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The Potential of Carbon Credits Market in Vietnam Electricity Market: Research and Proposal

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Abstract
This paper researches and evaluates the prospects of the carbon credit market in the context of the electricity market in Vietnam, a rapidly developing country with increasing energy demand. Vietnam is facing the challenge of simultaneously powering economic growth and reducing greenhouse gas emissions into the environment. The Vietnam Electricity Market has traditionally relied on a mix of fossil fuels, with nearly 50% capacity of coal and gas, to power its economic growth. However, this trajectory has raised environmental alarms, prompting the government to explore innovative solutions to balance economic expansion with environmental stewardship. Carbon credits, a globally recognized tool for incentivizing emission reductions, offer a strategic mechanism for Vietnam to transition towards a low-carbon and resilient energy landscape. The paper also highlights various challenges that must be addressed, including the imperative to establish robust legal frameworks, implement effective measurement and verification methods, and cultivate awareness and trust among stakeholders.

Keywords: Carbon, Electricity, Vietnam

1. Vietnam Electricity Market

A. Introduction to Vietnam Electricity Market

Vietnam Electricity Market (VEM) [1] was established with the specific objectives aimed at advancingthe electricity industry in Vietnam. These fundamentals include goals.

- Ensure stable and adequate electricity supply with reasonable electricity prices, without causing major disruptions to electricity production and business activities;
- Foster the sustainable development of the electricity industryin Vietnam. This involves adopting practices that promote environmental responsibility, resource efficiency, and the long-term viability of the sector;
- Attract investment capital from both domestic and international sources to participate in electricity-related activities. A key aspect of this goal is the gradual reduction of state investment in the electricity industry, with an emphasis on encouraging diverse economic sectors to contribute to its growth;
- Enhance competition, ensure fairness, equality, and transparency in electricity trading transactions and operations.

VEM was formed from a very different starting point than other countries in the world. Most countries' power markets stem from excess supply, leading to the need for a clearer competitive environment in the field of electricity generation, thereby reducing electricity purchase costs and reducing prices for consumers. However, the power market in Vietnam is operated in the context of low power reserve, but more importantly, creating a transparent playing field to attract investment capital into the power industry. Vietnam's power system infrastructure, including IT infrastructure serving the power market, still has many limitations. Therefore, the work of operating the power market faces many difficulties. In order to ensure the goal of forming and developing a competitive, stable electricity market and contributing to promoting socio-economic development while remaining within the ability of the infrastructure to respond, VEM is designed according to the gross-pool full market model, centralized dispatching, payment based on marginal prices and bidding based on variable costs.

Vietnam Electricity Market formally operated for buusiness on July 1, 2012, signaling a new development phase in the growth of the country’s electricity industry. Thus far, VEM has undergone two stages of development:

- Vietnam Generation Competitive Market (VGCM)
- Vietnam Wholesale Electricity Market (VWEM) [2, 3, 4]

At the time of VGCM's official operation, there were 73 power plants on the system with a total installed capacity of 23,372 MW. Of these, 31 power plants directly bid on the market, with a total installed capacity of 9,212 MW, accounting for about 38% of the total system installed capacity [5].

By the end of June 2023, the total installed capacity of the system is 82,617 MW. The total number of power plants operating in the power system under the control of National Load Dispatch Center (NLDC) is 351 power plants (excluding rooftop solar power plants, small power plants, imported sources) with a total capacity of 66,153 MW. Structure of installed capacity according to type of participation in the power market, including 108 power plants directly participating in the power market with a total installed capacity of 30,812 MW, accounting for nearly 37.3% of the total installed capacity of the entire system, specifically as follows:

- Directly participant: 37%;
- Strategic multi-purpose hydropower plants: 10%
- Build - Operate - Transfer: 11%
- Solar rooftop: 9%
- Renewable energy power plants: 22%
- Small hydro power: 6%
- And others: 5% [6]

B. Mechanism of VEM

Seller in VEM:

- Power generation units that possess power plants boasting an installed capacity exceeding 30 MW directly participate in the electricity market. Meanwhile, hydropower plants with an installed capacity of 30 MW or less retain the prerogative to opt for participation in the electricity market, provided they fulfill all requisite infrastructure conditions.
- In the current period, power plants are invested in the form of Build - Operate - Transfer (BOT), strategic multi-purpose hydropower plants (SMHP) directly engage in VWEM, while those utilize renewable energy sources indirectly participate in this market. As per the VWEM design, BOT and SMHP plants are expected to participate in the electricity market through one of two avenues: either direct participation in the market or involvement through the price offering unit of Vietnam Electricity (EVN).

Buyer in VEM:

- Five (05) Power Corporations: North, South, Central, Hanoi City and Ho Chi Minh City: Participate in competition to buy electricity on the spot market.
- Large electricity consumers who purchase electricity at the 110 kV voltage level or higher and directly linked to the 220 kV voltage transmission transformer station meeting the criteriasprescribed by the Ministry of Industry and Trade, possess the right to opt for involvement in the competitive wholesale electricity market.
- Electricity Trading Company (under EVN): Performs the task of purchasing electricity from power plants that are not engaged in VWEM and selling this electricity output to Electricity Corporations according to the law and regulations set forth by the Ministry of Industry and Trade.

Service provider in VEM:

- National Load Dispatch Center (NLDC): has the function of dispatching the national power system, operating the power market and managing measurement data within the power market;5 Power Corporations: North, South, Central, Hanoi City and Ho Chi Minh City: For electricity distribution and retail;
- National Power Tramission Corporations (NPT): has the mission to ensure the safe, continuous and stable power transmission supporting economic, political, social, security, defense and electricity market activities in Vietnam.

The mobilization schedule for generating unit is prepared by the Electricity System and Market Operating Unit (NLDC) for each transaction cycle based on the price quotation of the generating sets, the electricity system load forecast, load capacity of the transmission grid and other technical constraints according to the principle that the total cost of purchasing electricity is the lowest. Power ultilities that indirectly participae in the electricity market undergooptimal calculations by the SMO and publish the mobilization chart before the time of bidding by market members to review.

The full market price paid to factories consists of two components:

- The Spot Market Power Price (SMP) is established by NLDC employing the system marginal price principle. This determination generating relies on actual load, price quotes and actual available capacity of generating units. Annually, the market capacity price is set to ensure that the best new power plant fully recovers its total electricity generation costs during the year.
- The Capacity Add-On (CAN) price gives the amount of capacity scheduled to be mobilized during a transaction cycle. CAN is calculated based on the principle that the best new factory (BNE - Best New Entrant) can recover the average fixed and variable costs over a year, based on estimates utilized in the annual planning process.

Successful electricity markets rely not only on the spot market but also on a well-designed contractual mechanism. This mechanism plays a crucial role in shaping most of the financial results for both the sellers and the buyers aidingmarket paticipants in l mitigating and controling the risks associated with continuous fluctuations in prices and output on the spot market.

In addition, the contract mechanism serves as animportant tool in preventing manipulation and prices distortion within the spot market. VWEM is designed as a complete spot market, involves the sale and purchase of 100% of electricity output on the spot market for participating units in the electricity market. Consequently, the significance of the contractual mechanism is heightened, especially in the context of financial risk management within the VWEM market.

Power plants participating in competition in the market sign Contracts for Difference (CfD) with electricity wholesalers (EVN or power corporations). The contract price is agreed upon by both parties but does not exceed the price range issued by the Ministry of Industry and Trade. The annual contract output is determined before the start of the operating year according to the agreement between the buyer and seller or through the optimal calculation of the next year's power system. Contractual mechanisms in

VWEM include:
- Allocation contracts (vesting contracts);
- Bilateral contracts
- Centralized contract trading mechanism

Based on the nature of the types of ancillary services, currently the ancillary services designed in VWEM are as follows:

Frequency adjustment services (including frequency adjustment services and rotating reserve services):
- Purchase on the spot market. When applying ex-ante market price determination, implementing a co-optimization mechanism between electricity and frequency adjustment services.
- Other ancillary services serving the operation of the power system and electricity market: SMO signs contracts with service providers through a competitive bidding mechanism or appoints service providers.

C. Third stage of electricity market in Vietnam – Vietnam Retail Electricity Market (VREM)

When switching to VREM, the chain from production to power consumption of the power system will include 02 competing segments to buy and sell electricity:
- Competition in wholesale: Carry out purchase and sale transactions between electricity generating units and electricity trading units through the spot market. Transmission of electricity through the national electricity system from power plants (seller) to upstream delivery points (buyer).
- Competition in retail: Carry out purchase and sale transactions between electricity distribution units and customer. Distributing electricity through the national grid from upstream delivery points to consumption locations of electricity users.

Depending on the scale and connection voltage level, electricity users choose to buy electricity according to the models: Buy electricity on the spot market or from retailers.

2. Introduction to Carbon Credit Market

The carbon credit market is a key component of the broader carbon market, designed to combat climate change by incentivizing entities to reduce their greenhouse gas emissions, which contribute to global warming. This market operates on the principle of "cap and trade", where governments or regulatory bodies set a cap on the total allowable emissions. Entities that emit below their allocated limit can sell excess allowances (carbon credits) to those exceeding their limit. This system creates economic incentives for businesses and governments to adopt cleaner practices and invest in sustainable technologies.

A. The mechanism of carbon credit market:
- *Setting Emission Reduction Targets*: Governments or regulatory bodies set emission reduction targets for industries and organizations to combat climate change. These targets are often outlined in national or international agreements.
- *Baseline Emission Levels*: Each entity establishes its baseline emission levels, representing the amount of greenhouse gases it would emit without implementing any emission reduction measures.
- *Project Development*: Entities can undertake projects that reduce or sequester greenhouse gas emissions. These projects can involve the implementation of renewable energy sources, energy efficiency measures, afforestation, or other activities that contribute to emission reductions.
- *Emission Reduction Credits*: When a project successfully reduces emissions below the established baseline, it generates emission reduction credits, commonly known as carbon credits. One carbon credit is generally equivalent to one metric ton of carbon dioxide (CO2) or its equivalent in other greenhouse gases.
- *Verification and Certification*: Independent third-party auditors verify and certify the emission reductions achieved by the project. This involves a rigorous assessment to ensure that the claimed reductions are legitimate, additional, and measurable.
- *Issuance of Carbon Credits*: Once the verification is complete, carbon credits are issued and registered on a central registry. These credits can now be bought and sold on the carbon market.
- *Carbon Credit Trading*: Entities with excess carbon credits can sell them to those struggling to meet their emission targets. This creates a market where the economic principles of supply and demand determine the price of carbon credits. This trading mechanism provides financial incentives for emission reduction activities.
- *Compliance and Offset*: Some entities are required to meet specific emission reduction targets set by regulatory bodies. Carbon credits can be used to offset a portion of their emissions, allowing them to comply with regulations more cost-effectively.
- *Market Oversight and Regulation*: Government agencies or international bodies oversee the carbon credit market to ensure transparency, credibility, and adherence to established standards. This includes regulating the creation, verification, and trading of carbon credits

B. Carbon Market Classification

Mandatory carbon market: a market where carbon trading is based on countries' commitments under the United Nations Framework Convention on Climate Change (UNFCCC) to achieve greenhouse gas reduction targets. This market is mandatory and mainly for projects in the Clean Development Mechanism (CDM), Sustainable Development Mechanism (SDM) or Joint Implementation (JI).

Voluntary carbon market: based on bilateral or multilateral agreement cooperation between organizations, companies or countries. Credit buyers engage in transactions on a voluntary basis to meet environmental, social and corporate governance (ESG) policies to reduce carbon emissions.

C. Carbon Pricing [7]

ETS (Emission Trading System) - sometimes called cap and trade system - limits total greenhouse gas emissions. Tradable emissions permits or allowances are issued, facilitating cost- effective mitigation, each emitter trades between reducing or paying for the allowance. By creating supply and demand for emissions limits, ETS sets the market price. The cap ensures the necessary emissions reductions will occur to keep (aggregate) emission sources within their pre-allocated emissions budgets.

A carbon tax directly puts a price on greenhouse gas emissions by setting a tax rate on greenhouse gas emissions

or - more commonly - on the carbon content of fossil fuels with or without a cap. A tax differs from an ETS in that the emission reduction outcome is not predetermined but is a price.

D. Some Common Types of Carbon Credits:

There are several types of carbon credits, each representing a different approach to emission reduction:

- Certified Emission Reductions (CERs): CERs are generated under the Clean Development Mechanism (CDM), a project-based mechanism under the Kyoto Protocol. Projects in developing countries can earn CERs by reducing emissions and contributing to sustainable development.
- Emission Reduction Units (ERUs): ERUs are created under the Joint Implementation (JI) mechanism, another project-based approach established by the Kyoto Protocol. JI allows industrialized countries with emission reduction commitments to invest in emission reduction projects in other industrialized countries and receive ERUs in return.
- Verified Emission Reductions (VERs): Also known as voluntary carbon credits, VERs are generated through projects that reduce or capture greenhouse gas emissions. Unlike CDM or JI, VERs are not linked to international treaties but are created voluntarily and can be used by businesses or individuals seeking to offset their carbon footprint.

E. Participants in Carbon Credit Market:

The carbon credit market involves various participants, including governments, businesses, project developers, investors, and environmental organizations:

- Administrators: Governments play a crucial role in shaping the carbon credit market through the establishment of regulations, cap-and-trade systems, and the oversight of compliance mechanisms.
- Buyer: Power Utilities with fossil fuel-based power generation; Manufacturing and industrial facilities that are subject to emissions regulations may buy carbon credits to meet their compliance obligations; Voluntary buyers.
- Seller: Clean Development Mechanism (CDM) Project Developers develop emission reduction projects in developing countries that qualify for Certified Emission Reductions (CERs) under the CDM; Entities that own and operate renewable energy projects, such as wind farms, solar power plants, or hydropower facilities, may generate carbon credits based on the avoided emissions associated with clean energy production.

Sellers participate in the carbon credit market by offering their credits for sale through various channels, such as direct negotiations, brokers, or carbon credit exchanges. The revenue generated from these sales can provide funding for the continued operation and expansion of emission reduction projects.

The carbon credit market is diverse, with participants engaging in various activities to support emission reduction efforts and create a functioning marketplace for carbon credits. The roles and dynamics can vary depending on the type of credits (compliance or voluntary) and the regional regulatory frameworks in place.

F. Carbon credit project

Carbon credit projects encompass a wide range of activities aimed at reducing or removing greenhouse gas emissions. These projects contribute to the mitigation of climate change and are typically undertaken in sectors such as energy, forestry, agriculture, waste management, and industrial processes. Some common types of carbon credit projects:

- Renewable Energy Projects: Wind power, Solar power, Hydro power.
- Energy Efficiency Projects: Projects that enhance energy efficiency in industrial processes, reducing energy consumption and associated emissions.
- Forestry and Land Use Projects: Projects that involve planting trees on land that was not forested (afforestation) or replanting trees in areas that were previously deforested (reforestation), leading to carbon sequestration.
- Carbon Capture and Storage (CCS) Projects: Projects that capture carbon dioxide emissions from industrial processes, preventing their release into the atmosphere, and often storing the captured carbon underground.

These project types adhere to specific methodologies and standards to ensure the credibility.

G. International Experience

The European Union Emission Trading Scheme (EU–ETS), operating since 2005, is the first international emissions trading market and one of the key policy instruments. of the European Union to respond to climate change, implementing commitments in the former Kyoto Protocol and later the Paris Agreement on climate change. Having gone through 3 periods of revision and adjustment, currently in phase 3, this is the world's main and largest carbon emissions exchange market with all 28 European member states and 3 countries in the region. Participating areas, limiting emissions from more than 11,000 energy-intensive enterprises (focusing on energy production plants, industrial production plants that use a lot of energy such as iron and steel, cement, ceramic, paper and aviation industry). Market-traded emissions account for about 45% of total European emissions and about three-quarters of the global carbon emissions market. The operating principle of EU–ETS is based on the principle of cap–and–trade [8, 9].

Accordingly, absolute limits on the amount of greenhouse gas emissions are established and gradually reduced over time. Organizations and businesses can distribute or buy emission credits and permits through the auction mechanism, and can also trade with each other if necessary. The market allows trading and exchanging credits with other international emission reduction projects. With emission limits set, credits or permits become valuable and exchangeable in the market. In case of emissions exceeding the allowed limit, European companies and organizations are subject to a general fine of 100 EUR/ton of CO2 [10]. The list of violating organizations will also be announced annually [11].

As a country with many similarities to Vietnam, Thailand is a country we need to learn about and learn from experiences in the carbon market. The Thai government's 12th National Economic and Development Plan (2017–2021) has proposed solutions to reduce greenhouse gas emissions, including building a domestic carbon market. The National Climate Change Master Plan (2015–2050) also mentions carbon

markets as a potential mechanism for reducing greenhouse gas emissions in the private sector. From 2013–2016, the Thai Greenhouse Gas Authority (TGO) developed a Measurement–Reporting–Verification (MRV) system for Thailand's voluntary carbon market (Thailand V–ETS). The goal in the first phase of the pilot is to test the MRV system, develop industry-level MRV guidelines and establish emission limits and credit allocation for plants within the system. The second pilot phase from 2018 to 2020 will pilot the credit registration and transaction system. Although still under development, Thailand shows an interesting combination of linked market instruments, suitable for different sectors, with an emissions trading system for the power sector and other sectors. Concerns about constraints to growth have led to the adoption of relatively mainstream targets. Currently, the fundamentals of the ETS system that businesses voluntarily register to participate in will help improve environmental protection policies and find appropriate carbon pricing tools for State administration of Thailand [12].

3. Potential of Carbon Credit Market in Vietnam Electricity Market

Carbon emissions are becoming one of the most concerning issues in the world as well as in Vietnam. On a global scale, there are 195 countries, including Vietnam, have joined the Paris Agreement with the goal of keeping global temperatures from rising above 2 degrees Celsius and making efforts to limit the increase to 1.5 degrees at the end of this century [13]. In Vietnam, the determination to archieve that goal has been demonstrated by actions such as committing to achieving net zero emissions by 2050 at COP26; promulgating the National Plan to adapt to climate change in 2021-2030 period, with a vision to 2050; including the specific target of reducing emissions in the energy sector from 15% to 20% in Resolution 55-NQ/TW of the Political Bureau on development strategy orientation Vietnam's national energy until 2030, vision to 2045 [14, 15, 16].

Carbon exchange and offset mechanisms are mechanisms for registering and implementing programs and projects to reduce greenhouse gas emissions and create carbon credits according to methods recognized internationally or by Vietnam. By the end of June 2023, the total installed capacity of the system is 82,617 MW. The total number of renewable energy power plants operating in the power system is 245 power plants with a total capacity of 18,175 MW; Hydro power plants with a total capacity of nearly 25,000 MW; Solar rooftop with a total capacity of nearly 7,700 MW [17]. Therefore, green enery plants in Vietnam have huge potential to sell their carbon credits to fossil fuel power plants.

A. Participants

Entities developing and implementing programs and projects according to the carbon credit exchange and offset mechanism:

- Establishments on the list of sectors and establishments emitting greenhouse gases must take inventory of greenhouse gases promulgated by the Prime Minister.
- The organization participates in the implementation of domestic and international carbon credit exchange and offsetting mechanisms in accordance with the provisions of law and treaties to which the Socialist Republic of Vietnam is a contracting party.
- Other organizations and individuals involved in investment and trading in greenhouse gas emission quotas and carbon credits in the carbon market.

B. Regulations on the exchange of carbon credits in the domestic carbon market

The exchange of carbon credits shall be carried out on the carbon credit exchange, the domestic carbon market according to regulations. Carbon credits obtained from programs or projects under the mechanism of carbon credit exchange and offsetting are allowed to be converted into offsetting units for greenhouse gas emission quotas on the exchange. 01 carbon credit equals 01 ton of CO2 equivalent.

Auction, transfer, borrowing, remittance using carbon credits to offset greenhouse gas emissions:

- Establishments can bid to own additional greenhouse gas emission quotas in addition to the greenhouse gas emission quota allocated in the same 01 commitment period;
- Establishments can transfer the amount of unused greenhouse gas emission quota in the previous year to the following years in the same 01 commitment period;
- Establishments can borrow greenhouse gas emission quotas allocated for the next year for use in the previous year in the same 01 commitment period;

Establishments can use carbon credits from projects under carbon credit exchange and offsetting mechanisms to compensate for greenhouse gas emissions exceeding the allocated greenhouse gas emission quota in 01 commitment period. The number of carbon credits to offset emissions must not exceed 10% of the total greenhouse gas emission quota allocated to the facility;

- The allocated greenhouse gas emission quota will be automatically revoked by the Ministry of Natural Resources and Environment when the establishments stop operating, dissolve or go bankrupt;
- The State encourages establishments to voluntarily pay unused greenhouse gas emission quotas, contributing to the achievement of the national greenhouse gas emission reduction target;
- At the end of each commitment period, establishments must pay for greenhouse gas emissions exceeding the allocated greenhouse gas emission quota after applying the forms of auction, transfer, borrowing and using carbon credits to offset. In addition to payment required, greenhouse gas emissions exceeding the allocated quota amount will be subtracted from the allocated quota for the subsequent commitment period;
- The Ministry of Natural Resources and Environment shall guide the auction, transfer, borrowing and payment of greenhouse gas emission quotas.

C. Development Roadmap

By the end of 2027:

- Develop regulations on the management of carbon credits, the exchange of greenhouse gas emission quotas and carbon credits; develop regulations on the operation of carbon credit exchanges;
- Pilot the mechanism for exchanging and offsetting carbon credits in potential sectors and guiding the implementation of the mechanism for exchanging and

offsetting carbon credits domestically and internationally in accordance with the provisions of law and treaties to which the Socialist Republic of Vietnam is a contracting party;
- Establish and organize pilot operation of carbon credit trading platforms from 2025;
- Implement activities to strengthen human resources, raise awareness of carbon market development;

From 2028:
- Organize the operation of the official carbon credit exchange in 2028;
- Stipulate activities of connecting and exchanging domestic carbon credits with regional and world carbon markets.

4. Proposed Recommendations

To develop an effective and sustainable carbon credit market, the authors put forth the following recommendations:

The Ministry of Finance should take a leading role in the construction and establishment of a carbon credit exchange. Additionally, it should promulgate a financial management mechanism tailored to the efficient operation of the carbon market.

The Ministry of Natural Resources and Environment leads pilot programs and inaugurates the carbon credit exchange to enhance the management of the carbon market. It collaborates with relevant ministries to formulate regulations connecting domestic exchanges with global markets and develops guidelines for carbon credit exchange and offset mechanisms. Additionally, the ministry creates promotional materials and conducts capacity-building activities for carbon market participants.

Ministries, ministerial-level agencies, and Provincial People's Committees are responsible for coordinating with the Ministry of Natural Resources and Environment and the Ministry of Finance. Their joint efforts should focus on implementing the regulations outlined in Clauses 1 and 2 of Decree 06 [18]. Additionally, these entities are responsible for spearheading activities that promote the development of carbon market. This involves promoting widely disseminated and propaganda campaigns through mass media to raise community awareness regarding the carbon market.

5. Conclusion

In conclusion, the utilization of carbon credits within Vietnam Electricity Market not only addresses environmental concerns but also presents a unique opportunity for fostering sustainable growth. By leveraging the carbon credit market, Vietnam can accelerate its transition towards a low-carbon future, attract investment, and position itself as a regional leader in sustainable development. The effective incorporation of carbon credits into the electricity sector signifies the prospect of a robust, eco-friendly, and economically thriving Vietnam.

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