A Comparative Study on the Development Paths of New Energy in Indonesia and Vietnam

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Abstract: Southeast Asia, a pivotal engine of global economic growth, faces mounting pressure to balance surging energy demand with a low-carbon transition. Indonesia and Vietnam, as the region's largest economies, play a critical role in shaping sustainable development trajectories. This study conducts a comparative analysis of their new energy development paths, focusing on resource endowments, policy frameworks, implementation outcomes, and cooperation models. Indonesia drives energy diversification through its unparalleled geothermal resources and coal exports, prioritizing downstream industrialization of nickel-based battery production. Despite ambitious targets challenges persist in resource utilization efficiency and policy coherence. Vietnam, in contrast, has rapidly expanded solar and wind energy through strategic industrial policies, foreign investment incentives, and localized green technology adoption. Its focus on energy security and manufacturing self-reliance has enabled a more dynamic market response. The study reveals divergent pathways shaped by resource availability and governance models: Indonesia's resource-dependent approach is constrained by global market fluctuations, whereas Vietnam's state-directed strategy emphasizes strategic autonomy and execution consistency. By systematically comparing these cases, this research provides theoretical insights and policy implications for developing countries seeking to align energy transitions with national conditions. The findings underscore the importance of tailoring strategies to resource endowments and institutional capacities, offering a framework for sustainable energy development in resource-diverse contexts.

***Keywords*:** energy transition; renewable energy; Indonesia; Vietnam; Southeast Asia; policy comparison

1. Introduction

Southeast Asia, as a new engine for global economic growth, is facing the dual challenges of surging energy demand and a low-carbon transition. Population growth, industrial transfer and economic development in the region have led to a continuous increase in electricity demand, especially in Indonesia and Vietnam, which have become the largest electricity demand markets in Southeast Asia. Energy demand in ASEAN countries has grown by 73 per cent over the past 17 years and is expected to grow at an average rate of more than 2 per cent over the next 25 years, higher than the global average of 1 per cent, according to the Energy Institute.

Against this backdrop, Indonesia and Vietnam, the two largest economies in ASEAN, have a decisive impact on regional sustainable development through their energy transition paths. Vietnam plans to increase the share of non-hydro renewable energy, and Indonesia plans to increase the share of renewable energy generation. Despite similarities in economic development aspirations and initial energy structures, and both having set positive renewable energy targets, there are significant differences between the two countries in terms of energy resource endowments and policy promotion. Indonesia's abundant geothermal resources and Vietnam's rapid development in solar and wind energy can demonstrate policy and market responses under different resource conditions. This case selection not only helps to deepen the understanding of local practices in Southeast Asia but also has important implications and policy reference value for a wider range of developing countries to build green transition models that fit their own national conditions.

At present, academic research on the energy transition in Southeast Asia has mostly focused on regional overall analysis, lacking in-depth country-specific comparisons. This study constructs an analytical framework based on resource base, policy system, implementation effect and cooperation model to systematically sort out the driving factors and constraints of new energy development in Indonesia and Vietnam, aiming to provide theoretical insights and practical references for understanding the energy transition path in developing countries.

2. Review of the literature

The energy transition process in Southeast Asia has attracted considerable academic interest, particularly regarding the complex interplay between accelerated economic development and climate change mitigation obligations. Current scholarly investigations fall into three primary categories: macro-regional assessments, national policy evaluations, and

resource-focused examinations. Notably, however, there exists a persistent scholarly deficiency in comprehensive cross-national comparative studies that adequately consider heterogeneous political-economic contexts. To address this limitation, this systematic literature review integrates existing research paradigms and develops a conceptual analytical framework specifically tailored for comparative case studies of Indonesia and Vietnam.

2.1 Regional Trends and Macro-Level Analyses

A considerable body of scholarly and institutional literature has examined the energy transition in Southeast Asia from a regional perspective. Consistently underscore two salient features of the region: rapidly rising energy demand and persistent dependence on fossil fuels[1]. While these macro-level analyses effectively identify systemic challenges, such as inadequate grid infrastructure and limited access to financing[2]. They frequently treat ASEAN member states as a relatively uniform bloc, thereby overlooking the significant variations in their political economies, institutional capacities, and governance structures.

2.2 Resource Endowment as a Determinant

The literature firmly establishes resource endowment as a foundational factor shaping national energy strategies. Indonesia's unparalleled geothermal potential, accounting for roughly 40% of global reserves, is frequently cited as its primary renewable advantage. Research indicates that this abundance has oriented Indonesia's policy framework towards geothermal development, albeit with challenges in utilization efficiency and investment[3]. In contrast, policy-driven renewable energy expansion, with generous feed-in tariffs and supportive investment environments serving as the primary catalysts for Vietnam’s solar and wind power growth since the late 2010s [4]. The comparative dimension, however, is under-explored. Few studies explicitly analyze how Indonesia’s resource-rich profile contrasts with Vietnam’s resource-opportunistic approach, shaping divergent technological pathways.

2.3 Policy Frameworks and Governance Models

Scholarly consensus underscores that the design and coherence of energy policy constitute pivotal factors in determining the pace and scale of renewable energy deployment[5]. In the Southeast Asian context, Thailand and Vietnam are frequently cited as exemplars of proactive, state-driven strategies, particularly through the adoption of robust incentive mechanisms such as feed-in tariffs (FITs), which have been instrumental in catalyzing rapid market formation for renewables[6]. Vietnam’s FIT scheme, in particular, is widely acknowledged as the principal catalyst behind the country’s solar energy boom in the late 2010s[7]. By contrast, Indonesia’s policy trajectory has been described as comparatively fragmented and inconsistent[8]. Its energy governance framework remains heavily influenced by entrenched fossil fuel interests resulting in delayed regulatory action, policy reversals, and heightened uncertainty for investors. This stark policy divergence reflects a deeper theoretical distinction in state–economy relations. Indonesia’s trajectory aligns closely with a resource-dependent developmental model, wherein the state’s policy autonomy is structurally constrained by its reliance on revenues from primary commodity exports. Consequently, energy policy in Indonesia is often reactive and vulnerable to external shocks stemming from global commodity price volatility. Vietnam, on the other hand, exhibits hallmarks of a strategic development-oriented state. In this model, the government exercises deliberate and centralized control over industrial policy, deploying binding directives and coordinated institutional mechanisms to channel both domestic and foreign investment into priority sectors[4]. This approach prioritizes long-term strategic objectives, policy coherence, and implementation discipline. Although elements of this comparative political economy framework appear intermittently in existing literature, they have not yet been systematically operationalized in a structured, side-by-side analysis of Indonesia and Vietnam’s energy transitions. This study therefore seeks to formalize and apply this theoretical lens to elucidate the underlying institutional and political drivers of their divergent pathways.

2.4 The Role of International Cooperation and Finance

International cooperation is widely recognized as a critical enabler of energy transitions in developing economies[9]. Existing scholarship emphasizes the instrumental role of financial instruments, such as green bonds and multilateral climate funds, in mitigating investment risks and enhancing capital flows toward low-carbon infrastructure[10]. Notably, infrastructure financing under China’s Belt and Road Initiative (BRI) has supported substantial energy-related investments across Southeast Asia, particularly in grid development and power generation[11]. Likewise, Vietnam’s engagement with the Just Energy Transition Partnership (JETP) has been identified as a pivotal platform for mobilizing international financial resources, technical expertise, and institutional support to accelerate its decarbonization agenda[12].

Despite this growing body of work, the literature frequently treats international cooperation as a discrete thematic area, rather than situating it within a broader analytical framework that examines how distinct national development models

condition the structure, priorities, and outcomes of transnational partnerships. Specifically, insufficient attention has been paid to how contrasting strategic orientations actively shape international cooperation. For instance, Indonesia leverages its natural endowments to attract downstream investment through a resource-for-industrial-chain approach. In contrast, Vietnam's market-for-technology strategy exchanges regulatory access and scale for advanced clean energy technologies. Integrating these national-level logics into the analysis of global partnerships is essential for a more nuanced understanding of the political economy of energy transition finance.

2.5 Research Gap and This Study's Contribution

While the existing literature provides valuable insights into regional trends, resources, and policies, it suffers from two primary limitations. First, there is a predominance of macro-level regional analysis or single-country case studies, with a lack of structured, comparative work that rigorously contrasts the drivers and obstacles in key countries like Indonesia and Vietnam. Second, where comparisons exist, they often lack a robust theoretical framework to explain the root causes of the observed policy and outcome differences.

This study addresses these research limitations through a systematic comparative analysis of Indonesia and Vietnam, two ASEAN member states that exhibit both significant geopolitical influence and divergent developmental trajectories. The investigation transcends conventional policy inventory approaches by implementing an interdisciplinary analytical framework comprising four interrelated dimensions: (1) Resource endowment and strategic positioning, (2) Policy System, (3) Development achievements and challenges, and (4) International cooperation and future development. Anchored in the theoretical dichotomy between resource-dependent governance paradigms and strategic development state models, this research methodology enables dual objectives: first, to systematically document the heterogeneity in national energy transition pathways; second, to generate explanatory frameworks accounting for these observed divergences. Through this methodological approach, the study seeks to contribute theoretically refined insights and context-sensitive policy recommendations for developing nations engaged in navigating the multifaceted challenges of global energy system transformation.

3. Resource endowment and strategic positioning

3.1 Indonesia's Resource advantages and strategic choices

Indonesia has an extremely rich and diverse array of renewable energy resources, which provides a natural advantage for its energy transition. Indonesia holds 40 percent of the world's geothermal reserves, making it the global leader in this resource, which are widely distributed, mainly in regions such as Sumatra, Java and Bali. About 28.91 gigawatts of geothermal energy potential is spread across 312 sites on several islands including Java, Sulawesi and Sumatra. Even so, the potential for development of geothermal resources puts Indonesia at the forefront of the global geothermal energy sector. Indonesia is one of the world‘s largest exporters of coal, which makes up a major share of its energy mix. Despite its significant contribution to the Indonesian economy, the issue of its sustainability and environmental impact has gradually become a focus of attention both domestically and internationally. Indonesia's abundant natural gas and hydropower resources also provide a guarantee for its energy development. Natural gas is one of Indonesia's major energy exports and plays a crucial role in supplying energy in Asia, in particular. Hydropower resources, though promising, face dual challenges of geographical conditions and environmental protection in actual development.

This contradiction between abundant resources and underdevelopment highlights the complexity and potential of Indonesia's energy transition. Indonesia's energy strategy is positioned around the core theme of transforming its resource advantages. On the one hand, Indonesia uses its abundant nickel ore resources to build a complete industrial chain from laterite nickel ore to power batteries and electric vehicles. The Joko government has made it clear that Indonesia will become the world's third-largest battery producer by 2027 and produce 600,000 electric vehicles by 2030. On the other hand, Indonesia is promoting distributed photovoltaics through policy plans, with plans to install rooftop solar panels for millions of poor households within four to five years.

Indonesia's energy strategy is highly dependent on its rich resource endowment, particularly in the geothermal and coal sectors. The government has set ambitious targets to ensure a balance between energy diversification and the low-carbon transition. In terms of geothermal energy openness, the government has identified it as a key direction for the future energy transition, especially in reducing carbon emissions, due to the unique advantages of Indonesia's geothermal resources. The Indonesian government is vigorously promoting the development of geothermal energy through measures such as formulating policies, providing financial support, and attracting foreign investment. According to the plan of Indonesia's Ministry of Energy, Indonesia expects its installed capacity of geothermal power to reach 5,000 megawatts by 2025. In terms

of coal, although Indonesia is rich in coal resources, the government is gradually becoming aware of the environmental pressure on coal. For this reason, Indonesia has proposed a "clean coal technology" development strategy to promote the clean use of coal and the innovation of low-carbon emission technologies.

The development goals for renewable energy are clear. By 2025, the proportion of renewable energy in power generation will reach 23%, and by 2050, the proportion of renewable energy in power generation will be at least 70%. This target is in line with its commitment to achieving net zero emissions by 2060, but the path to realization is challenging. Indonesia is also actively developing solar energy at the same time. It is projected in its Power Supply Plan 2025-2034 that solar will dominate new renewable energy installations at 17.1 gigawatt. At present, new and renewable energy accounts for only 13.1% of Indonesia Is energy mix, indicating that its energy transition is still in its early stages. Overall, geothermal, wind and solar energy are the main development directions in Indonesia. Although Indonesia is still in the early stages of developing solar and wind energy, the proportion of new energy is gradually increasing as policies advance and technologies mature.

3.2 Vietnam's resource advantages and strategic positioning

Vietnam's renewable energy resources are significantly different from those of Indonesia, and its strategic choices are thus distinct. Despite its relatively limited mineral resources, Vietnam's renewable energy resources, particularly solar and wind energy, have great potential.

Vietnam is rich in solar energy resources, with an average annual sunshine duration of more than 2,000 hours, especially in the central and southern regions. According to Vietnam's energy plan, solar energy is one of the key directions for future energy development, and the government has issued policies to encourage investment and development in solar projects. Under revised PDP8, Solar power generation potential is projected to reach 46GW and wind at 26 GW by 2030, providing a natural foundation for the rapid development of its photovoltaic industry. Meanwhile, Vietnam's northern and southern coastlines have great potential for building large-scale offshore wind power, with more than 3,000 kilometers of coastline and annual wind speeds of over 6.5 meters per second, which is estimated to be suitable for wind power generation up to 160 gigawatts. Vietnam's wind power generation capacity is expected to reach 10GW by 2030, according to the Ministry of Energy. Vietnam is rich in hydropower resources, and hydropower accounts for a large proportion of total power generation. Biomass, an energy resource with great potential, mainly from agricultural waste and the wood processing industry, has been applied in some areas.

Vietnam's energy strategy, based on its abundant solar and wind energy resources and in combination with the government's strong support for renewable energy, has established a strategic positioning of "green energy transition". The government attaches great importance to the development of solar and wind energy, which has been listed as a priority area of the national energy policy. To achieve this goal, Vietnam has introduced a series of policies to attract foreign investment, including incentives such as green power purchase agreements (PPAs), fixed electricity price policies (FIT), and tax breaks. The development of renewable energy in Vietnam also focuses on distributed energy systems, especially in remote areas, providing electricity through photovoltaic and small wind power systems to enhance the sustainability and security of energy. To better develop new energy sources, Vietnam is actively seeking international cooperation to attract foreign technologies and capital, particularly with Germany, Japan and China, to promote the localization of solar and wind energy technologies and the improvement of the industrial chain. Vietnam has also joined several international climate cooperation agreements to promote green energy investment and policy alignment.

3.3 Resource endowments and strategic comparisons

Despite the significant differences in resource endowments between Indonesia and Vietnam, where Indonesia's geothermal and coal resources contrast sharply with Vietnam's solar and wind resources, there are still some similarities in the energy transition strategies of the two countries. On the one hand, both countries' energy transition strategies are profoundly influenced by their resource endowments. Indonesia relies on its geothermal and coal resources to drive energy diversification and the development of clean technologies; Vietnam, on the other hand, is making full use of its solar and wind energy resources, emphasizing the rapid growth of renewable energy. On the other hand, both countries face the dual challenges of energy security and low-carbon transition during the energy transition. Indonesia is committed to addressing energy security issues through clean coal technology, while Vietnam is reducing its reliance on traditional energy sources by developing renewable energy on a large scale. In general, Indonesia and Vietnam have distinct resource endowments, but both have combined their abundant natural resources with strategic goals to develop energy transition strategies that are in line with their national conditions. Indonesia is focusing more on the clean development of geothermal and coal resources, while Vietnam is advancing the green and low-carbon transition by rapidly developing solar and wind energy. The experiences of the two countries are of great reference value for the design and implementation of energy policies in other

developing countries.

4. Policy System

4.1 Indonesia's policy framework

Indonesia’s policy system reflects the inherent tensions characteristic of a resource-dependent developmental state. On the one hand, the central government has articulated ambitious national strategies and introduced market-oriented instruments, such as carbon trading schemes, to demonstrate its formal commitment to a just and sustainable energy transition. On the other hand, the effective implementation of these policies is persistently undermined by several interrelated structural constraints. These include the entrenched influence of fossil fuel–aligned interest groups, institutional fragmentation across ministerial and regulatory bodies, and the economy’s deep dependence on volatile international commodity markets—particularly for coal and other extractive exports. Together, these factors constrain policy coherence, delay regulatory enforcement, and limit the state’s capacity to pursue a consistent and transformative energy agenda. In 2014, the Indonesian government began to introduce a series of policies to support photovoltaic power generation, and in 2017, it allocated 100 million US dollars to subsidize renewable energy. These initial measures demonstrated Indonesia's emphasis on the development of new energy, but the implementation effect was limited. In 2022, Indonesia raised its emission reduction targets to "unconditional 31.9% reduction and 43.2% reduction with international support by 2030". To achieve this goal, Indonesia has taken a number of policy measures: First, it has issued presidential Decree No. 112 to accelerate the development of new renewable energy; 2 Push forward the legislative process of the New Energy and Renewable Energy Act; Third, create a carbon trading market and launch the first carbon exchange in September 2023. Indonesia's policy tools are expanding from traditional executive orders to creating market mechanisms and using economic means such as carbon pricing, although the initial effect is limited, it still represents the direction of evolution of its policy system. The underwhelming performance of Indonesia’s carbon market, evidenced by a trading volume of merely 608,000 metric tons of CO_2 equivalent during its initial operational phase from September 26, 2023, to June 30, 2024, according to Ministry of Economic Affairs of the Republic of Indonesia, underscores the systemic implementation challenges inherent in the country’s energy transition framework. This limited market activity can be attributed to three interrelated structural barriers: first, an immature regulatory architecture lacking comprehensive guidelines for market participants; second, suboptimal market participation stemming from weak enforcement mechanisms and limited institutional capacity for monitoring compliance; and third, a carbon pricing mechanism that remains insufficiently calibrated to counterbalance the entrenched dominance of coal in the national energy mix. These factors collectively diminish the market’s ability to generate meaningful financial incentives for emissions reduction, thereby perpetuating the status quo of fossil fuel dependency. This lackluster performance reflects deep-seated problems such as low market participation and an imperfect carbon pricing mechanism. In addition, key policies in Indonesia, such as the New and Renewable Energy Act, have long been under review and the legislative process has been slow, seriously undermining investor confidence and the finance ability of projects. In the field of electric vehicles, Indonesia's policies have been relatively successful. The government offers incentives such as corporate income tax breaks and purchase subsidies for the electric vehicle industry and plans to build at least 32,000 electric vehicle charging stations between 2024 and 2029. These policies have begun to bear fruit, with Indonesia's electric vehicle production rising from 1,500 in 2022 to 15,318 in 2023, and over 43,000 sold in 2024.

At present, the Indonesian government is accelerating the deployment in the renewable energy sector through systematic regulatory revisions and international cooperation. Its policy system demonstrates a dual pursuit of energy security and investment facilitation. Regulation No. 5 2025 issued by Indonesia's Ministry of Energy and Mineral Resources is one of the key policies. The regulation aims to enhance the legal certainty of power purchase agreements for renewable energy projects and provides a unified regulatory framework for multiple technologies such as solar, wind, hydropower and biomass energy. The core policy intent is to foster and regulate the renewable energy market by stabilizing the legal framework, reduce transaction costs and attract private sector investment. These policies serve Indonesia's more ambitious national goals. Under the Power Supply Business Plan 2025-2034, Indonesia plans to add 69.5 gigawatts of power generation capacity over the next decade, up to 42.6 gigawatts of which will come from renewable energy. In addition, President Prabowo's vision of energy independence has also driven an import substitution strategy in areas such as biofuels, with the goal of halting diesel imports in the second half of 2026.

4.2 Vietnam's policy system and innovation mechanism

Vietnam's energy policy system, characterized by top-level strategic guidance combined with flexible market incentives, is dedicated to the rapid deployment of renewable energy and the upgrading of energy infrastructure.

Between 2019 and 2021, Vietnam has driven explosive growth in photovoltaic installations by implementing feed-in tariff subsidies. This policy-driven development model reflects Vietnam's sense of urgency and action in the energy transition. Resolution 70-NQ/TW, issued in 2025, is a landmark policy turning point and the most important top-level design in recent times, setting out the strategic goals and vision for ensuring national energy security by 2030, with the core thinking shifting from passive "ensuring supply" to proactive and solid energy security. To implement the resolution, the government promptly introduced Resolution 328/NQ-CP as a program of action. In specific areas, Protocol No. 73 reduced the import duty on liquefied natural gas from 5% to 2%, aiming to encourage investment in LNG power generation projects. The National Power Development Plan (2021-2030, outlook to 2050), approved in April 2025, further clarifies the dominance of solar energy. Vietnam plans to increase the share of non-hydro renewable energy to between 28 percent and 36 percent by 2030, with solar energy contributing more than 25 percent, and for the first time incorporate nuclear energy into its energy structure, with plans to put the first nuclear power plants into operation between 2030 and 2035. Vietnam's strategic vision has gone beyond borders, with plans to export 400 megawatts of renewable power to Cambodia by 2030 and 5 to 10 GW to countries such as Singapore and Malaysia by 2035, clearly demonstrating its ambition to become a regional clean energy exporter. This strategic adjustment indicates that Vietnam is diversifying its energy strategy to meet the growing demand for electricity.

In contrast to Indonesia's negotiated and often fragmented approach, Vietnam's policy system aligns with the strategic development state model, characterized by top-down, mandatory directives and a clear prioritization of energy security and manufacturing self-reliance. This model has proven highly effective in mobilizing resources and achieving rapid capacity expansion, as evidenced by its solar boom. In 2025, Vietnam rolled out a series of key policies: Decree No. 57/2025/ND-CP comprehensively upgraded the renewable energy direct purchase power facility (DPPA); Decree No. 135 establishes a rooftop photovoltaic surplus purchase mechanism; Meanwhile, the government is drafting a clear electricity price mechanism for independent large-scale battery energy storage system (BESS) projects. According to the Eighth Power Plan, 13 power generation projects with a total installed capacity of about 22.4 gigawatts using imported LNG will be built by 2030. According to Decree No. 58/2025/ND-CP, offshore wind power projects are exempt from sea area usage fees for the first three years of construction and 50% for the first nine years after the project is completed; Large renewable energy projects are exempt from land use fees for three years from the date of commencement. At the same time, Vietnam is actively involved in the Just Energy Transition Partnership (JETP), using international financial and technological support with the aim of achieving net zero emissions by 2050.

The innovation of Vietnam's policy lies in its flexible design of market mechanisms. The DPPA mechanism allows renewable energy power generation companies to sign power purchase agreements directly with power consumption companies, breaking the traditional model of centralized power purchasing. For the first time, biomass power generation and electric vehicle charging enterprises are included in the qualified buyer range, and the three contract models are refined to provide more flexible options for transactions.

This market-oriented policy design has sparked enthusiasm for private sector participation and driven investment in the new energy sector. Under the JETP framework, the first three projects have received international funding support, including a €67 million credit from the French Development Agency for the 500kV transmission line project and a €480 million credit agreement from six development finance institutions. Vietnam is actively involved in international cooperation such as JETP, and one of its policy goals is to use international funds and innovative financial tools to reduce transition risks and clear obstacles and lay a solid foundation for introducing market mechanisms in the country.

Compared with Indonesia, Vietnam's policy system shows a stronger market orientation. The core of its policy innovation lies in the flexible use of various market-based tools to effectively mobilize social capital. The initial feed-in tariff subsidies are essentially the government setting price signals to quickly create the market; Recently introduced policies such as the direct power purchase mechanism and green certificate trading aim to gradually build a competitive, decentralized electricity market and facilitate the transition of renewable energy development from policy-driven to market-driven.

Overall, Indonesia's policies show long-term and systematic characteristics, with the advantage of creating a stable and predictable investment environment through continuous legal revisions and focusing on the deployment of local advantageous resources such as geothermal and bioenergy. The challenge lies in balancing the interests of traditional fossil fuels and overcoming the grid interconnection problems brought about by the archipelago terrain. Vietnam's policies, on the other hand, are characterized by top-level drive and flexibility, mobilizing social resources rapidly through strong national strategies and price signals. The results have been remarkable, especially with a leap in installed capacity of renewable energy, but the current problems such as insufficient policy coordination, complex administrative processes and grid congestion have also exposed the lag in market mechanism and regulatory capacity building.

The divergent policy systems of Indonesia and Vietnam are not merely a collection of different instruments, but reflections of their underlying political economies. Indonesia's resource-dependent model produces a policy environment that is reactive, susceptible to interest-group politics, and struggles to build consistent market signals. Vietnam's strategic developmentalism, conversely, enables rapid, state-directed mobilization but faces challenges in transitioning to a flexible, market-based system and managing the financial and infrastructural consequences of its own success. This fundamental divergence sets the stage for the very different implementation outcomes and challenges explored in the following chapter.

5. Development achievements and challenges

5.1 Achievements and bottlenecks in Indonesia's new energy development

The implementation outcomes of Indonesia's energy transition efforts systematically demonstrate the systemic constraints inherent in its resource-dependent developmental paradigm. While localized advancements have been recorded in strategically leveraging specific natural endowments—most notably in geothermal energy production and the emerging electric vehicle battery value chain—these sector-specific achievements remain insufficient to offset the country's broader challenges in meeting national renewable energy targets. Persistent systemic barriers continue to impede progress across three critical dimensions: first, inadequate financial mechanisms to scale clean energy investments; second, underdeveloped transmission infrastructure limiting renewable integration; and third, entrenched political economic dynamics that prioritize coal-based power generation over alternative energy sources. These interrelated constraints collectively undermine the coherence and effectiveness of Indonesia's energy transition strategy.

Indonesia's new energy transition has made initial progress over the past decade, as evidenced by increased diversification of its energy structure, the implementation of some renewable energy projects, and the gradual formation of international cooperation mechanisms. Data from Indonesia's Ministry of Energy and Mineral Resources shows renewable energy capacity reached 13.2 GW by end-2023. By the end of 2024, the actual installed capacity of new and renewable energy power plants had increased to 14 GW, representing about 13% of the country's total power generation capacity. Although the overall share is still low, it has more than doubled compared to 2015.

Indonesia has about 2.7GW of geothermal capacity, ranking second in the world after the United States. Thanks to the revision of the Geothermal Law and support from international financial institutions such as ADB and the World Bank, several large geothermal projects such as Sarulla and Wayang Windu have entered the commercial operation stage.

Indonesia has seen explosive growth in photovoltaic installations. By the end of 2024, Indonesia's installed capacity had exceeded 0.9 GW. This progress lays a solid foundation for achieving its target of adding 17.1 GW of photovoltaic power in the 2025-2034 power Supply Plan.

In the energy storage sector, Indonesia's most notable progress is the "Million Solar Project for Village Cooperatives" signed by President Prabowo. The plan aims to deploy 100 GW of solar power and 320 gigawatt-hours (GWh) of energy storage systems in 80,000 villages within five years, with the goal of ending the power shortage for 60 million people. The first 10,000 villages are planned to be connected to the grid by August 2025. This move marks a crucial step for Indonesia from planning to large-scale implementation. Economically, the plan's photovoltaic storage cost of electricity (LCOE) is expected to be $0.12 - $0.15 per kilowatt-hour, far lower than the $0.20 - $0.40 per kilowatt-hour for diesel power generation in rural areas, showing a significant cost advantage.

However, Indonesia's grand plan also faces multiple severe challenges ranging from technology to finance. First, there is an extreme shortage of certified photovoltaic installers and operators in Indonesia. Second, coal dependence is hard to break through. As the world's largest exporter of coal, Indonesia's economic growth relies on cheap coal-fired power, and its existing coal-fired power units are young and costly to transform. Third, the power grid infrastructure is weak and difficult to build. Indonesia plans to build a super grid connecting islands and a cross-border grid, but the investment demands are huge. At the same time, 48,000 kilometers of new transmission lines need to be built to achieve power transmission, and the outlying islands project relies more on submarine cables, which is extremely challenging. Fourth, policy uncertainty affects investor confidence. Such as repeated rooftop net metering policies hitting household photovoltaic demand. Fifth, poor access to financing is also a significant obstacle. The high initial investment and long payback period of new energy projects, coupled with Indonesia's low credit rating, have led to financing costs generally being about 2-3 percentage points higher than those of Vietnam. The weighted average cost of capital for renewable energy projects in Indonesia is high, with a median of 9.4% in 2024, remaining 2-3% higher than Vietnam's. This is backed by the dominance of dollar loans and financing difficulties resulting from limited project reserves. Despite new rules for power purchase agreements attempting to boost foreign confidence, lowering the cost of capital remains key to unlocking investment potential. Indonesia needs to invest approximately $1.08-1.22 trillion by 2060 to achieve its net zero emissions target, with $65 billion required from

2025-2030 alone. Such a huge demand for funds is hard to meet on government finances alone, and the cautious attitude of international financial institutions towards financing Indonesia’s oil and gas projects has further exacerbated the funding gap.

5.2 Achievements and Challenges of Vietnam's New Energy Development

Vietnam's implementation trajectory exemplifies both the formidable power and the inherent pitfalls of the strategic developmentalist model. The state's ability to orchestrate an explosive renewable rollout through aggressive FIT policies yielded one of the world's most remarkable solar capacity growth stories. However, this very success exposed the limitations of a top-down, quantity-focused approach, leading to a painful but necessary period of adjustment characterized by grid congestion and financial strain.

Vietnam has seen a rapid increase in new energy installations over the past five years, especially in the photovoltaic sector. Strongly driven by feed-in tariff subsidies, the enthusiasm of domestic and foreign investors has been stimulated. Vietnam has made a leap in renewable energy between 2018 and 2023, 18.6 GW cumulative solar capacity by end-2023, to become the largest solar producer in Southeast Asia, according to the International Energy Agency. This achievement marks a significant scale of success in Vietnam's first phase of transition.

However, the high growth has also brought about new complex problems, putting Vietnam's transformation into a deep adjustment period. Aggressive FIT policies have led to a surge in electricity purchase costs for the State power company (EVN) from $4.5 billion in 2018 to $11.5 billion in 2023, imposing a heavy burden of more than $1 billion in losses for the EVN in 2023. In response to the crisis, the government adjusted the terms of electricity prices for 173 wind and solar projects, causing investorsI expected income to plummet by 25% to 46%. The move has severely dampened investment confidence, and as of October 2025, the vice premier is still personally demanding solutions to the problems faced by these projects.

Vietnam's new energy development faces bottlenecks in grid connection and consumption. The mismatch between the rapid growth of installed capacity and the lag in grid construction has led to severe grid congestion and the risk of power curtailment in the central and southern coastal provinces of Vietnam. Due to the lag in grid construction, the utilization rate of photovoltaic power generation is low, with a curtailment rate of up to 15%. This problem has become one of the core bottlenecks restricting the further development of renewable energy in Vietnam. To make up for the power shortfall, Vietnam has had to speed up the construction of gas projects, which has instead held back the energy transition process. This problem highlights the need for coordinated development of the energy system.

Vietnam's challenges also include the dilemma of transforming its energy structure. Despite the rapid growth of renewable energy, coal power still plays a significant role in Vietnam's energy structure. Similar to Indonesia, Vietnam's coal-fired power units are relatively young, and early decommissioning would pose a huge risk of asset stranded. Meanwhile, Vietnam's electricity market mechanism is still imperfect, and the market structure of the state power company as a single buyer is difficult to adapt to the demand for a high proportion of renewable energy grid connection.

Policy fluctuations and market uncertainties. Thanks to the FIT policy from 2017 to 2021, Vietnam built more than 10GW of rooftop photovoltaic systems in three years, becoming a landmark case of energy transition in developing countries. After the FIT policy ended, Vietnam switched to a bidding electricity price system, but the long transition period and the immature pricing mechanism led some investors to wait and see.

The direct electricity purchase mechanism is difficult to implement. To transition to a market-based mechanism, Vietnam has issued Decree No. 57/2025/ND-CP on direct power purchase agreements. However, the policy support for marketization is incomplete and the mechanism is difficult to implement. At the same time, cumbersome administrative approval procedures and long cycles have also hindered the progress of green production. This indicates that the success of a market-oriented policy depends not only on its top-level design but also on the coordinated advancement of supporting details, regulatory capabilities and enforcement levels.

In recent years, Vietnam has made breakthroughs in energy storage systems and electric vehicles. In 2025, Vietnam's Ministry of Industry and Trade is drafting a clear electricity price mechanism for independent large-scale BESS projects, with a target of 10,000-16,300 megawatts of energy storage capacity by 2030. The electric vehicle market is also experiencing explosive growth, with registrations soaring from 4,040 in 2022 to 79,781 in 2024. These developments suggest that Vietnam is building a more complete new energy ecosystem.

Despite this, Vietnam still outperforms most developing economies in terms of policy implementation, foreign investment attraction and the construction of a green investment ecosystem.

The energy transition in developing countries is not just a race of installations, but a comprehensive competition of policy coherence, grid modernization, capital cost reduction and talent development systems. Indonesia has chosen the right path of transition based on its resource endowment, but its grand top-level design is facing rigid constraints at the

implementation ecological level such as talent, power grid and financing. The key to its success lies in whether it can translate the national strategy into a stream of implementable projects through systematic capacity-building. Vietnam has rapidly expanded its market size through strong subsidy policies, but the financial pressure, grid bottlenecks and policy uncertainties that followed clearly reveal the cost of the development path of prioritizing scale development and then optimizing mechanisms. The current core task is how to rebuild investor trust and accelerate the upgrading of the power grid and the construction of the market mechanism.

6. International cooperation and future development

6.1 Indonesia Is Path to international cooperation and carbon Neutrality

In the context of the global development of clean energy, Indonesia, as the country with the richest geothermal resources in the world, can realize the huge potential of geothermal energy through technological innovation and international cooperation and become an important supplier of clean energy globally. At the same time, as global climate change and green finance policies are increasingly strengthened, Indonesia is expected to take this opportunity to attract more international funds to support its energy transition.

Indonesia actively participates in global climate governance and international energy cooperation to promote the realization of the sustainable development goals. Its international cooperation is mainly focused on green investment, technology transfer and climate action. Indonesia has become an active participant in global climate finance under the framework of the Paris Agreement. At the same time, Indonesia is working with many countries in the Asia-Pacific region to promote the establishment of regional carbon markets. Indonesia has established multiple green project partnerships with international climate finance institutions such as the Green Climate Fund and the Global Environment Facility. Indonesia has collaborated with several international partners on technology transfer, particularly in geothermal power generation and clean coal technology. Indonesia has been actively involved in multilateral platforms such as the Belt and Road Green Development International Alliance, and its cooperation with the United States, Japan and Germany has provided it with significant technical support in geothermal exploration and development technologies. These collaborations not only bring capital, but also the transfer of advanced technologies and the creation of local jobs. These cooperations have injected valuable international capital and policy experience into its energy transition.

At the core of Indonesia's international cooperation lies the transformation of its resource advantages into industrial chain advantages. Its cooperation model has gone beyond simple resource exports and is moving towards deep cooperation based on green industrial parks. Using the world‘s largest nickel reserves, Indonesia has successfully attracted leading Chinese companies, including CATL, Huayou Cobalt and BYD, to invest in battery and electric vehicle manufacturing. How does Indonesia's resource-driven cooperation model serve its resource-dependent development path? The essence of its cooperation is to exchange resources for industrial chains.

6.2 China-Vietnam New Energy Cooperation Model

Vietnam's international cooperation is closely centered around its national power plan, focusing on filling the funding and technology gaps, and its cooperation shows a stronger problem-oriented "feature. Despite rapid development in renewable energy, Vietnam lags behind in the construction and upgrading of its power grid, making it difficult for new energy to be connected to the grid and causing severe wind and solar power curtailment. In addition, although Vietnam has made some progress in wind and solar energy, the overall technological level and the completeness of the industrial chain still need to be improved.

With the rise of global green investment, Vietnam, with its policy advantages and market potential, can attract more international capital. Vietnam is actively cooperating with the international community in promoting energy transition and green economic development. Vietnam's international cooperation is mainly focused on green investment, technology introduction and the fulfillment of international climate commitments. In terms of financing, Vietnam is an important partner of the Green Climate Fund and the World Bank and has received a large amount of green financing support. In particular in the wind and solar sectors, Vietnam has attracted a large amount of international capital. Through cooperation with international financial institutions, Vietnam has been able to obtain low-interest loans and financial subsidies for renewable energy projects. Technically, Vietnam has extensive technical cooperation in wind and solar energy with countries such as Japan and Germany. In particular, Japan's investment and technology transfer in Vietnam's solar power sector have helped Vietnam achieve a leapfrog growth in solar installed capacity. In addition, Vietnam has collaborated with several international climate organizations to promote the introduction and localization of green technologies. As a participant in the Just Energy Transition Partnership (JETP), Vietnam uses this mechanism to attract international public and private capital to

support its grid upgrade and renewable energy deployment. The focus of their cooperation is on reducing investment risks and innovating financing tools to advance the process of replacing coal power.

At the regional level, energy cooperation among Southeast Asian countries is highly aligned with carbon reduction targets. Indonesia and Vietnam, as important energy transition countries in Southeast Asia, have huge potential for cooperation in the future in regional electricity market construction, cross-border energy cooperation, and green infrastructure construction. Southeast Asia is expected to have a place in the global energy transition by strengthening the ASEAN energy cooperation framework, promoting cross-border power connectivity, and developing low-carbon technologies in a coordinated manner. How does Vietnam's problem-oriented cooperation model reflect its characteristics as a strategic development-oriented country, where cooperation is essentially about exchanging market for technology and capital.

7. Conclusions and Recommendations

First, although both countries are emerging economies in Southeast Asia, there are significant differences in their paths to new energy development. Indonesia has made some progress in the electric vehicle industry chain and geothermal power generation by relying on its abundant nickel and geothermal resources, while Vietnam has rapidly advanced the development of photovoltaic and wind power through policy-driven and market-mechanism-centered means such as feed-in tariff subsidies and direct power purchases. This path difference reflects the different conditions and strategic choices in terms of resource endowment, industrial structure and policy orientation between the two countries.

Secondly, Indonesia and Vietnam face common challenges in the development of new energy, including structural problems such as lagging grid infrastructure, limited financing channels, and reliance on fossil fuels. These problems suggest that the energy transition is not just about technological substitution, but rather a complex project that requires systematic solutions, involving the synergy of electricity market reforms, infrastructure investments, and policies and regulations.

Based on the above research, this paper presents the following policy recommendations:

For Indonesia, first simplify the approval process and improve the efficiency of project development, especially lowering the entry threshold for distributed energy; The second is to innovate financing mechanisms by developing local currency financing tools and attracting long-term institutional investors, with a focus on reducing high capital costs. For Vietnam, the first step is to speed up the construction of the power grid, enhance the grid connection capacity of renewable energy, and reduce the curtailment of solar and wind power; Second, deepen market-oriented policy reforms by introducing detailed implementation rules for policies such as direct power purchase and green certificate trading to remove institutional obstacles and truly play the decisive role of the market in resource allocation; Third, promote technological diversification. While continuing to develop photovoltaic power, actively develop complementary resources such as wind power and biomass energy to enhance the resilience of the energy system.

In terms of new energy cooperation with ASEAN, differentiated strategies should be adopted based on the specific characteristics of each country. For Indonesia, focus on strengthening industrial chain cooperation such as nickel ore processing and battery manufacturing; For Vietnam, the focus could be on photovoltaic technology, grid upgrades and energy storage solutions. At the same time, Chinese companies should focus on local operations and technology transfer to achieve a shift from "going out" to "integrating in" and promote win-win cooperation. Through the perspective of comparative political economy, this paper reveals the deep logical differences in the development paths of new energy in Indonesia and Vietnam. Indonesia's resource-dependent development path, although able to quickly take advantage of its resource endowment to enter the upstream of the global green industry chain, also faces challenges constrained by the international commodity market cycle and domestic fossil energy interest groups, presenting greater uncertainty and wobble. In contrast, Vietnam's strategic development state model, which has achieved rapid growth in new energy installations in the short term relying on strong industrial policies, also faces challenges in policy systematicness and sustainability, as well as the risk of market mismatch that may arise from aggressive administrative intervention.

The contribution of this study to the energy transition in the Global South lies in revealing the diversity of energy transition paths and emphasizing that there is no single path. A country's energy transition path is the result of the interaction of its resource endowment, political and economic structure, institutional capacity and the global geopolitical and economic landscape. Future research could further explore the performance of these paths in terms of long-term resilience, social equity and applicability, as well as how to further optimize energy transition strategies in light of the specific social and economic conditions of each country.

The limitations of this study lie in the insufficient analysis of the micro-implementation mechanisms of new energy policies in Indonesia and Vietnam, especially the differences in policy implementation at the local level have not been fully examined. Future research could delve deeper into the practical differences at the local level, particularly the differences

in policy implementation across regions and the role of local governments in policy implementation. In addition, social dimension issues such as community participation and equitable transition should also be important directions for future research, providing more comprehensive theoretical guidance and practical references for energy transition in developing countries.

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