

Accelerating Vietnam's Transition from Coal-Fired Power to Renewable Energy: Challenges and Strategic Solutions

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Abstract: Vietnam's commitment to achieve net-zero greenhouse gas emissions by 2050 presents both an environmental necessity and a development opportunity. Yet, the country's transition from coal-fired power to renewable energy remains constrained by financing bottlenecks, infrastructure deficits, regulatory ambiguity, and socio-economic adjustment costs. This paper provides a comprehensive assessment of Vietnam's energy transition through policy, technical, and socio-economic lenses. Drawing upon national datasets, international frameworks, and sectoral studies, the analysis identifies five systemic barriers: (1) financial barriers, (2) Grid and infrastructure limitations, (3) Regulatory complexity, (4) Technological and operational issues, and (5) labour dislocation in the fossil fuel sector. An integrated, sequenced transition framework combining innovative financing, accelerated grid digitalisation, regulatory streamlining, localisation of renewable manufacturing, and workforce reskilling under a just-transition model were proposed. The study concludes that Vietnam can achieve a secure and equitable energy transition if institutional coordination, investment de-risking, and social inclusion are strengthened in parallel.

Keywords: Energy transition, coal-fired power, renewable energy.

INTRODUCTION

Coal-fired power has served as a foundation of Vietnam's industrialisation and electrification since the late nineteenth

century. The first coal plant, Nha Den Vuon Hoa, was built in Hai Phong in 1894 under French colonial administration. By May 2023, the nation operated 29 coal-fired power plants with a total installed capacity of 26,087 MW, representing 32.3% of national generation capacity. Coal accounted for 104.9 TWh, or 39.1% of total electricity output in 2022 (Chuong Phuong, 2024).

While coal ensured energy reliability during decades of rapid economic growth, its externalities—air pollution, carbon emissions, and ecosystem degradation—are increasingly unsustainable. The United Nations Development Programme warns that current and planned global coal capacities exceed the trajectory consistent with limiting global warming to 1.5 °C (Cuong, T.T. et al, 2021)

Vietnam, as a signatory to the Paris Agreement and COP26 commitments, has pledged to phase down coal use, with the Politburo's Resolution No. 55-NQ/TW (2020) establishing a national energy development strategy to 2030 and vision to 2045 (Ministry of Industry and Trade, 2018). This shift demands balancing energy security, economic competitiveness, and social justice - an exceptionally complex optimisation problem for a developing, export-oriented economy.

In National policy evolution, over the past decade, Vietnam has enacted an extensive policy framework to support renewable energy. Key milestones include in Table 1.

Table 1. Key milestones of policy framework to support renewable energy.

No.	Year	Policy / Regulation	Strategic Objective
1	2007	Decision No. 1855/QĐ-TTg	National Energy Development Strategy 2020–2050
2	2015	Decision No. 2068/QĐ-TTg	Renewable Energy Development Strategy 2030–2050
3	2017	Decision No. 11/2017/QĐ-TTg	Feed-in Tariff (FiT) for Solar Power
4	2020	Resolution No. 55-NQ/TW	Energy restructuring; 15–20% renewables by 2030
5	2023	Power Development Plan VIII	Full coal phase-out by 2050; 67–71% renewables share

Sources: Prime Minister (2015); Ministry of Industry and Trade (2018; 2019; 2021).

These instruments collectively envision renewables providing 32% of electricity by 2030 and 43% by 2050. PDP VIII further specifies that solar and wind will contribute ~65% of total generation by mid-century, while coal's share will decline from 33% (2022) to zero by 2050.

At COP26 in Glasgow 2021, Vietnam pledged to reach net-zero emissions by 2050 (Politburo, 2020). The Just Energy Transition Partnership (JETP), launched at COP28 2023, mobilises US \$15.5 billion in concessional and private finance to accelerate decarbonisation while ensuring fairness for workers and communities (Prime Minister, 2007). Vietnam's success in operationalising the JETP will determine its credibility in global climate governance and its ability to attract green capital.

METHODOLOGY

This study integrates policy document analysis, energy data synthesis, and

comparative benchmarking with regional peers (Indonesia, Philippines, Thailand). Data sources include Ministry of Industry and Trade (MOIT)'s annual reports, Electricity of Vietnam (EVN) statistics (2015–2025), UNDP JETP assessments, International labor organization (ILO) and academic literature. The research employs a multi-criteria evaluation framework (MCEF) encompassing four dimensions (Jessica V. L. et al. 2025) as in table 2.

Table 2. Four dimensions used for multi-criteria evaluation framework in this study

No	Dimension	Evaluation Metrics	Data Sources
1	Financial	Levelized Cost of Electricity trends, Capital Expenditure/MW, FiT stability	MOIT
2	Technical	Grid loss rates, storage penetration, curtailment ratio	EVN, UNDP
3	Institutional	Permitting duration, policy clarity, inter-agency coordination	MOIT,
4	Social	Employment shifts, regional equity, energy access	ILO

A qualitative comparative analysis (QCA) approach is applied to identify barrier interdependencies and formulate a sequenced solution roadmap.

RESULTS AND DISCUSSION

Renewable Energy Resource Potential

Vietnam's tropical monsoon climate, diverse topography, and extensive coastline yield substantial renewable resources.

Solar energy: Annual solar radiation ranges from 897–2,108 kWh/m²/year, with the highest levels in the Central Highlands and southern provinces as Dak Lak, Gia Lai, Khanh Hoa, Tay Ninh. Average insolation exceeds 5 kWh/m²/day in southern Vietnam, compared to 4 kWh/m²/day in the north (Prime Minister (a), 2017); Prime Minister (b), 2017). The

technical potential is estimated at 386 GW, positioning Vietnam as ASEAN's solar leader.

Wind energy: With 3,260 km of coastline and mean wind speeds of 6 m/s at 65 m hub height, Vietnam possesses roughly 311 GW of onshore and 475 GW of offshore wind potential. About 31,000 km² of land are suitable for wind generation, including 865 km² with generation cost < USD 0.06/kWh (Priyanka Sharma, 2024).

Biomass energy: Agricultural residues and municipal waste can support up to 5,000 MW of generation capacity (P. T. S. Thuong, N.T.Truong, 2024; Phan Trang, 2023). Rice straw alone can yield 2,565 MW, with Kiên Giang and An Giang provinces showing highest density.

Hydropower: Vietnam's 2,360 rivers and annual rainfall of 1,600–2,000 mm generate an exploitable hydropower potential of 120 billion kWh/year (UNDP, 2016). While large-scale hydropower is nearing saturation, small and pumped-storage hydropower remains promising for balancing renewables.

Key Challenges of developing Renewable Energy Resource

a) Financial barriers

Renewables demand high upfront capital: onshore wind USD 1.7 million/MW, offshore USD 3.5 million/MW, compared to coal's USD 1.3 million/MW. Limited domestic capital markets and unclear power purchase agreements discourage long-term investors (UNDP, 2024).

Vietnam's previous high solar prices created a solar boom but also overloaded the grid, and recent moves to retroactively revise FiT contracts have put more than US\$13 billion of solar and wind investment at risk and damaged investor confidence (Mark Barnes, 2023).

b) Grid and infrastructure limitations

Transmission congestion, especially in Khanh Hoa and Lam Dong causes curtailment losses of 10–20% for solar and wind projects

(Vietnam Energy Association, 2017). In 2020, the rapid deployment of solar and wind power, about 25% of installed capacity, has outpaced the capacity of Vietnam's grid and storage infrastructure, leading to congestion and frequent renewable energy curtailments, (Case for Southeast Asia, 2021).

c) Regulatory complexity

Permitting for renewable projects often exceeds 18 months, with inconsistent environmental and technical standards. Absence of unified grid codes and land-use zoning slows project rollout (Vietnam Energy Association, 2020).

Moreover, at present, there is no integrated planning platform that connects the scenarios from the National Power Development Plan (PDP8) with JETP commitments, grid constraints, and climate risk models. Additionally, there is no access to non-sensitive data. Coordination among ministries, the EVN, and local authorities within the Energy Transition Council is weak, and there is a lack of coherence in policies.

d) Technological and operational issues

High renewable penetration increases variability and grid imbalance. Curtailment and line losses (averaging 6.7%) cost EVN about 200 million USD annually (Vietnam Electricity Group, 2023).

e) Labour dislocation in the fossil fuel sector

Over 100,000 coal miners and 10,000 plant workers face displacement (ILO, 2022). Reskilling programs remain fragmented and underfunded. The social cost of a poorly managed transition could erode public support for decarbonisation.

Comparative regional analysis

Vietnam's renewable adoption rate surpasses regional peers, but integration readiness particularly grid flexibility and storage is comparatively weaker. Table 3 present comparative regional analysis of renewable energy

Table 3. Comparative regional analysis of renewable energy

STT	Country	Renewable Share (2022)	JETP/Equivalent	Coal Phase-Out Target	Feed-in Tariff Scheme
1	Vietnam	26.4%	JETP (2023)	2050	Solar (USD 0.0935/kWh); Wind (USD 0.085/kWh)
2	Indonesia	14.5%	JETP (2022)	2050	Mixed auction + FiT
3	Philippines	24%	Clean Energy Transition	2040	Competitive auction
4	Thailand	20%	None (policy alignment)	2050	Reverse auction

Proposed Solutions to Overcome Transition Challenges

a) Strategic priorities

A central priority is upgrading the transmission system: early PDP8 investments should focus on 220-kV-and-above trunk lines, North-Central - South interconnections, and grid digitalization. Clear rules for storage - pumped hydro, batteries, and flexible biomass or gas - are needed so these assets function as real balancing resources.

Regulatory predictability is essential. Vietnam should avoid retroactive PPA changes (Prime Minister, 2023), resolve FiT disputes transparently, and improve Decree 57's capped-tariff system by publishing auction schedules, grid-connection rules, and standardized PPAs (Prime Minister, 2025).

PDP8 must align with feasible financing. Meeting the 183 - 236 GW target by 2030 - including scaling solar, wind, and reintroducing nuclear- requires USD 8 - 10 billion annually for renewables and storage. The country should use the JETP's USD 15.5-billion package to derisk grid and storage projects and build standardized, pre-permitted pipelines to attract global capital.

Power-market reform is essential. Expanding direct PPAs would allow industrial users to contract directly with renewable generators, reduce pressure on EVN's balance sheet, and create more stable cash flows.

A just transition requires early identification of job losses in coal, oil, and gas through a national employment inventory

linked to PDP8's retirement schedule. Support should include temporary income assistance, early-retirement options, and continued health and pension benefits. Reskilling must target real labour demand grid expansion, renewables, transmission and storage, industrial efficiency, and environmental remediation delivered through short certified courses in local vocational colleges, with public funding tied to job-placement outcomes.

b) Policy implications

Institutional coordination is critical. Inter-agency overlaps among Ministry of Industry and Trade, Ministry of Agriculture and Environment, and provincial authorities causes delays of more than 18 months per project. Investment derisking via long-term power purchase agreements (PPAs), stable tariffs, and transparent auctions could attract USD 20-25 billion annually. Social acceptance hinges on equitable benefit-sharing. Community ownership models (2-5% equity stake) have succeeded in Thailand and Denmark and could be piloted in Vietnam's Mekong Delta.

CONCLUSION

Vietnam's pathway from coal to renewable energy represents one of the most ambitious transitions in Southeast Asia. The technical potential is vast, policy commitment is evident, yet institutional inertia and financing constraints remain decisive bottlenecks. A coordinated "Finance - Infrastructure - Policy - Society" approach offers a pragmatic framework for balancing decarbonisation with economic growth. By

leveraging JETP financing, localising supply chains, and ensuring just transition measures, Vietnam can achieve a resilient, low carbon energy system by mid-century and emerge as a model for equitable transition in the Global South.

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