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Legal Frameworks for Greenhouse Gas Emissions Trading Markets: Global Developments and Emerging Challenges

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Abstract

The greenhouse gas (GHG) emissions trading market has emerged as a central instrument in global climate governance over the past three decades. Grounded in the economic theory of pollution rights trading pioneered by Dales and Coase, emissions trading systems (ETS) translate environmental obligations into market mechanisms, enabling cost-effective emission reductions through the allocation and exchange of emission allowances. Notwithstanding their theoretical elegance, ETS legal frameworks face profound challenges: establishing legally robust allowance allocation regimes, ensuring market integrity against fraud and manipulation, resolving conflicts between domestic regulatory sovereignty and international market linkage commitments, and adapting legacy legal structures to accommodate novel market actors and instruments. This paper examines the international legal foundation of GHG emissions markets, analyses the European Union Emissions Trading System as the most mature legislative model, surveys emerging frameworks in China and Vietnam, and identifies four core legal dilemmas that transcend jurisdictional boundaries. Drawing on the theory of adaptive governance, the paper argues that effective ETS law requires a dynamic, multi-level architecture capable of responding to technological change, evolving scientific knowledge, and shifting geopolitical realities, without sacrificing the legal certainty that market participants require.

Keywords: Emissions trading system, greenhouse gas, carbon market, climate law, Paris Agreement, EU ETS, cap-and-trade.

Introduction

The intersection of environmental science, economic theory, and law has produced one of the most consequential institutional innovations of the late twentieth century: the emissions trading market for greenhouse gases. At its core, an emissions trading system (ETS) is a regulatory mechanism that caps aggregate GHG emissions across a defined sector or economy, distributes tradeable emission allowances to covered entities, and permits those entities to buy and sell allowances in response to their individual abatement costs. The resulting market price of carbon internalises the social cost of emissions, channelling investment toward least-cost abatement opportunities.

The theoretical lineage of emissions trading runs through two canonical works in law and economics. Coase's analysis of the social costs of

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externalities demonstrated that, under defined property rights and low transaction costs, parties will negotiate efficient outcomes regardless of the initial entitlement allocation (Coase, R.H. 1960). Dales translated Coase's insight into a concrete environmental policy proposal, arguing that governments could achieve any desired level of pollution control by issuing a fixed number of tradeable pollution rights and allowing market forces to determine their distribution (Dales, J.H. 1968). Montgomery provided the formal proof that a permit market achieves cost-effective pollution reduction across heterogeneous sources (Montgomery, W.D. 1972). These intellectual foundations subsequently shaped the landmark acid rain trading programme established under the United States Clean Air Act Amendments of 1990 and, more consequentially for the present analysis, the Kyoto Protocol's flexible mechanisms and the European Union Emissions Trading System (EU ETS).

Despite the apparent consensus on the efficiency of market-based instruments, the translation of emissions trading theory into durable legal frameworks has proved contentious. Stavins observed that market-based environmental instruments, while theoretically superior to command-and-control regulation in terms of static and dynamic efficiency, require sophisticated institutional prerequisites—including credible monitoring, enforceable property rights in allowances, and stable regulatory commitment—that are not easily achieved in practice (Stavins, R.N. 2003). The Stern Review underscored the urgency of the legal challenge, characterising climate change as 'the greatest and widest-ranging market failure ever seen' and calling for a comprehensive framework of carbon pricing, technology policy, and international cooperation (Stern, N. 2007). The Paris Agreement of 2015 reinforced the centrality of carbon markets by preserving voluntary international linkage under Article 6 while establishing a new mechanism to replace the Kyoto Protocol's Clean Development Mechanism (CDM) (UNFCCC, 2015).

This paper proceeds as follows. Section I surveys the international legal foundation underpinning GHG emissions markets. Section II analyses the EU ETS as the most developed legislative model. Section III examines emerging frameworks in China and Vietnam. Section IV identifies four core legal dilemmas that cut across jurisdictions. Section V proposes directions for a more coherent global legal architecture, before concluding remarks are offered.

I. The International Legal Foundation for GHG Emissions Markets

(I) From the UNFCCC to the Kyoto Protocol

The legal basis for international GHG emissions markets is rooted in the United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992, which established the foundational obligation of Annex I parties to adopt national policies and measures with the aim of returning their GHG emissions to 1990 levels. The UNFCCC itself did not mandate any particular instrument, leaving domestic implementation to state discretion. It was the Kyoto Protocol, adopted in 1997 and entering into force in 2005, that introduced binding quantified emission limitation and reduction commitments

for developed countries alongside three 'flexibility mechanisms': emissions trading under Article 17, joint implementation under Article 6, and the CDM under Article 12 (Kyoto Protocol, 1997).

The Kyoto mechanisms represented a paradigm shift in international environmental law. Rather than prescribing uniform national policies, the Protocol created an international carbon market in which assigned amount units (AAUs), certified emission reductions (CERs), emission reduction units (ERUs), and removal units (RMUs) could be transferred across borders. Wara's critical assessment of the CDM revealed significant dysfunctions in this early market architecture: perverse incentives for industrial gas destruction projects, inadequate additionality standards, and geographic concentration of project activity, collectively undermining the environmental integrity of the mechanism (Wara, M. 2007). These shortcomings prompted extensive legal reform of the CDM and informed the design of the Article 6 mechanisms under the Paris Agreement.

(II) The Paris Agreement and Article 6 Mechanisms

The Paris Agreement, adopted at COP21 in December 2015 and entering into force in November 2016, represented a structural transformation of international climate law. Abandoning the top-down, binding quantified targets of the Kyoto Protocol for Annex I parties, the Agreement adopted a 'bottom-up' architecture of nationally determined contributions (NDCs) applicable to all parties. Article 4 requires each party to pursue domestic mitigation measures with the aim of achieving its NDC, while Article 6 provides the legal basis for voluntary international cooperation in the implementation of NDCs, including through market mechanisms.

Article 6.2 authorises the use of 'internationally transferred mitigation outcomes' (ITMOs) toward NDC achievement, subject to robust accounting requirements to avoid double counting—a fundamental legal requirement for market integrity. Article 6.4 establishes a new centralised mechanism supervised by a body constituted by the Conference of Parties serving as the Meeting of the Parties to the Paris Agreement (CMA), designed to generate emission reductions and removals that may be used by parties or authorised entities toward NDCs. The rules, modalities and procedures for these mechanisms were finalised at COP26 in Glasgow in 2021, completing a six-year negotiation process (UNFCCC, 2015). The legal significance of the Article 6 outcome lies in its establishment of corresponding adjustment requirements, activity standards, and a share-of-proceeds mechanism for adaptation finance—elements that bring the Paris market architecture considerably closer to a rule-based international carbon law than the Kyoto framework.

II. The European Union Emissions Trading System: A Legislative Model

(I) Legislative Architecture

The EU ETS, established by Directive 2003/87/EC of the European Parliament and of the Council, constitutes the world's first major multinational cap-and-trade system and remains the largest carbon market by value. The Directive established a scheme for GHG emission allowance trading within the Community, initially covering CO2 emissions from energy-intensive industries

and power generation across EU Member States. Subsequent amendments extended the system's scope to aviation in 2008, to additional gases and sectors in the third trading phase (2013–2020), and to maritime transport from 2024 under the 'Fit for 55' package (European Parliament and Council, 2003).

Ellerman, Convery, and de Perthuis provided a comprehensive assessment of the EU ETS's first two trading phases, documenting the critical over-allocation problem of Phase I (2005–2007), in which the price of EU Allowances (EUAs) collapsed to near zero as a result of excessive allocation based on unreliable baseline data (Ellerman, A.D., Convery, F.J., and de Perthuis, C. 2010). This experience generated important legal lessons: the integrity of a cap-and-trade system depends critically on the credibility of the cap itself, the quality of emission data underlying allocations, and the flexibility to adjust the cap as new information becomes available.

Phase III introduced full auctioning as the default allocation method for the power sector and a move toward auctioning in industry, replacing the grandfathering approach of earlier phases. A linear reduction factor reduces the cap by 2.2 percent annually from 2021 onward, increasing to 4.3 percent under the 2023 revision. The Market Stability Reserve (MSR), introduced in 2015 and operational from 2019, constitutes a novel legal mechanism for managing allowance supply in response to surplus accumulation, addressing the structural price weakness that characterised Phases I and II. These developments illustrate the evolutionary, adaptive character of ETS legislation—a quality that effective GHG market law must institutionalise.

(II) Key Legal Instruments

Several subsidiary legal instruments are integral to the EU ETS's operation. The EU Registry, governed by Commission Regulation (EU) No. 389/2013 and its successor regulations, provides the electronic infrastructure through which allowances are held, transferred, and cancelled. The Monitoring, Reporting and Verification (MRV) framework, established by Commission Implementing Regulation (EU) 2018/2066, governs the methodologies by which covered installations determine and report their verified emissions—the empirical foundation upon which the market's integrity rests. The Accreditation and Verification Regulation establishes requirements for independent third-party verifiers, creating a private regulatory function analogous to auditing in financial markets. These instruments collectively constitute a multi-level regulatory architecture spanning EU legislation, Commission delegated and implementing acts, and national implementing measures—an architecture whose coherence is a prerequisite for market confidence.

III. Emerging Carbon Market Legislation: China and Vietnam

(I) China's National Emissions Trading Scheme

China's national ETS, launched formally in February 2021 following a pilot phase involving eight regional carbon markets from 2011 onward, constitutes by coverage the world's largest carbon market, regulating approximately 4.5 billion tonnes of CO2-equivalent annually from the power

sector. The legal framework rests on the Interim Regulations for the Administration of Carbon Emission Trading (2020), administrative measures issued by the Ministry of Ecology and Environment, and a series of technical guidelines governing MRV and allowance allocation.

Zhang's analysis of the evolution from pilots to the national scheme identified three defining legal characteristics of China's approach: an intensity-based benchmark allocation system rather than an absolute cap, a sectoral expansion strategy that prioritises power generation before extending to industry, and a strong administrative rather than market-driven enforcement model (Zhang, Z.X. 2015). Jotzo and Löschel, drawing on comparative lessons from established systems, highlighted the challenges posed by weak data quality, limited institutional capacity for independent verification, and the tension between climate ambition and industrial policy objectives (Jotzo, F. and Löschel, A. 2014). These challenges are inherently legal in nature: they reflect gaps in the MRV regulatory framework, insufficient penalties for non-compliance, and the absence of an independent regulatory agency with insulated authority to set and enforce the cap.

The intensity-based allocation methodology of China's national ETS warrants particular attention from a legal standpoint. Unlike the absolute cap of the EU ETS, China's benchmark-based approach ties each installation's allowance allocation to its output, meaning that aggregate emissions may increase as production grows even if all covered entities comply with their obligations. This creates a fundamental tension with the Paris Agreement's requirement that NDC implementation involve genuine mitigation below a business-as-usual trajectory—a tension that the Article 6.2 corresponding adjustment requirement is designed to surface and address.

(II) Vietnam's Emerging Carbon Market Legal Framework

Vietnam represents a significant case study in the establishment of GHG emissions market legislation by a developing country party to the Paris Agreement. The Law on Environmental Protection No. 72/2020/QH14 (LOEP 2020), adopted by the National Assembly in November 2020, constitutes the primary legal instrument governing GHG emissions management and the establishment of a domestic carbon market. Chapter IX of the LOEP 2020 introduces obligations for large emission sources to conduct GHG inventories, mandates the development of a GHG database, and expressly authorises the establishment of a domestic carbon market (Vietnam National Assembly, 2020).

The implementing framework was substantially developed by Decree No. 06/2022/ND-CP of the Government of Vietnam on the Reduction of Greenhouse Gas Emissions and Protection of the Ozone Layer, effective from January 2022. Decree 06 specifies the legal regime for the quota allocation, trading, and cancellation of GHG emission quotas, as well as the conditions and procedures for carbon credit certification under the domestic carbon market pilot programme. The Decree establishes a multi-phase implementation timeline: a 2022–2027 pilot phase for the domestic carbon credit exchange,

followed by the operationalisation of the full domestic carbon market from 2028 onward (Government of Vietnam, 2022).

Vietnam's legal framework reflects both the ambitions and constraints characteristic of developing country ETS development. On the one hand, the LOEP 2020 and Decree 06 establish a legally sophisticated architecture drawing on international best practices. On the other hand, institutional capacity for MRV—the empirical backbone of any credible carbon market—remains at an early stage of development. The gap between legal design and operational capacity is a recurring challenge in developing economy carbon market law, underscoring the importance of coupling legislation with sustained capacity building and institutional investment.

Table 1: Comparative Overview of Selected GHG Emissions Trading Frameworks

Jurisdiction	Legal Basis	Type of Cap	Sectors Covered	Status
European Union	Directive 2003/87/EC (as amended)	Absolute declining cap	Power, industry, aviation, maritime	Operational (Phase 4: 2021–2030)
China	Interim Regulations (2020); MEE Measures	Intensity benchmark (no absolute cap)	Power generation	Operational (National ETS since 2021)
Vietnam	LOEP 72/2020; Decree 06/2022	Quota-based (to be determined)	To be determined by sector	Pilot phase 2022–2027; Full market from 2028
New Zealand	Climate Change Response Act 2002 (as amended)	Absolute cap	Energy, industry, transport, waste	Operational (reformed 2020)

IV. Core Legal Challenges in GHG Emissions Markets

(I) The Allowance Allocation Dilemma: Free Allocation versus Auctioning

The method of initial allowance allocation is among the most consequential and contentious decisions in ETS legal design. Free allocation—the grandfathering of allowances to existing operators based on historical emissions or output benchmarks—is politically expedient but economically distorting: it generates windfall profits when recipients pass the opportunity cost of foregone allowance sales to consumers while simultaneously receiving allowances at no charge. The EU ETS Phase I experience documented by Ellerman et al. illustrated these perverse distributional effects starkly, providing the empirical basis for the progressive shift to auctioning in subsequent phases (Ellerman, A.D., Convery, F.J., and de Perthuis, C. 2010).

Auctioning, by contrast, ensures that permit costs are reflected in production decisions from the outset, generates public revenue that may be hypothecated for climate investments or used to offset regressive impacts of carbon pricing, and eliminates allocation-based windfall profits. Tietenberg argues that auctioning is theoretically superior on efficiency, equity, and

revenue grounds, and that the political resistance to auctioning—rooted in the lobbying power of incumbent industries—represents a governance failure rather than an economic rationale for free allocation (Tietenberg, T.H. 2006). The legal challenge lies in designing allocation transition pathways that maintain political viability without sacrificing the environmental integrity and economic efficiency of the system.

The carbon leakage problem further complicates allocation law. Where ETS coverage creates a competitive disadvantage for energy-intensive industries relative to unregulated competitors in third countries, production—and associated emissions—may relocate, producing no net global environmental benefit. The EU ETS response has been to maintain free allocation for sectors deemed at significant risk of carbon leakage, as determined by a legislative list updated periodically by the Commission. The EU Carbon Border Adjustment Mechanism (CBAM), established by Regulation (EU) 2023/956, represents a more legally sophisticated response: rather than subsidising domestic producers through free allowances, the CBAM imposes a carbon price on imports of covered goods equivalent to the cost they would have borne under the ETS, thereby levelling the competitive playing field without distorting domestic market signals.

(II) Market Integrity, Fraud, and Regulatory Jurisdiction

Emissions allowances are intangible assets created by regulatory act, held in electronic registries, and transferred via market transactions—properties that make them vulnerable to fraud, manipulation, and jurisdictional arbitrage. The EU ETS has experienced a series of market integrity failures: Value Added Tax carousel fraud in 2009-2010 resulted in estimated losses exceeding EUR 5 billion; phishing attacks, registry hacking incidents, and the theft of allowances through fraudulent account registrations exposed systemic vulnerabilities in registry security; and the recycling of invalidated CERs from the CDM temporarily undermined market confidence in 2012-2013.

These episodes prompted the classification of emission allowances as financial instruments under the revised Markets in Financial Instruments Directive (MiFID II) and the extension of market abuse prohibitions under the Market Abuse Regulation (MAR) to the spot carbon market from 2019—a significant convergence of environmental and financial market law. The legal challenge of market integrity is further complicated by the cross-border nature of carbon trading: regulatory jurisdiction over market participants spans multiple national legal systems, creating opportunities for regulatory arbitrage and gaps in supervisory oversight that no single authority can fill. International coordination of carbon market regulation, analogous to cooperation between securities regulators through the International Organization of Securities Commissions (IOSCO), is an emerging institutional imperative.

(III) The Linkage Problem: Sovereignty and International Coordination

Linking separate ETS regimes—permitting covered entities to use allowances from one system to meet obligations in another—offers significant efficiency gains by expanding the market and equalising marginal abatement

costs across jurisdictions. Jaffe, Ranson, and Stavins identified international ETS linkage as a key element of emerging international climate policy architecture, modelling the conditions under which bilateral linkage produces net welfare gains and examining the legal prerequisites for successful linkage agreements (Jaffe, J., Ranson, M. and Stavins, R.N. 2009).

The legal barriers to linkage are, however, formidable. Regulatory harmonisation requirements—particularly on allowance price floors and ceilings, MRV standards, registry interoperability, and offset eligibility—constrain the policy autonomy of linking jurisdictions. The abandoned linkage negotiations between the EU ETS and the proposed Australian Carbon Pricing Mechanism illustrate how domestic political change can derail linkage commitments, while the long-delayed operationalisation of the Swiss ETS–EU ETS link (formally agreed in 2017, operational from 2020) demonstrates that even where political will exists, legal harmonisation is a slow and technically demanding process. Pizer's analysis of the tension between price certainty and quantity certainty in permit systems has direct implications for linkage law: jurisdictions employing price collars are difficult to link with unconstrained systems because linked prices converge, potentially breaching one jurisdiction's collar (Pizer, W.A. 2002).

(IV) The MRV Foundation: Data Quality and Enforcement

The environmental credibility of any ETS depends entirely on the accuracy of the emissions data on which allowance obligations are based. Monitoring, reporting, and verification (MRV) frameworks thus constitute the evidentiary foundation of carbon market law. Weaknesses in MRV—overstated emission baselines, understated verified emissions, insufficient verifier accreditation requirements, or inadequate penalties for non-compliance—undermine market integrity, distort price signals, and produce 'hot air' emission reductions with no real-world impact.

The IPCC Sixth Assessment Report emphasised that robust measurement and verification of emission reductions is a prerequisite for the effective functioning of Article 6 market mechanisms and for accounting under nationally determined contributions (IPCC, 2022). At the national level, MRV regulatory design must address the allocation of verification responsibilities between public authorities and accredited private verifiers, the liability of verifiers for errors or fraud in emission reports, the evidentiary standards required in enforcement proceedings, and the proportionality of penalties. China's national ETS has faced documented instances of falsified emission data submitted by covered entities and verification agencies, prompting the Ministry of Ecology and Environment to impose penalties and withdraw accreditation—revealing that legal penalties, however proportionate on paper, are ineffective absent robust enforcement capacity.

V. Toward an Effective Legal Architecture for GHG Emissions Markets

(I) Adaptive Governance as an Organising Principle

The foregoing analysis reveals that GHG emissions market law must accommodate a paradox: legal certainty is a prerequisite for market confidence and long-term investment, yet the rapidly evolving scientific understanding of

climate change, the pace of technological innovation, and the shifting geopolitical landscape require frameworks capable of continuous adaptation. The theory of adaptive governance, developed in the context of natural resource management and applied to climate institutions, offers a conceptual response to this paradox (Wiener, J.B. 1999). Adaptive governance frameworks institutionalise processes for iterative review and adjustment of regulatory parameters in response to new information, while providing procedural guarantees—notice, consultation, impact assessment, legislative approval thresholds—that protect market participants from arbitrary rule changes.

Applied to ETS law, adaptive governance implies: legislatively mandated periodic review cycles aligned with NDC update cycles under the Paris Agreement; statutory criteria governing the conditions under which cap levels, sectoral scope, and allocation methods may be adjusted; independent regulatory agencies insulated from short-term political pressure, modelled in part on financial regulatory bodies; and international coordination mechanisms that enable jurisdictions to align review processes and share learning without requiring full regulatory harmonisation. The EU ETS's experience with the Market Stability Reserve—a rule-based, automatic supply management mechanism—illustrates how adaptive regulatory logic can be embedded in legislation without sacrificing legal certainty.

(II) Institutional Capacity Building and Technical Assistance

The gap between legal design and operational implementation that characterises emerging carbon markets in China, Vietnam, and other developing economies is ultimately an institutional capacity problem. Effective ETS law requires not only a well-designed statutory framework but also the administrative infrastructure to populate registries with accurate entity data, process allowance transfers, conduct enforcement proceedings, and regulate the conduct of market intermediaries. International technical assistance—whether through bilateral cooperation programmes, the World Bank's Partnership for Market Readiness, or the capacity-building provisions of Article 11 of the Paris Agreement—is an important complement to domestic legislative development.

Vietnam's trajectory illustrates the interaction between legislative ambition and capacity constraints. The sophisticated multi-tier architecture of the LOEP 2020 and Decree 06/2022 creates a legally credible framework on paper, but its operationalisation depends on the development of sector-specific MRV guidelines, the training of an accredited verifier community, the commissioning of a domestic carbon registry, and the establishment of an institutional oversight body with the mandate and expertise to enforce compliance. Legal scholars working in this domain have a responsibility to engage with these implementation challenges—designing legal instruments that are not merely technically sophisticated but institutionally feasible in the contexts in which they will be applied.

(III) International Coordination and the Role of Article 6

The long-term effectiveness of GHG emissions markets depends on the progressive development of internationally coordinated rules governing cross-border carbon trading, avoiding the fragmentation of incompatible domestic systems that would undermine both environmental integrity and economic efficiency. The Article 6 mechanisms of the Paris Agreement provide the current legal scaffold for this coordination, but their operationalisation through the Glasgow and subsequent COP decisions reveals the difficulty of achieving multilateral agreement on technical standards in the absence of a centralised international regulatory authority.

A more ambitious vision of international carbon market law would involve the negotiation of a multilateral agreement establishing common standards for allowance eligibility, MRV, corresponding adjustments, and registries—analogous to international financial regulatory standards developed by the Financial Stability Board. Jaffe, Ranson, and Stavins suggested that bottom-up bilateral and plurilateral linkage agreements, gradually converging on common standards, may be a more feasible pathway than a top-down multilateral framework (Jaffe, J., Ranson, M. and Stavins, R.N. 2009). Either pathway requires sustained legal scholarship and practitioner engagement to develop the institutional designs, treaty language, and domestic implementing legislation that would give effect to international carbon market law in practice.

Concluding Remarks

The law of GHG emissions trading markets has evolved substantially since the Kyoto Protocol's flexible mechanisms were first operationalised in the early 2000s. The EU ETS has provided a laboratory for carbon market legislation whose lessons—on allowance allocation, market integrity, registry security, MRV standards, and adaptive cap management—have informed the design of subsequent systems worldwide. China's national ETS brings the world's largest emitter squarely within the carbon market architecture, while Vietnam's emerging framework illustrates the particular legal challenges faced by developing economies seeking to deploy market-based climate instruments.

Four legal dilemmas—allowance allocation, market integrity, international linkage, and MRV—cut across jurisdictional boundaries and resist resolution through any single legal tradition or instrument. Addressing them effectively requires adaptive governance frameworks that institutionalise iterative review without sacrificing legal certainty; robust institutional capacity to give effect to legislatively sound frameworks; and progressive international coordination grounded in the Article 6 mechanisms of the Paris Agreement but ultimately aspiring to a more coherent multilateral architecture.

As the IPCC's Sixth Assessment Report makes clear, the window for limiting global warming to 1.5°C above pre-industrial levels is closing rapidly (IPCC, 2022). The law of GHG emissions markets will not, by itself, close that window—but without credible, effective, and internationally coherent legal frameworks for carbon pricing, the economic transformation required by the

Paris Agreement's temperature goals cannot be achieved. Advancing the quality, coverage, and coordination of emissions market law is therefore among the most consequential tasks confronting the international legal community in the years ahead.

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