods. They are also shaped by regulatory uncertainty and the credibility of long-term commitments,[11] market participants may discount future stringency, behave myopically, or bank insufficiently,[12] leaving current prices depressed despite ambitious targets. In addition, overlapping domestic policies and sectoral schemes can create a "waterbed effect,"[13] reducing demand for credits in ways that the baseline-and-credit architecture alone cannot adjust for. Thin liquidity, market power by large firms, or high transaction costs can further distort price discovery and undermine the intended scarcity signal. A PSAM provides resilience against these imperfections: it buffers shocks, complements banking, sustains liquidity, and anchors expectations when confidence wavers. In this sense, PSAMs are not just corrective add-ons but integral safeguards, ensuring that even a well-designed market continues to deliver credible, investment-grade signals under the messy realities of economic cycles and policy transitions.

> **A PSAM remains essential even in a well-designed market. It provides resilience against external shocks, regulatory uncertainty, and policy interactions, ensuring that carbon prices remain credible, predictable, and investment-worthy under real-world conditions.**

The need for a PSAM in India's CCTS is particularly significant. As a baseline-and-credit system, the CCTS will generate credits and allow trade only after facilities report verified emissions. This output-linked, retrospective crediting delays issuance and compresses liquidity into the later part of the compliance cycle, making the market more prone to volatility and delayed price discovery. A PSAM

[11] Koch, N., Grosjean, G., Fuss, S., & Edenhofer, O. (2016). Politics matters: Regulatory events as catalysts for price formation under cap-and-trade. Journal of Environmental Economics and Management, 78, 121-139.
[12] Trotignon, R., Jouvet, P. A., Solier, B., Quemin, S., & Elbeze, J. (2015). European carbon market: lessons on the impact of a market stability reserve using the Zephyr model (No. 1511).
[13] Occurs when companion policies reduce emissions within the ETS but, because the overall cap does not adjust, total emissions remain unchanged and allowance demand falls, lowering prices.

provides a responsive tool to stabilise these dynamics by releasing or withholding credits in a timely, rule-based manner, reinforcing confidence in the system's price signal while maintaining market trust.

> **While benchmark adjustments and banking limitations are key to providing structural supply management, integrating a PSAM would offer a responsive mechanism to address market imbalances. This addition would create an important lever for market management, functioning as a circuit breaker against price extremes.**

PSAMs can serve a critical institutional role. By codifying supply adjustment in advance, they reduce reliance on discretionary government interventions, and send a credible signal to market participants that the system will respond predictably to imbalance. This is particularly important since regulatory discretion risks politicisation when long-term institutional trust in climate policy is still developing across the world.

A well-designed PSAM shifts the system from reactive to rule-based governance, helping carbon markets and credits evolve from policy experiments to stable, investment-grade instruments.

This institutional reliability is vital for stimulating low-carbon investment, especially in capital-intensive sectors. Firms making long-lived abatement investments are not deterred by price volatility per se, but by the risk of sustained low prices that fail to justify upfront costs. While a PSAM cannot guarantee specific price levels or long-term trajectories, it can reduce the likelihood of prolonged price collapse and dampen extreme fluctuations, both of which increase investment risk.

More broadly, embedding a PSAM affirms that carbon pricing is not a transitional tool but a core component of India's climate policy architecture. By institutionalising adaptive capacity, a PSAM enables real-time course correction while minimising the need for ad hoc interventions. In doing so, it reinforces transparency, predictability and confidence in the governance of India's carbon market.

> **PSAMs are not just market stabilisers, they are institutional anchors that make carbon pricing credible, investment-worthy and politically resilient. In India's CCTS, it can offer a rule-based buffer against volatility, enabling the system to respond predictably to imbalance while supporting long-term climate and development goals.**

A PSAM should be embedded as a central feature of India's CCTS, not only to help regulators and firms manage credit supply, but also to offer clarity and confidence to a wider set of stakeholders, including investors, financiers, technology providers, and policymakers. When paired with mechanisms like vintaging and banking limits, it can enhance credibility, price stability, and long-term market viability. By enabling disciplined, rule-based responses to market imbalances, a well-designed PSAM supports effective expectation-setting and reinforces India's broader climate and development goals.

Designing a PSAM for India's CCTS

Embedding a well-structured PSAM in India's CCTS requires adherence to four fundamental design principles that will determine its effectiveness in supporting market credibility and stability as discussed in Table 1.

Table 1: Design framework for a PSAM in India's CCTS

Design principle	Fundamental purpose	Implementation requirements	Why this matters for India's CCTS	Expected market impact
Predictability & transparency	Builds market legitimacy through clear, rule-based interventions	• Pre-specified, rule-based triggers • Defined adjustment conditions and procedures • Transparent implementation mechanisms	• Essential during PAT to CCTS transition • Supports early-stage financial sector engagement • Fosters trust in a developing market	• Reduces uncertainty • Enables long-term planning • Discourages opportunistic behaviour • Enhances market credibility
Resilience	Maintains functionality through economic or regulatory shocks without losing ambition	• Capacity to respond to external shocks (fuel price volatility, policy shifts) • Maintains consistent forward signals during disruption	• Addresses volatility in emissions due to development trajectory • Manages global fuel price shifts and regulatory delays • Ensures continuity amid policy transitions	• Stabilises price signals • Sustains long-term functionality • Avoids breakdown during disruptions
Flexibility	Enables intervention when needed while preserving natural price discovery	• Activates only during significant imbalances • Avoids micromanaging prices • Leaves room for market-based outcomes • Clearly defined, non-discretionary triggers	• Responds to intensity-based emissions variability • Manages surplus from low-cost abatement • Adjusts for uneven sectoral rollout or delayed tightening	• Prevents overcorrection • Allows organic market dynamics • Avoids distortion while retaining responsiveness

Institutional feasibility	Aligns design with administrative and regulatory capacity	• Fits within existing roles of BEE, CERC, and State Designated Agencies (SDAs) • Accounts for capacity constraints in MRV • Streamlines implementation pathways	• Leverages BEE's administrative structure • Aligns with CERC's emerging regulatory role • Navigates multi-tiered governance	• Ensures practical execution • Minimises administrative burden • Reinforces governance credibility

The PSAM design architecture proposed below includes consignment auctions, vintaging, and a price corridor. Each of these elements are grounded in the above discussed design principles, offering an integrated pathway to embed predictability, resilience, flexibility, and institutional feasibility into India's evolving carbon market.

Consignment auctions, vintaging and price corridor: PSAM architecture for India's CCTS

While the rationale for a PSAM is clear, a critical question remains: how can regulators intervene in the market to adjust credit supply? PSAMs need a practical, dynamic mechanism through which credits can be withheld, released or retired when market conditions require intervention.

The proposed PSAM for India's CCTS, comprising three mutually reinforcing design elements, shares the core objective of established market stability mechanisms like the EU ETS's Market Stability Reserve (MSR) – maintaining market balance through rule-based supply adjustments. However, it employs a fundamentally different architectural approach suited to India's developing carbon market infrastructure.

The MSR operates through sophisticated quantitative metrics, using the Total Number of Allowances in Circulation (TNAC) to trigger automatic interventions. For instance, it withholds 24% of surplus allowances when they exceed 1,096Mt or releases 100Mt annually when the surplus falls below 400Mt. Such mechanisms demand extensive historical emissions data, precise surplus calculations, and sophisticated modeling capabilities that may prove challenging for India's early CCTS phases.

Additionally, the MSR assumes regular government auctions exist for implementing supply adjustments. India's baseline-and-credit system, however, issues credits only after verification, creating a fundamental implementation gap. To address this challenge, we propose a three-component integrated architecture: consignment auctions, vintage-based credit classification, and price corridors. These mechanisms can function effectively with limited historical data and evolving institutional capacity. As India's CCTS evolves and accumulates operational data, this architecture can transform into more sophisticated designs with well-designed triggers as used in markets like EU-ETS, US Regional Greenhouse Gas Initiative (RGGI), or California's cap-and-trade system.

Component 1: Consignment auctions – creating a market interface

In most cap-and-trade systems, regulators can adjust credit supply relatively easily because allowances are auctioned regularly. When oversupply occurs, fewer allowances are auctioned; when allowances are scarce, more are auctioned. The auction serves as the government's "control panel" to manage market supply.

India's CCTS faces a challenge here. Unlike cap-and-trade systems, credits are only issued after a firm's performance is verified at the end of the compliance cycle. There are no regular government auctions of credits during the year. This creates a key implementation gap: the regulator has no way to intervene in the market without resorting to disruptive rule changes or administrative decisions.

A consignment auction (similar to that implemented in California's Cap-and-Trade programme) offers a pragmatic and transitional solution for this issue. Rather than issuing credits upfront, it allows firms that have already earned credits through overperformance to voluntarily (or as proposed, mandatorily) consign a portion of those credits to a government-run auction. These credits are then sold to the highest bidders, with proceeds returned to the original holders. The model maintains the property rights of entities while supporting price discovery, enabling liquidity and providing the state a transparent, centralised infrastructure for future supply interventions.

> **A consignment auction preserves property rights while enabling price discovery, boosting liquidity and creating a transparent channel for future supply interventions.**

The consignment auction also creates the institutional foundation necessary for a PSAM to function. To ensure meaningful participation and avoid adverse selection, a share of all eligible credits could be compulsorily consigned. If prices fall below a predefined threshold, the regulator can withhold consigned credits from the auction temporarily (with predefined timelines); if prices spike, additional credits from a supply reserve could be released. The CCTS can build a dedicated reserve over time by setting aside a portion of consigned credits.[14] These credits would not be removed from the system permanently but held in a regulated buffer, enabling rule-based interventions without revoking ownership or reducing firms' entitlements.

Because the credits are already earned, a reserve respects the baseline-and-credit architecture while offering flexibility. Over time, as the auction matures, the reserve can serve as a strategic pool

[14] This could work as follows: Firms when aware of a vintage mechanism will put up their older vintages (from earlier cycles) for the consignment auction, while newer ones will be banked. These older vintages will then be considered for the reserve. This approach simultaneously addresses early-phase oversupply and builds a reserve without revoking firm entitlements at the outset.

for price stability and market confidence, much like the MSR in the EU ETS. These interventions occur within the market's own operational rhythm i.e. there is no need for retroactive allocation changes or one-off directives. As the market matures, the auction can evolve into a more conventional allocation mechanism, allowing India to gradually shift from free allocation to auction-based governance.

Firms have several incentives to participate. First, participating in the auction ensures early access to market liquidity. In the absence of continuous bilateral trading infrastructure (as India is initially adopting a periodic MCP model), the consignment auction becomes one of the few viable avenues for price discovery and monetisation (between MCP periods). Second, firms might prefer to sell credits on a transparent platform rather than wait for the next compliance period trade. Third, when credit usage is tied to vintage rules or banking limits, auction participation offers an opportunity to realise value before units lose compliance eligibility or market worth. Over time, the auction can become a central implementation vehicle for any PSAM.

Component 2: Vintaging – soft cap on indefinite banking and targeted supply discipline

Complementing the consignment auction is a vintage-based credit classification system. Every credit issued under the CCTS would carry a vintage tag, denoting the year of issuance. Compliance in any given year would be permitted only with credits from that year or up to two prior years (e.g., 2027 emissions may be covered using 2027, 2026 or 2025 vintage credits). Older vintages would either expire or be devalued according to a predefined schedule.

This approach serves as a supply modulator and a soft cap on credit banking, avoiding the accumulation of long-dated surpluses that can destabilise price signals and undermine mitigation incentives. It also creates dynamic supply discipline: in the event of oversupply, the regulator could (with predefined rules) selectively restrict older vintages from being used for compliance without affecting newer credits or interfering with upcoming auction cycles. Importantly, this approach preserves intertemporal flexibility for firms while maintaining a clear link between credit validity and the evolving decarbonisation trajectory.

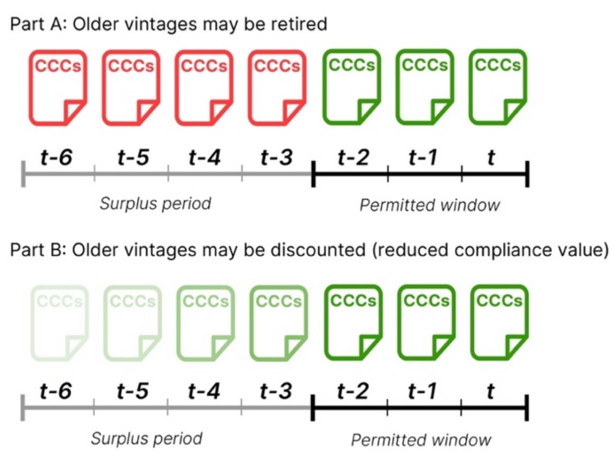
> **Vintage rules act as a soft cap on credit banking, preserving flexibility while preventing destabilising surpluses.**

Regulators can use credit vintages as a tool to manage market imbalances which may arise from PSAM interventions. For instance, if the regulator needs to cancel credits to reduce systemic surplus, doing so by targeting the oldest vintages (with rules) helps preserve the value of newly generated credits, and avoids price suppression in upcoming auctions.[15] Moreover, a visible vintage price structure (with older credits trading at a discount) gives the market signals about expected future scarcity and regulatory ambition, enhancing investment predictability and generating price indicators that reflect market expectations about future abatement costs.

Washington's Cap-and-Invest programme demonstrates how vintage tracking can be operationalised effectively.[16] By assigning vintage years to allowances and distinguishing regular units from those issued through price-containment reserves, it shows how temporal rules and unit tagging can reinforce market stability and regulatory control. While introducing vintages may increase market complexity, as each vintage may carry different prices based on perceived cancellation risk, this also generates useful price signals that reflect market expectations about future abatement costs and regulatory ambition.

By tagging credits with the year of issuance, vintaging gives regulators leverage over which credits are eligible for trade. For example, only credits from vintages t (year of issue) to t–2 (issue year minus two) may be permitted in the trade, while older vintages may be discounted (reduced compliance value) (Part B of Figure 4) or retired (Part A of Figure 4).[17] Figure 4 shows how vintaging rules can define an allowable window for credit use while progressively constraining older vintages. This allows the system to selectively clear or contain surpluses without undermining the integrity of new credit issuance. It also enables targeted use of price- or supply- adjustment measures; for example, a reserve release could be limited to recent vintages to avoid affecting the value of older banked credits or distorting long-term price signals.

Figure 4: Treatment options for vintages



[15] While there are other methods to modulate supply such as ad hoc tightening of baselines or buying back of credits it is important to underscore that any future method should ideally not be abrupt or rely on the government purchasing credits that were originally allocated
without charge, as doing so would effectively deploy public resources to reabsorb privately held, cost-free units - a fiscally inefficient approach that could undermine both market discipline and policy credibility.
[16] Washington State Department of Ecology. Cap-and-invest auctions & market.
[17] One could also consider vintage lifetimes being predefined at the time of issuance to ensure predictability.

The strategic value of vintaging extends beyond individual credit management – it transforms the consignment auction from a simple trading venue into the operational core of market-based governance. This builds crucial institutional experience around auction design and regulatory timing, critical for managing market evolution.

Implementing vintaging in India's CCTS would provide multiple advantages:

- First, it would create a scalable, rule-based method to manage legacy surpluses. Regulators could restrict or cancel older vintages without disrupting newer credits or penalising performance.
- Second, vintaging integrates seamlessly with India’s intensity-based, baseline-and-credit model, as it does not constrain allocated rights but defines which subset of earned credits remains eligible for future use.
- Third, clear rules on credit lifespan reduce the risk of long-term surplus accumulation that could potentially arise from generous early allocation, encouraging a more predictable and balanced distribution of abatement over time.

> **Credit vintaging enables selective management of banked credits through issuance-year tagging, balancing business flexibility with the regulatory need to maintain meaningful market scarcity.**

Rather than requiring complex data analytics like the EU ETS’s MSR, this system offers a practical entry point for supply adjustments in a system where neither cap setting nor upfront allocation exist – positioning India’s carbon market for evolution towards more sophisticated mechanisms as capacity and data availability grow.

Box 2: Vintaging as a governance and value-preservation tool

Vintaging should be viewed as a standard feature of ETSs worldwide, introduced as part of rule-based governance. India’s CCTS, like all ETSs, is a regulatory construct: every element from benchmark-setting to compliance deadlines, is defined by design. Within such a construct, assigning a time-bound window of compliance use is not a retrospective withdrawal but a design choice. Vintaging should therefore be understood as a governance tool: it preserves the ownership of credits while clarifying their eligibility horizon, ensuring that accumulated stocks do not undermine the credibility of future price signals. By establishing this rule from the outset, policymakers avoid any perception of retroactive change while maintaining a vital lever for supply management in a baseline-and-credit system.

Vintaging also serves as a practical supply-management tool, giving effect to a broader stability mechanism that ultimately benefits all stakeholders. The purpose of a carbon market is not only to issue credits, but to ensure that those credits hold a meaningful and predictable price. By placing time-bound limits on compliance use, vintaging helps maintain scarcity and price credibility. In this sense, it is not a loss for industry but a gain: a mechanism that safeguards existing credits and ensures that the market remains a reliable channel for investment and decarbonisation.

Vintaging also promotes fairness within the market. Without time-bound limits, large legacy surpluses can weigh on prices for an extended period, making it harder for newer entrants and smaller firms to benefit from a credible price signal.[18] By linking credit use to their year of creation and maintaining value only within a defined horizon, vintaging ensures that credits reflect genuine and timely abatement. This mechanism also helps sustain a level playing field across participants, and supports a more equitable distribution of market benefits.

Component 3: Price corridor – guiding intervention

While quantity is the PSAM’s direct lever, a price corridor serves as the system’s navigational aid. India’s CCTS already incorporates indicative upper and lower price thresholds (although the criteria guiding their selection have not yet been formally detailed), which do not enforce hard price controls but may guide the PSAM’s response. If market prices fall below the lower bound or in the lower zone, the consignment auction can withhold a portion of credits from sale or limit older vintages’ eligibility for compliance. If prices exceed the upper threshold or are in the higher zone, reserve credits, perhaps held in a supply adjustment account, can be released through the same auction platform.[19]

> **The price corridor serves as the system’s navigational aid in implementing a PSAM**

[18] Hastings-Simon, S. (2017, November). Carbon price vintaging of credits in the output-based allocation system: Technical note. Pembina Institute.
[19] Some jurisdictions, such as California, use multi-tiered mechanisms like the Allowance Price Containment Reserve (APCR), which release allowances at rising price points to manage volatility more precisely. While such designs offer greater flexibility, they involve more upfront design judgment and may be better suited as the Indian carbon market deepens. Initially, a simpler price band-based approach with clear rules and periodic review can achieve the core objectives without overcomplicating governance.

This price corridor supports both political and economic objectives. At the low end, it helps ensure carbon prices remain high enough to justify abatement investments. At the high end, it provides assurance to industries and policymakers that the system will not trigger uncontrolled cost escalation, making tighter benchmarks more politically acceptable. Importantly, the corridor would be updated periodically, tied to factors such as marginal abatement cost trajectories, inflation and India's long-term NDC decarbonisation pathway.

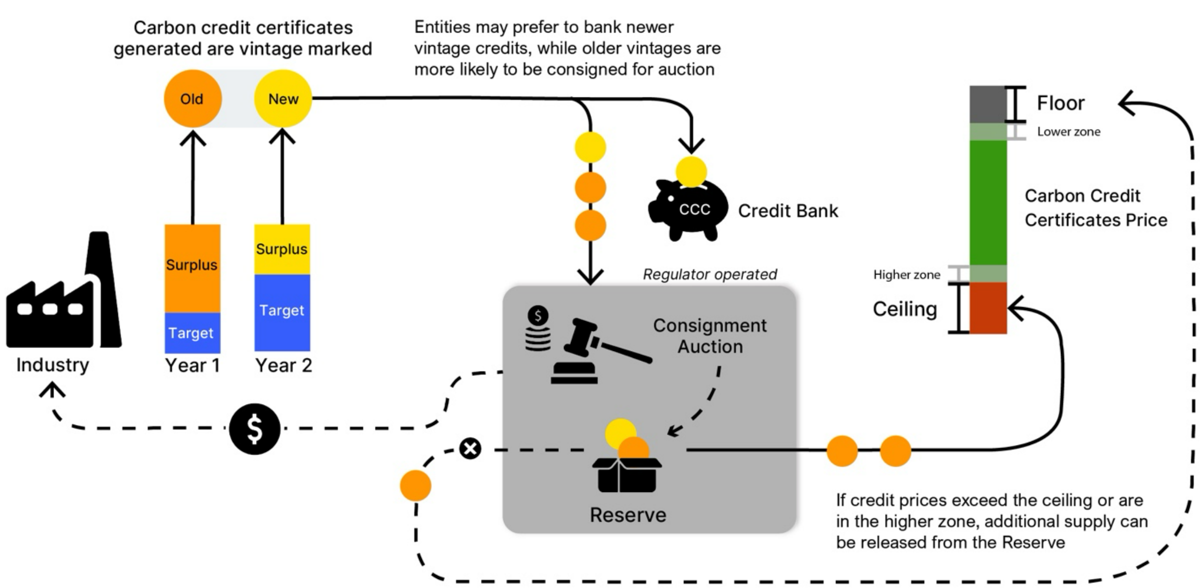
Integrated architecture and implementation

This integrated PSAM model is well suited to an intensity-based system like India's CCTS. A consignment auction gives the regulator a structured interface with the market, along with a mechanism to build a reserve; vintages provide temporal control over accumulated supply; and a price corridor creates clarity for market participants while anchoring regulatory decisions.

Moreover, this framework aligns with India's institutional constraints and evolution timeline. Each instrument is rule-based, scalable and implementable within current mandates. Vintage limits could be particularly valuable in the early stages of market development, offering a predictable way to manage oversupply risks while policy credibility builds. The consignment auction, building on India's existing MCP-based trading model, could be structured to support strategic supply interventions, especially when paired with a transparent price corridor. Initially, participation could be voluntary or sector-specific, allowing for a measured rollout. As data systems and institutional capacity grow, the architecture allows for progressively more sophisticated market stabilisation tools to be integrated.

Figure 5 illustrates how these components interact to form functional PSAM infrastructure within India's CCTS, enabling rule-based interventions without disrupting core intensity-based design.

Figure 5: PSAM architecture for CCTS



Institutional feasibility of a PSAM

For a PSAM to succeed within India’s CCTS, it must be treated as a core component of the country’s long-term climate strategy. Its feasibility hinges on political prioritisation, institutional clarity, regulatory capability and sustained analytical support.

Institutional feasibility requires making the CCTS and its stability mechanisms integral to India’s climate policy. When carbon markets operate in isolation, they risk distortion from fragmented policies and sector-specific schemes, leading to mixed signals and a waterbed effect – where mitigation in one area is offset by slackening elsewhere. Embedding a PSAM enhances coherence, avoids duplication, and safeguards the integrity of India’s decarbonisation pathway.

This integration demands institutional capacity. Regulatory roles must be well-defined: the BEE or its suggested entity – as administrator – could oversee credit banking, consignment auctions, and rule-based interventions; the CERC – as regulator – could enforce rules, and supervise adjustment triggers.

Beyond administrative roles, a PSAM demands significant analytical infrastructure. Operating a rule-based supply adjustment mechanism requires regular modelling exercises to track credit generation, banking behaviour and price evolution. These models must simulate different scenarios, assess the impact of surplus or scarcity, and help regulators make informed decisions about adjustments. Without such forecasting and diagnostic tools, interventions risk being either too weak to be effective or too aggressive to maintain credibility. Establishing an institutional home for such analysis, supported by credible data and transparent assumptions, is vital.

A PSAM builds market trust only if participants believe it will be applied consistently. This demands a stable regulatory environment and long-term policy commitment. Firms factor carbon pricing into investment decisions only when they trust the system’s durability. A PSAM grounded in law and applied predictably signals that carbon pricing is here to stay, and that credit supply will reflect real scarcity and mitigation ambition.

As the CCTS expands to cover more sectors and a larger share of national emissions, the institutional burden will increase. New sectors may bring data challenges, verification gaps, resistance and compliance variation. A PSAM provides a structured tool to manage such diversity by absorbing shocks and maintaining market balance. However, this is only possible if the mechanism is supported by institutions, is not politicised and has the mandate to act when necessary.

In short, institutional feasibility is not only about operational capacity. It is about embedding the PSAM within the broader climate governance architecture, ensuring the mechanism is aligned with policy priorities, backed by competent regulators and underpinned by analytical rigour. When these elements are in place, a PSAM can function as both a stabiliser and a signal, guiding India’s carbon market towards stability, credibility and long-term effectiveness.

Why timely introduction of a PSAM is crucial

The introduction of PSAMs in India's CCTS is not merely a question of whether such mechanisms are needed, but critically, when they should be deployed. A timely implementation represents a strategic choice that can fundamentally shape market evolution and effectiveness. Rather than aggressive early intervention, it entails establishing rule-based frameworks that can operate predictably as needed. Early implementation offers four distinct advantages:

Avoiding reactive corrections: International experience demonstrates that delayed responses to market imbalances typically result in politically contested, disruptive reforms. The backloading of allowances in the EU ETS Phase 3 and abrupt invalidation of banked credits in New Zealand proved costlier and more contentious than preventive measures would have been. When systems drift significantly from their intended price signals, restoring credibility often requires more aggressive interventions than would have been necessary initially.

Preventing structural oversupply: The combination of lenient initial benchmarks, output-linked crediting and unrestricted banking, all features of India's forthcoming CCTS, creates high risk of early credit accumulation. A PSAM can serve as a backstop to prevent temporary imbalances from becoming structural distortions.

Establishing predictability and clear expectations: A well-communicated PSAM framework signals to market participants how the system will respond under specific conditions.

Enabling gradual adjustment: A PSAM implemented early can begin with modest parameters, gradually increasing in influence as the market matures. This measured approach prevents the "too much, too late" scenario, where delayed intervention necessitates more severe measures that destabilise prices and disrupt planning. The political economy of carbon markets demonstrates that small, predictable adjustments face less resistance than major corrective reforms.

Empirical evidence: Lessons from global carbon markets

Global carbon markets offer strong evidence that stability mechanisms are essential for effective price formation. This section examines both cap-and-trade and baseline-and-credit systems to highlight the risks of delayed intervention and the benefits of early, rule-based design. Markets that postponed such mechanisms often faced disruptive corrections and prolonged price instability.

The analysis draws on diverse economic contexts, with three systems examined in detail. The EU ETS, despite its different cap-and-trade architecture, is included as a detailed case study because it represents the world's longest-running and most thoroughly documented carbon market. The Alberta TIER and Australian Safeguard Mechanism are examined in detail because their baseline-and-credit, intensity-based designs align closely with India's CCTS, providing directly applicable insights into the unique challenges of such systems. Table 2 summarises key evidence from these systems.

Table 2: Comparison of market stability mechanism timing and outcomes in other ETSs

Carbon market	PSAM implementation/ stability mechanism	Observed market effects	Economic consequences and reforms undertaken
EU ETS	The EU launched its cap-and-trade system in 2005 without stability mechanisms in its initial phases. In 2014, the EU implemented "backloading", temporarily withdrawing 900 million allowances. The MSR was only implemented in 2019.	Between 2012 and 2017, carbon prices in the EU ETS languished between €3 and €7 per tonne. These low prices were insufficient to drive meaningful emissions reductions or incentivise significant low-carbon investments.	Research by Climate Strategies[20] found that nearly two-thirds of the efficiency losses from the EU ETS's early years could have been avoided with earlier intervention. When price recovery finally occurred in 2018-2019, it was more abrupt than necessary, creating market disruption that could have been avoided.
China	China launched its national ETS in 2021 as an intensity-based system focused initially on the power sector. Despite regional pilot experience suggesting oversupply risks, the national system deferred formal stability mechanisms. Benchmarks were set conservatively based on historical performance, with yearly compliance periods and unlimited banking allowed, although restrictions on banking were introduced in 2023.	By 2022, China's ETS had accumulated ~600 million surplus allowances relative to the 4.5 billion tonnes of annual allowances under the cap. This growing surplus required ad-hoc iterative interventions from the Ministry of Ecology and Environment rather than relying on predetermined rules.	Some modelling works[21] demonstrate that delayed intervention increases economic costs substantially, from 0.36% of GDP with immediate implementation of stability measures to 0.67% with delayed reforms. Analysis projects a ballooning surplus reaching 4.88 billion tonnes by 2030 under business as usual conditions. Weak price signals[22] have delayed industrial transformation, and missed early abatement opportunities in the power sector.
Alberta Technology Innovation and Emissions Reduction (TIER) system	Alberta implemented its TIER system as a baseline-and-credit approach with intensity targets. The initial design included a limited credit expiry period of eight years but lacked automatic adjustment mechanisms. Comprehensive reforms were only introduced	By 2023, Alberta's TIER system had accumulated more than 53 million emission performance credits and offsets, creating significant market imbalance. Market prices for TIER credits had fallen to a ~40% discount relative to the official TIER fund	In response to oversupply, Alberta doubled the benchmark tightening rate from 1% to 2% per year and scheduled more aggressive 4% tightening for oil sands facilities starting in 2029. The reforms also shortened performance credit lifespans to five years (down from eight) and temporarily increased the credit

[20] Neuhoff, Karsten, W. Acworth, R. Betz, D. Burtraw, J. Cludius, H. Fell, C. Hepburn et al. "Is a Market Stability Reserve likely to improve the functioning of the EU ETS." No. VIII). Climate Strategies (2015).
[21] Journal of Environmental Management. Design and impact assessment of policies to overcome oversupply in China's national carbon market. March 2024. Volume 354, *Ji, C.J., Wang, X., Wang, X.Y., & Tang, B.J.*
[22] Prices crossed 100 yuan/tonne (US$14) in May 2024.

	in 2023 after prolonged oversupply became evident.	price, a sharp decline from the 5% discount observed in 2020, reflecting expectations of persistent oversupply.	usage limit from 60% to 90% by 2026 to draw down accumulated surpluses.
Australian Safeguard Mechanism	Australia established its Safeguard Mechanism in 2016 as a baseline-and-credit system, but its initial phase was effectively voluntary with extremely flexible baselines. The system operated without price or supply management for seven years before major reforms in 2023 introduced meaningful trading and a price ceiling.	For its first seven years, the Safeguard Mechanism delivered effectively zero carbon price signal to covered facilities. Industrial emissions actually grew rather than declined during this period due to substantial "headroom" between generous baselines and actual emissions, eliminating any need for abatement.	The 2023 reforms restructured the system, setting baselines to decline by a default 4.9% each year for most facilities. The redesign included a cost-containment reserve with a price ceiling of AU$75 per tonne in 2024 (rising with inflation and 2% annually) to manage the transition costs of this accelerated tightening.
US Regional Greenhouse Gas Initiative (RGGI)	The RGGI included a price floor from its 2009 launch but implemented its stability mechanisms in phases. The Cost Containment Reserve was added in 2014, but the Emissions Containment Reserve came much later in 2021, creating an asymmetric approach to price management for many years.	During 2009-13, RGGI prices remained anchored at the administrative floor, reflecting persistent oversupply. The system implemented a revised cap between 2014 and 2020, ultimately tightening emissions limits by 28%, from 78 million tons to 56 million tons, which helped strengthen price signals.	Analysis in 2017 suggests earlier introduction of the Emissions Containment Reserve could have avoided much of the RGGI's prolonged low-price phase, delivering both greater environmental benefits and more consistent price signals to market participants.[23]
California Cap-and-Trade	California implemented comprehensive stability measures from its 2013 launch, including a rising price floor (initially US$10, increasing by 5% plus inflation annually) and an Allowance Price Containment Reserve with tiered release prices to prevent price spikes.	California's system has maintained consistently stronger price signals than other ETSs, with limited price volatility through multiple economic cycles. The auction reserve price (price floor) was set at US$10 in 2013, rising by 5% plus inflation each year, reaching US$19.70 by	Research in 2019 highlights that the early adoption of a price floor in California shaped investment strategies in the power sector, enabling firms to make forward-looking capital allocation decisions based on expected future carbon price trajectories.[24]

[23] Resources for the Future. Expanding the Toolkit: The Potential Role for an Emissions Containment Reserve in RGGI. August 2017. Page 36. *Burtraw, D., Holt, C., Palmer, K., Paul, A., & Shobe, W.*
[24] American Economic Review. Expecting the Unexpected: Emissions Uncertainty and Environmental Market Design. November 2019. Volume 109(11), Pages 3953-3977. *Borenstein, S., Bushnell, J., Wolak, F.A., & Zaragoza-Watkins, M.*

		2020, providing a predictable minimum carbon price.	
New Zealand ETS	New Zealand launched its ETS in 2008 without meaningful stability mechanisms. The system allowed unlimited use of international credits, and implemented a "one-for-two" [25,26] obligation from 2010-16 that effectively halved the carbon price. Major reforms with price controls came only in 2020.	Between 2012 and 2015, New Zealand Unit prices hovered between NZ$2 and NZ$5, providing minimal incentive for domestic abatement. The system included a fixed price option of NZ$25 for immediate surrender, but the accumulated bank of NZUs grew to exceed annual surrender volumes by a factor of three to five, creating persistent oversupply.	The NZ ETS had limited impact on domestic emissions for its first decade of operation due to weak price signals and design flaws. The excess banked credits significantly delayed the transition to a meaningful carbon price, and required extensive retrospective interventions to restore market balance.

EU ETS

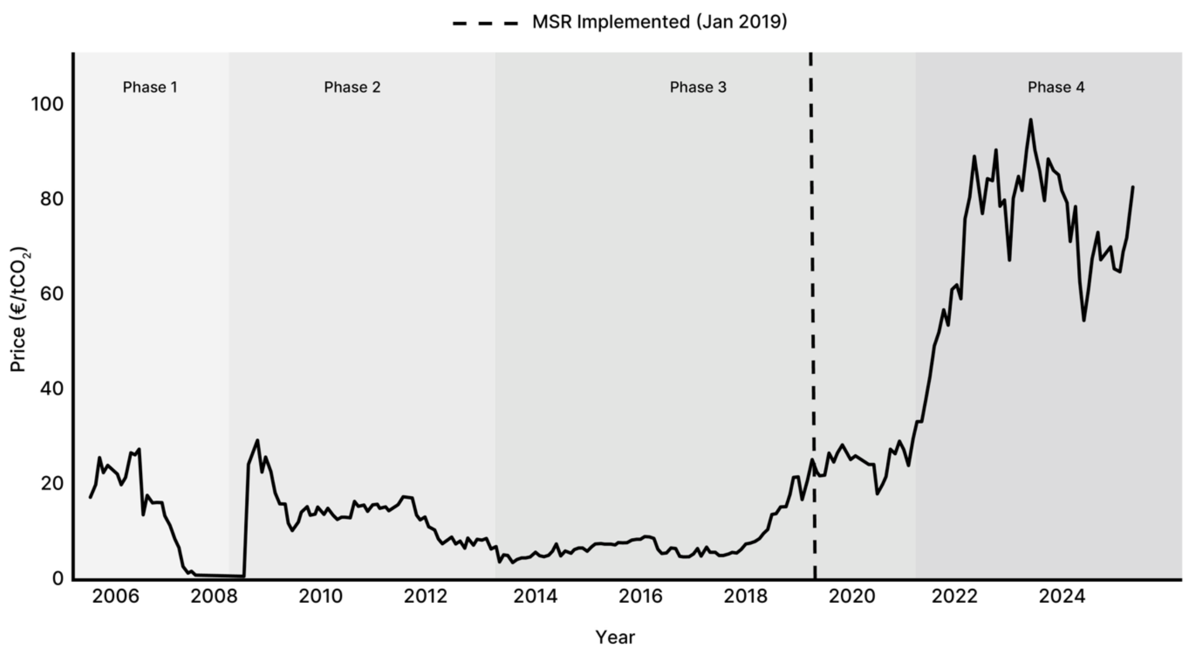
The EU ETS experience demonstrates how oversupply combined with delayed response stability measures can fundamentally undermine a carbon market's effectiveness. In its initial phases (Phase I: 2005-07 and Phase II: 2008-12), the system grappled with significant oversupply of allowances. This surplus was caused by generous initial allocations, the influx of international credits, and the economic downturn of 2008, leading to a depressed carbon price environment (Figure 6). Between 2012 and 2017, carbon prices languished to record low levels, insufficient to drive meaningful emissions reductions or incentivise low-carbon investments.

In response to this, the EU implemented key reforms after 2014: backloading 900 million allowances, introducing a cancellation mechanism, and launching the MSR in 2019. The MSR adjusts allowance supply based on predefined thresholds of the TNAC to restore balance and market resilience. The European Commission's 2014 Impact Assessment warned that each year of delay in structural reform deepened the surplus and weakened price signals. When the MSR was finally implemented, prices began to recover more sharply, reflecting a catch-up after years of suppressed expectations. An earlier introduction of the MSR might have smoothed this adjustment and reduced volatility in later years.

[25] Motu Economic and Public Policy Research. Evolution of the New Zealand Emissions Trading Scheme. April 2017.
[26] Climate Policy. Delinking the New Zealand Emissions Trading Scheme from the Kyoto Protocol: Comparing Theory with Practice. February 2021. *Kerr, S., J. Ormsby & D. White.*

Research by Climate Strategies[27] offers a deeper evaluation of the cost of this delay. Their analysis found that if the MSR had been introduced by 2017 and surplus allowances removed more decisively, nearly two-thirds of the efficiency losses from the EU ETS's early years could have been avoided. These losses refer to how much more expensive it became to reduce emissions over time compared with a more balanced approach. In simple terms, if prices had been higher and more stable earlier, firms could have made cheaper emissions reductions sooner rather than being forced into more expensive changes later.

Figure 6: EU ETS allowance price evolution



Sources: Bloomberg, IEEFA

The market failed to self-correct in the early years for three key reasons. First, firms were unable to "bank at the social discount rate" – that is, they didn't abate and save credits in anticipation of higher prices – due to internal investment barriers, lack of affordable finance and distrust in future carbon prices, challenges especially relevant to capital-constrained sectors in India. Second, policy uncertainty about the future direction and stability of the ETS led firms to view it as a short-term compliance tool rather than a credible investment signal.[28] Third, despite the existence of forward markets, system complexity and frequent rule changes undermined the credibility of long-term price signals. Many firms discounted future prices due to policy uncertainty, low trust in sustained scarcity,

[27] Neuhoff, Karsten, W. Acworth, R. Betz, D. Burtraw, J. Cludius, H. Fell, C. Hepburn et al. "Is a Market Stability Reserve likely to improve the functioning of the EU ETS." No. VIII). Climate Strategies (2015).
[28] Grantham Research Institute on Climate Change and the Environment; Centre for Climate Change and Policy. System responsiveness and the European Union Emissions Trading System. January 2014. *Taschini, L., Kollenberg, S., & Duffy, C.*

and experience with shifting rules especially regarding offsets and early allocation procedures. These factors made it harder for firms to plan long-term investments based on the carbon price.

The MSR helped to correct some of these failures. It introduced a rule-based mechanism for reducing supply, which, over time, helped lift prices and improve market credibility. However, it was not designed to eliminate price fluctuations; rather, its focus was to prevent persistent imbalances and restore confidence in the carbon price signal. In fact, Phase IV of the EU ETS has experienced more price fluctuations than Phase III. What the MSR did achieve was a more sustained increase in average prices, helping bring allowance values closer to the actual cost of reducing emissions, and encouraging firms to start planning for long-term decarbonisation.

The critical insight from this experience is about timing. Between 2010 and 2017, investment decisions were made based on an expectation of persistently low prices. This led to decisions about technologies, fuel choices and capital allocation that locked in high-emissions pathways. Even when prices rose later, these legacy investments were difficult to reverse. The efficiency losses from that delay were not only economic, but strategic.

> **Implementing the MSR by 2017 could have prevented nearly two-thirds of efficiency losses from market failures, avoiding both prolonged price depression and market volatility.**

For India's CCTS, the message is clear. Introducing a PSAM early can help avoid the same lock-in risks. Even if interventions are minimal in the early years, their presence in the system builds trust, supports price credibility, and ensures the market evolves with resilience rather than requiring costly corrections down the line.

Alberta's TIER system

Alberta's Technology Innovation and Emissions Reduction (TIER) system illustrates how credit oversupply can arise in baseline-and-credit intensity-based ETS designs. Instead of a fixed cap, TIER sets facility-level emissions intensity benchmarks, allowing total emissions to grow with output. While this output-based approach keeps compliance costs manageable, it also makes the system highly sensitive to benchmark stringency; overly lenient benchmarks can flood the market with credits, weakening price signals and undermining mitigation incentives.

By 2023, TIER was experiencing precisely this challenge. More than 53 million emission performance credits and offsets had been banked, driving market prices for TIER credits to about 40% below the official TIER fund price. This was a sharp decline from the 5% discount observed in 2020, and it reflected both the accumulation of excess credits and prevailing expectations that oversupply would persist. Without intervention, it became clear that low credit prices would continue to undermine the programme’s purpose by reducing the incentive for emissions improvements.[29]

In response to growing surplus and falling credit prices, Alberta reformed its TIER system in 2023 through a combination of structural and dynamic interventions. It doubled the benchmark tightening rate from 1% to 2% annually, with oil sands[30] facing a steeper 4% from 2029, addressing the lenient baselines that led to oversupply.[31] Although not a formal PSAM, this structural adjustment was key to restoring balance.

> **Alberta’s delayed reforms came at a cost: credit prices fell to 40% below the fund price by 2023. Earlier use of tools such as credit expiry and benchmark tightening could have preserved price integrity, and avoided years of weakened investment incentives.**

To actively manage supply, Alberta shortened credit lifespans (performance credits to five years, offsets to six), limiting long-term banking, and reinforcing future scarcity. It also temporarily raised the credit usage limit from 60% to 90% to create space for surplus absorption without collapsing prices. A Compliance Cost Containment Program was introduced to support firms facing excessive carbon costs, ensuring political feasibility during transition. These reforms demonstrate how benchmark tightening and dynamic tools such as credit expiry and usage limits can be used in tandem to stabilise an intensity-based ETS. They also underscore the cost of delay: Alberta’s credit prices remained 37-40% below the fund price, a gap that could have been avoided with earlier supply-side measures.

For India’s CCTS, the lesson is clear: in systems where credit supply grows with output, early introduction of a PSAM with credit vintaging, usage limits and reserve-based consignment auctions is critical to prevent persistent oversupply, and protect price signals.

Australia’s Safeguard Mechanism

Launched in 2016, Australia’s Safeguard Mechanism was designed as a baseline-and-credit system for large industrial emitters, but its initial architecture lacked ambition. Facilities were assigned

[29] Clean Prosperity. Strengthening TIER for Alberta’s low-carbon growth: Measuring credit oversupply risks in Alberta’s carbon market. July 2024.
[30] Oil sands are one of Alberta’s largest and most emissions-intensive industrial sources due to the energy required to extract and upgrade bitumen into synthetic crude oil.
[31] International Emissions Trading Association. Alberta tightens emissions benchmarks and credit rules under TIER reforms. 2023.

emissions baselines based on historical or industry-average intensity, with no cap on total emissions. Firms could choose the most lenient option, resulting in significant "headroom" – baselines set far above actual emissions. This created a de facto oversupply of allowable emissions, leaving most facilities with little to no compliance obligation.

With no real scarcity or cost pressure, the system delivered a negligible carbon price signal. Firms under their baselines faced no cost, and those exceeding could offset with low-cost Australian Carbon Credit Units (ACCUs). As a result, industrial emissions rose steadily, and by 2022, the sector was on track to surpass power generation as the country's largest emitter.

The delay in tightening baselines led to nearly a decade of rising emissions and lost mitigation opportunity. This changed in 2023, when Australia overhauled the Safeguard Mechanism to create a functioning emissions market. Baselines are now set to decline by 4.9% annually, calibrated to align with national climate targets. The reforms have eliminated excess headroom, and require all facilities to transition to site-specific baselines that better reflect actual emissions.[32]

Facilities emitting below their baseline now earn tradable Safeguard Mechanism Credits (SMCs), while those exceeding limits must surrender SMCs or ACCUs. A cost-containment reserve allows firms to buy ACCUs from the regulator at a fixed price (A$75 in 2024), capping compliance costs and anchoring market expectations.[33]

> **Australia's decade-long delay in tightening baselines led to rising industrial emissions and weak carbon prices. Only after the 2023 reforms introduced annual baseline cuts and a price ceiling did the system begin delivering scarcity and credibility.**

Together, the introduction of baseline tightening, SMC trading and a price ceiling forms a comprehensive PSAM framework. These changes are expected to generate immediate scarcity and a credible carbon price, but were launched only after years of delay.

Australia's case highlights the risks of deferring key reforms. Early leniency allowed oversupply to accumulate, delaying investment and making later course correction more abrupt. For India's CCTS, the lesson is that timely baseline calibration and market stability mechanisms are essential to ensure a smoother, more credible path to decarbonisation.

[32] Australian Department of Climate Change, Energy, the Environment and Water. Safeguard Mechanism reforms: Factsheet 2023. May 2024.
[33] Australian Government Clean Energy Regulator. Cost containment measure. 2023.

Counterarguments and responses

While the preceding sections make a strong case for the early adoption of a PSAM, it is important to acknowledge and address common concerns. This section examines whether delayed implementation can avoid potential short-term costs or administrative complexity. Table 3 outlines these concerns alongside responses, showing how deferring action may in fact exacerbate supply-demand imbalance and market inefficiencies.

Table 3: Delayed vs early implementation of PSAM

Argument for delayed implementation	Counterargument
Risk of short-term price spikes: Stringent early supply management might drive up credit prices, increasing compliance costs.	**PSAM's built-in flexibility:** A PSAM can release credits if the surplus falls below a lower threshold, preventing undue price volatility. Policymakers can set conservative thresholds to avoid supply constraints. **In fact, PSAMs are implemented precisely to avoid these problems.**
Liquidity concerns: Strict application of an MSR-like mechanism could significantly restrict available credits, impairing market liquidity, particularly for smaller participants reliant solely on allocations or their limited banking capacity. Large participants might be hesitant to sell due to uncertainty regarding future stringency and price increases, a situation starkly evident in China's ETS. Small firms, unlike large entities, lack the internal flexibility to redistribute allowances across facilities, exacerbating liquidity risks.	**Light-touch design:** Empirical insights indicate that a cautiously calibrated reserve primarily targets structural oversupply rather than severely constraining liquidity. Further, recognising the lessons from China's ETS, India can implement complementary market mechanisms, such as regular consignment auctions or periodic releases from the reserve, to proactively inject liquidity. Auction-based mechanisms can particularly benefit smaller entities, establishing transparent and predictable avenues to acquire necessary credits and mitigate severe liquidity constraints observed in other jurisdictions.
Mid-course corrections are possible: If oversupply emerges later, adjustments can be made through supply corrections, cap revisions or credit invalidation.	**Delayed fixes are disruptive:** Retrospective adjustments often lack credibility and face political and legal resistance, as seen in the EU ETS and RGGI. Moreover, unless embedded in a predictable rule-based framework, ad hoc corrections can create significant regulatory uncertainty. For

	example, in China's ETS, biennial allocation revisions offer flexibility but simultaneously fuel uncertainty, encouraging precautionary banking and speculative behaviour. A better approach is to institutionalise **predictable and periodic allocation adjustments** informed by long-term climate pathways, such as the EU's Fit for 55 package,[34] and guided by independent advisory bodies, as seen with the UK Climate Change Committee.
Precedent from other ETSs: Many global ETS markets, such as the EU ETS, operated for years without an MSR to assess real-world performance.	**Precedents show costly delays:** The EU ETS adopted an MSR after prolonged periods of weak prices and market imbalances.[35] Deferring action risks multiple compliance cycles with weak price signals, discouraging early abatement and hurting market confidence, especially at a time when delays risk weakening credibility in climate policy, including emerging instruments such as the CBAM.

Conclusion

India's CCTS marks a pivotal step in the country's climate and industrial policy evolution. But its long-term credibility will depend less on its launch and more on whether it embeds mechanisms to prevent structural imbalances, especially the accumulation of surplus credits that weaken price signals and delay abatement.

This report has shown that while intensity-based, baseline-and-credit systems offer flexibility and political feasibility, they are structurally prone to over-crediting and price suppression, particularly in the early phases. Lessons from the EU's ETS, Alberta's TIER and Australia's Safeguard Mechanism reveal that delaying corrective mechanisms increases the cost of reform and undermines market trust.

A PSAM offers a dynamic, rule-based solution that can adapt to evolving market conditions while preserving the CCTS's fundamental design principles. It does not manipulate prices but anchors expectations, ensuring the carbon market fulfills its core purpose: delivering a credible price on emissions. The architecture proposed in this report – combining a consignment auction, vintage-based credit rules and a transparent price corridor – provides a fiscally prudent and administratively

[34] European Commission. Fit for 55: Delivering on the proposals. 2025.
[35] Also acknowledging that the inclusion of pilots in EU design allowed them to mitigate some concerns around initial phases oversupply creeping into the fully functional ETS.

efficient rule-based tool to manage credit flows without undermining participation or the integrity of earned credits. It addresses a critical institutional gap in the CCTS, which lacks an ex-ante cap or ongoing auctioning process.

Early action is not just technically prudent but institutionally strategic. Embedding a PSAM in a timely manner signals that India's carbon market is built for durability, not experimentation. It avoids the credibility traps experienced by other systems, and lays the foundation for a market that can scale with ambition to support India's broader net-zero transition. In this context, delay is not neutral, it risks locking in fragility. India has a window to act with foresight, and design a carbon market that is not only functional but also transformative.

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