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Mitigating greenhouse gas emissions through law in Vietnam

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Abstract
This article provides a comprehensive analysis of Vietnam's emerging legal framework on greenhouse gas (GHG) mitigation in the context of the country's commitment to achieving net-zero emissions by 2050. It examines the core regulatory components governing GHG inventories, emission-quota allocation, mitigation planning and measures, measurement-reporting-verification (MRV), and compliance enforcement. The study highlights the foundational role of the Law on Environmental Protection 2020, together with its implementing decrees and technical circulars, in establishing a data-driven and market-oriented approach to national GHG mitigation. While recognizing the significant progress Vietnam has made in aligning its domestic law with international standards under the Paris Agreement, the article identifies remaining institutional, technical, and regulatory gaps. It further proposes targeted recommendations to refine inventory methodologies, strengthen quota-allocation mechanisms, standardize mitigation plans, modernize MRV systems, and enhance enforcement to safeguard the integrity of the emerging carbon market. By synthesizing legal, technical, and policy perspectives, the article contributes to the understanding of Vietnam's transition from administrative management of emissions toward a transparent, market-based, and legally robust GHG-mitigation regime.

Keywords: Greenhouse gas mitigation, GHG inventories, MRV, carbon market, environmental regulation, Vietnam

Introduction

Greenhouse Gases and the Mitigation of Greenhouse Gas Emissions

1. Greenhouse Gases

According to the Intergovernmental Panel on Climate Change (IPCC), from a natural science perspective, "greenhouse gases" (GHGs) are defined as those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and clouds [1]. Concurrently, under Article 1, Paragraph 5 of the United Nations Framework Convention on Climate Change (UNFCCC, 1992) [6, 13], greenhouse gases are defined as "those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation."

In essence, when solar radiation reaches the Earth's surface and is converted into infrared heat, GHGs trap a portion of this thermal energy within the atmosphere rather than allowing it to escape entirely into space. This property of absorption and re-emission drives the global warming effect. According to the IPCC, the primary GHGs in the Earth's atmosphere include water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Additionally, there are purely anthropogenic gases introduced into the atmosphere, such as halocarbons and other industrial gases. Although these synthetic gases typically exist in minute concentrations, they are classified as GHGs due to their high Global Warming Potential. While the natural greenhouse effect is fundamental to maintaining life on Earth, the escalation of GHG concentrations due to anthropogenic emissions has intensified this effect, precipitating global warming and climate change.

GHGs play a pivotal role in maintaining planetary temperatures at levels capable of supporting life. However, the proliferation of these gases poses severe environmental threats. According to NASA, the global average temperature has risen by approximately 1.1°C compared to pre-industrial levels, driving unprecedented changes in recent history, including large-scale glacial melting at the poles. Climate warming accelerates the melting of ice sheets in Greenland, the Arctic, Antarctica, and glaciers worldwide. NASA data indicates that Greenland loses an average of approximately 279 billion tons of ice annually, while Antarctica loses roughly 148 billion tons [2]. This contributes to a continuous rise in global sea levels; over the past century, sea levels have risen by approximately 20cm, with the rate nearly doubling in the last two decades. Rising sea levels increase the risks of coastal inundation, saltwater intrusion, and the loss of arable land and coastal settlements [3]. Furthermore, the thawing of permafrost releases significant quantities of methane, creating a feedback loop that intensifies global warming. The rate of temperature increase over the past decade is unprecedented in human records [4]. Moreover, global warming induced by GHGs leads to a marked increase in extreme and severe weather events. The IPCC Sixth Assessment Report (AR6) states that every 0.5°C increment in global temperature causes clearly discernible increases in the frequency and intensity of heatwaves, heavy precipitation, and droughts. For instance, extreme heat events that occurred once every 10 years in a climate without human influence would likely occur 4.1 times per decade at 1.5°C of warming; at 2°C, this frequency increases to 5.6 times, and at 4°C, to 9.4 times. Similarly, extreme precipitation, agricultural droughts, and tropical cyclone intensity all increase with every additional increment of warming. These findings demonstrate that

even fractional increases in average temperature result in profound climatic consequences.

2. Mitigation of Greenhouse Gas Emissions

Given the universal consequences of GHGs on the environment and human life, the mitigation of GHG emissions has been a critical global mandate over recent decades. According to the IPCC, mitigation is defined as "human intervention to reduce the sources or enhance the sinks of greenhouse gases [5]. Although definitions may vary slightly across legal instruments, the core concept focuses on GHG management. This aligns with the ultimate objective of the UNFCCC, which is to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system [6]." Alongside adaptation, mitigation constitutes a central pillar in the framework to address climate change under the Convention and related legal instruments. While climate change is driven by multifarious factors, the core driver remains the emission of GHGs into the environment; consequently, controlling these emissions is a binding obligation for State Parties in their efforts to uphold international climate agreements. Therefore, it can be concluded that: Mitigation of greenhouse gas emissions is the human intervention to reduce the level and intensity of GHG emissions into the environment and/or to enhance the absorption capacity of atmospheric GHGs through various measures.

In the context of the negative environmental impacts caused by the greenhouse effect, controlling GHGs has been a paramount objective since the post-industrial era to protect the environment and ensure sustainable development. Theoretically, benefits of GHG mitigation can be analyzed through three primary sectors:

From an environmental perspective, GHG mitigation directly contributes to decelerating climate change. Deep and sustained reductions in GHGs will "discernibly slow global warming within a few decades," thereby reducing the risk of extreme weather events such as record-breaking heatwaves, droughts, floods, and super typhoons [7]. Consequently, ecosystems and biodiversity - currently under severe threat from rising temperatures - are better protected. Furthermore, lower atmospheric GHG concentrations correlate with improved environmental quality: reduced air, soil, and water pollution due to lower toxic emissions from industry and transport. This helps preserve biodiversity and natural ecosystems against harsh climatic impacts. Thus, the environmental role of mitigation is immense: it simultaneously prevents dangerous climatic shifts and fosters a safer, healthier habitat for humans and other species.

From an economic perspective, GHG mitigation offers long-term economic benefits that outweigh the costs. Primarily, through improved energy efficiency and the development of clean technologies, nations can achieve significant savings in fuel and resource costs compared to fossil-fuel-dependent development models [8]. Prioritizing the transition to renewable energy or enhancing fossil fuel efficiency allows for direct savings on fuel procurement, redirecting funds toward reinvestment in other sectors. Furthermore, the transition to a green economy generates new employment opportunities in sectors such as renewable energy, grid modernization, public transport, and sustainable agriculture. Additionally, mitigation avoids the economic losses and damages caused by climate change, such as storms, floods, wildfires, and sea-level rise. Therefore, investing in emission reductions today prevents astronomical future costs associated with climate change, ranging from disaster recovery to productivity losses and increased healthcare burdens.

From a social perspective, efforts to reduce GHG emissions contribute to enhancing quality of life and community welfare [9]. The most tangible social benefit is the improvement of public health. Reducing emissions from transport, energy, and industry significantly lowers particulate matter $PM_{2.5}$ and secondary pollutants, thereby limiting the risk of premature death and diseases related to respiratory and cardiovascular systems. Research by Anenberg suggests that global measures to reduce methane and black carbon could prevent between 0.6 and 4.4 million premature deaths annually by 2030, while simultaneously reducing low-level ozone concentrations - a potent lung irritant [10]. These results indicate that the health benefits of mitigation are immediate and local, distinct from the long-term and global nature of climate impacts. Beyond qualitative benefits, numerous studies quantify the health benefits of emission reductions in economic terms. Estimates suggest that in the United States alone, the monetized health benefits from avoided deaths due to air pollution range from approximately $45 to $137 for every ton of CO_2 reduced [11]. At a societal level, GHG mitigation contributes to narrowing inequalities in health and living conditions, particularly in low-income communities subjected to high pollution levels [12]. This demonstrates that workable climate policies deliver positive social impacts, not only preserving the living environment but also improving human welfare, fostering equity, and promoting sustainable development.

Vietnamese Law on Greenhouse Gas Mitigation

Vietnamese law on GHG mitigation has developed within a context in which the country has made strong climate commitments, demonstrating a clear determination to transition its development model toward carbon neutrality and climate resilience. The most important milestone was Vietnam’s pledge to achieve net-zero emissions by 2050 at COP26, which has provided strong impetus for building a comprehensive legal framework for GHG mitigation. At the core of this system are the Law on Environmental Protection 2020, Decree No. 06/2022/ND-CP, and Decree No. 119/2024/ND-CP amending and supplementing regulations on GHG mitigation, alongside a system of technical circulars on inventories, measurement–reporting–verification (MRV), emission quota allocation, and carbon credit administration. The fundamental areas governed under the current Vietnamese legal system on GHG mitigation include the following:

1. Regulations on Greenhouse Gas Inventories

Within this legal architecture, GHG inventories hold a particularly important position as they serve as the basis for designing emission-reduction measures and determining the responsibilities of each sector and large-emitting establishment. The Law on Environmental Protection 2020 for the first time establishes mandatory GHG inventory obligations at the national, sectoral, and facility levels. Decree No. 06/2022/ND-CP details the list of sectors and types of facilities required to conduct periodic inventories

while also defining methods of data collection, emission factors, reporting cycles, and the authority of managing agencies. Subsequent technical circulars provide detailed guidelines for conducting inventories in line with the 2006 IPCC Guidelines and Vietnam-specific emission factors. Mandatory GHG inventories lay the foundation for a unified national GHG database, which supports the establishment of emission quotas, assessment of sectoral emission trends, and formulation of appropriate mitigation policies.

2. Regulations on Greenhouse Gas Emission Quotas

Closely linked to inventories is the regulatory framework on GHG emission quotas, which constitutes one of the most market-oriented legal instruments in Vietnam's GHG mitigation regime. The Law on Environmental Protection 2020 authorizes the State to allocate emission quotas to major sectors and emitting facilities, while also providing for the establishment of a domestic carbon market where quotas may be traded. Decree No. 06/2022/ND-CP and Decree No. 119/2024/ND-CP lay down the basic legal structure of the quota mechanism, including principles for determining quotas, allocation methods, auctioning mechanisms, and the rights to trade quotas. Quotas are determined based on historical emission baselines or on emission intensities per unit of product. Guiding documents also specify the rights and obligations of facilities receiving quotas, covering the receipt, use, reporting, trading, and settlement of quotas under the regulatory cycle. The establishment of quotas and a carbon market reflects a significant shift from traditional administrative regulation to a market-based approach designed to incentivize cost-effective emission reductions.

3. Regulations on Mitigation Plans and Mitigation Measures

Parallel to inventories and quota allocation, Vietnamese law also prescribes plans and measures for GHG mitigation to be developed and implemented by ministries, sectors, and major emitting facilities. The Law on Environmental Protection 2020 mandates the formulation of national-level, sectoral-level, and facility-level GHG mitigation plans. These plans set out emission-reduction targets, identify mitigation options, provide implementation roadmaps, and define responsibilities for execution. Mitigation measures are categorized into several groups, including technological measures (equipment upgrades, process improvements, adoption of cleaner fuels, expansion of renewable energy), managerial measures (operational optimization, energy-consumption control, waste management aligned with circular-economy principles), natural absorption measures (reforestation, ecosystem restoration, enhancement of carbon sinks), and market-based measures (participation in carbon credit trading and engagement in international cooperation mechanisms under Article 6 of the Paris Agreement). This diversity of measures illustrates that Vietnamese law adopts a comprehensive approach addressing both emission reductions at source and carbon sequestration, while simultaneously encouraging innovation and technological transition within enterprises.

4. Regulations on Measurement, Reporting, And Verification (MRV)

For mitigation measures to be implemented accurately and transparently, a regulatory system on MRV has been established to ensure precision and consistency in emission data. MRV is a central requirement under the Paris Agreement and is embedded in the Law on Environmental Protection 2020 and its implementing decrees. These regulations require major emitting facilities to collect and measure activity data relevant to emissions, calculate emissions using standardized methodologies, maintain records, and report periodically. Reports on emissions and GHG inventories must follow a uniform template and include all necessary activity data, emission factors, calculations, adopted mitigation measures, and quantified reductions. An independent verification system is established to assess the reliability and accuracy of the reports, thereby providing a solid legal basis for quota allocation, carbon-credit transactions, and determination of Vietnam's contribution to national targets. MRV is not only a technical tool but also a mechanism for transparency, oversight, and enhanced accountability of emitting entities.

5. Regulations on Inspection, Supervision, And Sanctions for Violations

Together with MRV, the regulatory framework on inspection, supervision, and sanctions ensures compliance with legal obligations relating to GHG mitigation. The Law on Environmental Protection 2020 defines the authority of State management bodies to inspect inventory performance, monitor implementation of mitigation plans, assess the use and reporting of quotas, and supervise carbon-credit trading activities in the domestic carbon market. Drafting of the decree on administrative sanctions in the environmental sector is underway in the direction of expanding the scope of violations relating to emission reporting, failure to conduct inventories, provision of inaccurate data, non-compliance with quota regulations, or unlawful carbon-credit trading. The supervision mechanism includes review of approved mitigation measures, requests for information and data, unscheduled inspections, and assessments of compliance levels. This shift demonstrates Vietnam's transition from a voluntary-based management approach to a mandatory regime with sanctions, consistent with the needs of a transparent and effective GHG-mitigation system.

Overall, Vietnam's legal framework on GHG mitigation is developing toward comprehensiveness and modernization, covering inventories, quotas, mitigation plans, mitigation measures, MRV, enforcement mechanisms, and the carbon market. These regulations reflect not only domestic legal adjustments but also the country's efforts to harmonize with international standards and deepen its integration into global climate governance. The emissions-management model is gradually shifting from a traditional administrative approach to a market-based and data-driven model, thereby creating incentives for technological innovation, enhancing enterprise competitiveness, and supporting national energy and green-transition processes. The establishment of robust regulations on inventories, MRV, and quotas represents a significant step toward the future operation of a national carbon market, contributing effectively to Vietnam's long-term emission-reduction goals and fulfillment of its international climate commitments.

Remarks and Recommendations

Although Vietnamese law on GHG mitigation has made significant contributions, further improvement remains

essential in light of the national commitment to achieve net-zero emissions by 2050 and the increasing stringency of international standards on transparency, carbon pricing, and emission traceability. A review of the current regulations indicates that while a foundational legal framework has been established, various gaps and technical limitations persist. To address these challenges, several recommendations may be proposed corresponding to the key groups of regulatory content.

First, regarding regulations on GHG inventories and emission quotas, improvements should aim at clarifying methodologies, criteria, and data-responsibility requirements for major emitters. Accurate inventories must rely on credible national emission factors; however, Vietnam continues to rely significantly on IPCC default values. Therefore, investment is needed to develop sector-specific and technology-specific national emission factors for greater precision, particularly in sectors such as electricity, cement, steel, and agriculture. Simultaneously, mechanisms for standardizing facility-level activity data and fuel data should be codified to ensure data compatibility across national and facility-level inventories. For emission quotas, methods for determining baselines should be refined to avoid overly generous allocations, which reduce incentives for mitigation, or excessively restrictive allocations, which may undermine competitiveness. Existing law sets out only general principles for quota determination; thus, more detailed methodologies—whether intensity-based or absolute-based—should be developed to reflect sectoral characteristics. Furthermore, rules on quota auctioning, transparency in free-allocation criteria, and provisions for independent oversight must be finalized to minimize conflicts of interest in carbon-market operation.

Second, regarding regulations on mitigation plans and mitigation measures, the priority should be strengthening the linkage between national, sectoral, and facility-level plans. Current planning processes largely follow a top-down approach without sufficient engagement from major emitters—those who bear primary responsibility for actual reductions. The law should therefore establish mandatory consultation mechanisms between sectoral regulators and enterprises when setting sectoral reduction targets, particularly for heavy-industry sectors. The selection of mitigation measures should also be standardized through a unified national list of approved mitigation options to avoid inconsistencies and facilitate monitoring and evaluation. Additionally, legal mechanisms that directly link mitigation plans with access to carbon credits, emission quotas, and green-finance instruments would substantially enhance compliance incentives. The potential establishment of a support fund for low-emission technology transition or tax incentives for investments in emission-reduction projects is also worth considering to enhance the feasibility of mitigation plans.

Third, regarding MRV regulations, legal improvements should prioritize modernization and digitalization of the entire MRV process to ensure accuracy, transparency, and reduced compliance costs. Current rules remain largely technical guidelines and should be elevated into binding legal requirements specifying minimum standards for measurement devices, data-collection methods, and record-retention periods. An electronic GHG reporting system should be developed with an open-data architecture that allows integration of data from ministries and automated measurement systems at enterprises. Equally important is strengthening the legal framework for accreditation and oversight of independent verification entities, including clearly defined professional standards, legal liabilities, and periodic quality-assurance mechanisms to reduce reliance on foreign verifiers. Harmonizing Vietnam's MRV system with international standards such as ISO 14064, the GHG Protocol, and IPCC methodologies will further enhance the international acceptance of carbon credits issued domestically under Article 6 of the Paris Agreement.

Fourth, regarding inspection, supervision, and sanctions, legal reform should enhance enforcement capacity and align sanctions with the operational needs of a carbon market. The current administrative-sanctioning system does not fully capture violations relating to GHG mitigation, particularly acts such as data fraud, misreporting, evasion of MRV obligations, or manipulation of quota and carbon-credit trading. The law should therefore expand the scope of sanctionable conduct and increase penalty levels to ensure deterrence, including consideration of criminal liability for large-scale falsification of emission data. A coordinated inter-ministerial supervision mechanism among the Ministry of Natural Resources and Environment, the Ministry of Industry and Trade, the Ministry of Agriculture and Rural Development, and the Ministry of Transport should also be established to ensure consistent enforcement. The development of continuous emissions-monitoring systems (CEMS) for major emitting facilities should be integrated into the legal framework to reduce risks of data tampering. Likewise, compliance-assessment procedures and early-warning mechanisms should be institutionalized to identify risks before they undermine the integrity of the carbon market.

In conclusion, improving Vietnam's legal framework for GHG mitigation requires building a coherent regulatory architecture that effectively integrates inventories, quotas, mitigation planning, MRV, and enforcement mechanisms. Only when these components operate in a mutually reinforcing manner can the mitigation regime become a truly effective instrument to support the national green transition, enhance enterprise competitiveness, and ensure that Vietnam meets its long-term climate-commitment objectives.

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