ENERGY TRANSITION PARTNERSHIP

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MANAGING VIETNAM'S GRID ISSUES

for Effective Energy Transition

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Abbreviations

BESS	Battery Energy Storage System
EVN	Vietnam Electricity Corporation
FACTS	Flexible Alternating Current Transmission Systems
FCAS	Frequency Control and Ancillary Services
NDC	Nationally Determined Contribution
NPT	National Power Transmission Corporation
PDP8	Power Development Plan for the period of 2021-2030, with a vision to 2050
PPA	Power Purchase Agreement
PSH	Pumped Storage Hydropower
RE	Renewable Energy

Highlights

1. The rapid development of variable renewable energy (RE) amid limited grid and energy storage infrastructure has led to congestion and curtailment in Vietnam.

2. The absence of an adequate grid system hampers the full utilization of renewable power in the Central and Southern regions and prevents it from meeting the power demand in the North.

3. Proposed reforms include better planning for new generation capacity and locating generation sources closer to load centers. Alternatively, shifting demand to areas with abundant RE resources can be explored.

4. Enhancing the resilience of physical infrastructure in the power sector could improve transmission and distribution system capacity.

5. In the long term, investment in grid capacity and energy storage is crucial to enable dispatch flexibility for variable RE.

Problem context

Vietnam's electricity sector has experienced substantial growth, becoming the second largest in Southeast Asia in terms of installed capacity, behind Indonesia.[1] The country has witnessed a significant increase in electricity consumption, with an average annual growth rate of 12% between 2000 and 2020. This growth was mainly due to the rapid expansion of the manufacturing sector, residential consumption, and electrification efforts[2].

However, fulfilling Vietnam's net-zero by 2050 pledge while meeting the growing energy demand poses a massive challenge. The eighth Power Development Plan for the period of 2021-2030, with a vision to 2050 (PDP8), estimates that by 2050, installed power generation capacity will need to increase by 8.0-9.3 times from the 2020 level. With limited potential for new large-scale hydroelectric power projects, the plan stipulates that additional capacity will come from coal, gas, and renewables in the short term (pre-2030), and predominantly from solar, onshore, and offshore wind in the long term (post-2030). Coal capacity is expected to peak at 30GW in 2030 and gradually phase out towards 2050[3] and renewables will take on an increasingly important role.

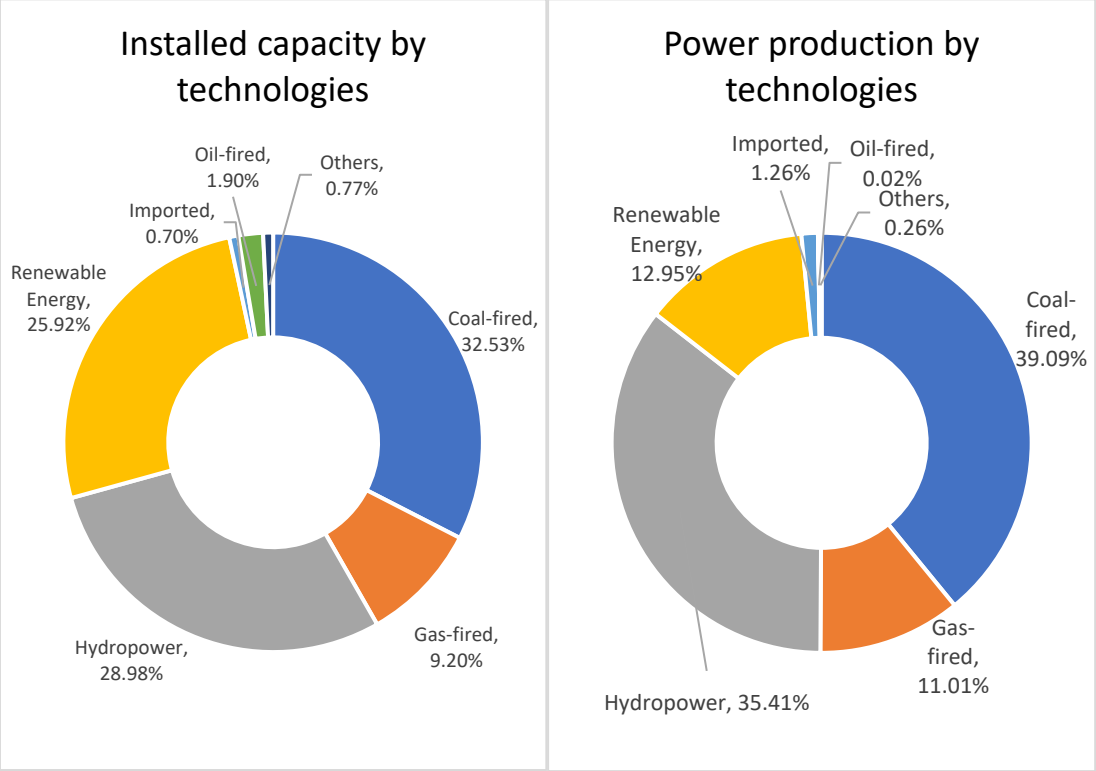
Vietnam has initiated steps to promote renewables through the implementation of feed-in tariffs for utility-scale solar, rooftop solar, and onshore wind since 2017. These measures have exceeded expectations, leading to the deployment of 16.5 GW of solar capacity in just two years (2019-2020). As of the end of 2022, the composition of the country's power system capacity was 33% coal-fired, 29% hydropower, 26% renewables, 9% gas-fired, with the remaining 3% consisting of oil-fired plants and electricity imports from Lao PDR and China (Exhibit 1).

The rapid deployment of RE in Vietnam during 2019-2020 has revealed a major challenge related to transmission grids. Grid congestion issues have halted the deployment of utility-scale solar projects in Vietnam for two years, posing significant challenges of curtailment and economic losses to existing solar projects. If left unresolved, these issues could further delay the deployment of solar and wind capacity, which is crucial for Vietnam's decarbonization agenda outlined in its nationally determined contributions (NDCs) and PDP8.

This policy brief examines the emerging transmission challenges facing Vietnam in managing the increasing penetration of renewable energy. It provides recommendations based on the policy roundtable, involving more than 120 Vietnamese national and provincial stakeholders and organized by AMPERES and ANU for the Southeast Asia Energy Transition Partnership in November 2022 in Vietnam. The deep dive grouped the main challenges of grid congestion into three main types – infrastructure, investment and climate resilience.

[1] ASEAN Centre for Energy. (2021). *ASEAN Power Updates 2021*. ASEAN Centre for Energy.
[2] IEA. (2023). Vietnam Country Profile. IEA. https://www.iea.org/countries/viet-nam
[3] Vietnam's Prime Minister. (2023). Decision 500/QD-TTg dated 15 May 2023 on Approving the Power Development Plan for the period of 2021-2030, vision to 2050.

Exhibit 1 | Generation technology by installed capacity (left) and by production (right) 2022.
Source: EVN, 2023[4]



Grid-related challenges in Vietnam's Energy Transition

Insufficient transmission infrastructure

A key challenge lies in the lack of infrastructure to support RE integration. As of 2020, Vietnam had 8,527 km of 500kV transmission lines and 18,477 km of 220kV lines (Table 1). While transmission and distribution grids have undergone substantial upgrades in the past decade, they remain under significant pressure and require significant investment. The 500kV grid is nearing capacity, and the construction of new lines has been relatively slow. Only 78% and 74% of the planned 500kV and 220kV lines, respectively, were added to the system between 2016 and 2020.

Incorporating the newly added 16.5GW of solar and 4.1GW of wind capacity into the system faces challenges due to the distance between renewable deployment sites and the main centers of demand growth. Currently, nearly

[4] EVN. (2023). Vietnam Electricity in 2022–Challenges in development direction. https://cosodulieu.evn.com.vn/pages/cms/news-tap-doan-dien-luc-viet-nam-nam-2022---thu-thach-huong-phat-trien-id-6448.html#:~:text=Trong%20%C4%91%C3%B3%2C%20t%E1%BB%95ng%20c%C3%B4ng%20su%E1%BA%A5t,t%E1%BB%B7%20tr%E1%BB%8Dng%2029%2C0%25.

95% of solar deployment is concentrated in Southern provinces with ample solar irradiation but limited electricity demand and grid capacity. On the other hand, the Northern region experiences rapid demand growth, surpassing the growth in power capacity. The absence of an adequate grid system hampers the full utilization of renewable power in the Central and Southern regions and prevents it from meeting the power demand in the North.

As a result, the rapid development of variable RE has led to challenges such as congestion and curtailment in South-Central Vietnam. In 2020, approximately 364 GWh of solar energy was curtailed, resulting in significant financial losses and wasted power resources.

Table 1 | Transmission grid as of 2020 and proposed development plan.
Source: Report 2770/TTr-BCT on approval of PDP8[5] (MOIT, 2023) and Decision 500/QD-TTg on approval of PDP8[6].

Items	Unit	2020	Development plan for 2021-2030	Development plan for 2031-2050
500 kV line	Km	8,527	Build 12,300 km Refurbish 1,324 km	Build 9,400-11,152 km Refurbish 801 km
220 kV line	km	18,477	Build 16,285 km Refurbish 6,484 km	Build 11,395 – 11,703 km Refurbish 504-654 km

Climate dependency of the generation portfolio

Vietnam's power system remains reliant on hydropower and is hence vulnerable to the impact of climate change on water availability. During the dry season, when water availability in the reservoirs is low, the Northern region increasingly faces power shortages. In 2021, there was a power shortage of about 14 GWh in the North[7]. The power stress is exacerbated by the onset of El Niño, which brings warmer weather and reduced rainfall. During May and June 2023, when the demand for electricity for air conditioning surged, the North power system experienced a deficit of 4,350 MW during certain periods[8].

No storage capacity

Energy storage options could reduce the variability of RE generation and deal with grid congestion if and where it occurs. However, in Vietnam, there is a widely held industry perception that Battery Energy Storage Systems (BESS) are not economically feasible at this moment, while the country's first pumped storage hydropower (PSH) project Bac Ai with a capacity of 1,200 MW will not be commissioned until 2028[9]. These limitations in energy storage, combined with restricted grid capacity, impose constraints on the future renewable uptake.

Investment barriers to grid expansion and upgrade

Grid development necessitates significant capital investments at a scale difficult for the state budget alone; however, an enabling environment to mobilize private finance is still lacking. According to PDP8, the total investment

[5] MOIT. (2023). Report 2770/TTr-BCT on Approval of the Power Development Plan for the period of 2021-2030, vision to 2050 dated 10 May 2023.
[6] Vietnam's Prime Minister. (2023). Decision 500/QD-TTg dated 15 May 2023 on Approving the Power Development Plan for the period of 2021-2030, vision to 2050.
[7] MOIT. (2022). Report 2715/BCT-DL on Reviewing Power Development Plan 8 dated 20 May 2022.
[8] VN Economy. (2023, June 7). Phụ tải không đáp ứng được nhu cầu, miền Bắc có nguy cơ thiếu điện trong hầu hết các giờ trong ngày. https://vneconomy.vn/phu-tai-khong-dap-ung-duoc-nhu-cau-mien-bac-co-nguy-co-thieu-dien-trong-hau-het-cac-gio-trong-ngay.htm.
[9] Do, T. N., & Burke, P. J. (2023). Phasing out coal power in a developing country context: Insights from Vietnam. Energy Policy, 176, 113512. https://doi.org/10.1016/j.enpol.2023.113512

required for the development of grid from 2021 to 2030 amounts to $14.9 billion, equivalent to $1.5 billion per year or 0.4% of Vietnam's GDP in 2020 (Table 1). The strained state budget alone may struggle to accommodate such substantial financial requirements. As such, the participation of the private sector in grid development is becoming increasingly critical to realize PDP8.

To date, investment, construction, management, and operation of the transmission and distribution grids are the responsibility of the Vietnam Electricity Corporation (EVN). EVN assigns the National Power Transmission Corporation (NPT) the responsibility for transmission grids, including 500 kV transmission lines and substations, 220 kV lines and substations, and some specific 110 kV transformers in specific locations.

Following the revision of the Electricity Law No.03/2022/QH15 dated 11 January 2022, private investment in transmission infrastructure is permitted. Article 4.2 stipulates that private investors can develop grid assets and operate them subject to ensuring national defense and security and compliance with other relevant regulations.

During 2019-2020, only a few private investors, such as Trung Nam Group in Ninh Thuan province and Xuan Thien Group in Dak Lak province, invested in transmission lines, primarily to provide electricity transmission services from their RE generation plants to EVN's connection point[10]. Even with the recent amendments to the Law of Electricity in 2022, which created a legal basis for non-state actors to invest and operate transmission infrastructure, their involvement in grid upgrades has remained limited for a number of reasons.

First, Vietnam's electricity sector has been mired by significant policy uncertainty. During the past four years, the finalization of the 8th National Power Development Plan undertook an unprecedented number of revisions, while Vietnam's Energy Masterplan was also under development. Prior to their approval, the sector was left with considerable uncertainty as to the direction of the future generation mix and the pace of decarbonization, creating uncertainty unconducive to investment. In addition, the revised electricity law is vague and makes it difficult to interpret the specific details necessary for investment decision-making, such as which projects (location, scale etc.) and how projects are priorities against national defense and security concerns. There is a need to provide clear guidance/clarification on this regulation.

Second, investors also identify the complex and inefficient administration procedures during the grid development process, such as site identification, land acquisition and compensation, which often frustrated their investment decision and served as barriers to grid investment.[11] Investment and construction of transmission grids can be implemented only if the project is included in the provincial annual land use plan which is under the authority of the Provincial People's Council, which is time-consuming and, in many cases, does not match the implementation timeline of the project. While the Law on Planning, effective on 01 January 2019, stipulates the procedure for supplementing projects, it is complicated and, in some cases, impossible. For a developing country whose investment depends on investment policies, such regulation is inappropriate.

Third, Vietnam's progress on market reform has been slower than expected, which means there are no market mechanisms to value improved efficiency

[10] Vietnam Investment Review. (2023, February 15). Fresh approaches sought for electricity transmission. https://vir.com.vn/fresh-approaches-sought-for-electricity-transmission-99773.html
[11] Do, T. N., & Burke, P. J. (2023). Phasing out coal power in a developing country context: Insights from Vietnam. Energy Policy, 176, 113512. https://doi.org/10.1016/j.enpol.2023.113512

and performance of the power system. Similar to the retail tariff, the transmission fee is strictly regulated. It was set at 75.85 VND/kWh in 2022[12], and is not cost-reflective and therefore insufficient for cost-recovery investment.

Proposed solutions

Participants of the Energy Transition Partnership Roundtable Deep Dives, held in October 2022 virtually and in-person, identified three key solutions. Solutions 1 and 2 could help reduce the need for new grid infrastructure in the short term. Solution 3 is geared towards long-term benefits.

1

Plan the power system to better co-locate sites of both generation and energy-grid capacity issues in transmitting electricity from production sites to consumption sites.

Historically, the grid has been planned based on the majority of generation sites located in the North and Centre of Vietnam, while the load growth is concentrated in the South. However, renewable energy generation sites have been shifted to coastal regions in southern Vietnam. Reforms in planning approaches can improve the deployment of new generation capacity, avoiding congestion and locating generation closer to load centers. This can be achieved through measures such as Renewable Energy Zones and integrated provincial energy plans.

Additionally, the development of wind power, especially offshore wind projects, in the North can partially meet the electricity needs of the region while reducing dependence on coal-fired power[13]. To support this, the development of marine spatial planning approaches will function in a similar vein to REZs onshore and support improvements and efficiency in offshore wind planning.

2

Improve the contracting processes for private investors

Private sector investors perceive significant potential in the Vietnamese electricity system based on the size and growth profile of the sector. However, under the current regulatory and governance environment, there remain significant risks prohibiting a larger involvement in the sector. Three main recommendations were identified in the deep dive to address this. First, the Government of Vietnam should reform the structure of power purchase agreements (PPAs) to better share risk between investors and the single-buyer EVN. Second, more nuanced economic incentives, such as reverse auctions, should be used to provide market incentives that level the playing field for renewables. These auction mechanisms should include safeguards like 'contracts-for-difference', which are emerging as a key feature of PPAs to de-risk variable RE for both the seller and buyer. Last, efforts should be made to streamline and improve the efficiency of permitting processes that are not fit-for-purpose and unnecessarily cumbersome.

[12] Ministry of Industry and Trade (2022). Decision 1052/QD-BCT dated 31 May 2022 on regulating transmission fee in 2022.
[13] Do, T. N., Burke, P. J., Hughes, L., & Thi, T. D. (2022). Policy options for offshore wind power in Vietnam. Marine Policy, 141, 105080. https://doi.org/10.1016/j.marpol.2022.105080

3 Improve the resilience of transmission infrastructure

Enhancing the resilience of physical infrastructure in the power sector is crucial to improve capacity and reduce transmission and distribution losses. Factors such as loading criteria of substations, conductor size selection criteria, and improving busbar diagrams of transmission substations should be considered[14]. Utilizing flexible alternating current transmission systems (FACTS) can enhance controllability and increase power transfer capability. FACTS improve power factor and grid performance, strengthening the grid's capacity to manage power fluctuations.

4 Invest in transmission grid and energy storage

In the long term, it is important to invest in transmission grid and energy storage. Without grid development, it would be challenging to accommodate new RE. Also, energy storage solutions can provide dispatch flexibility for variable renewable energy and alleviate the burden on the grid. Pumped hydro-energy storage and utility-scale battery storage are proven options for energy storage[15]. Vietnam has substantial potential for pumped storage hydro and a well-established hydropower industry that can effectively develop such projects. Market instruments that incentivize dispatchable power, such as capacity markets and markets for frequency control and ancillary services (FCAS), could be considered to unlock the opportunity for pumped hydro and battery energy storage.

Conclusion

Grid-related challenges have impeded the growth of renewable energy in Vietnam since 2022. The solutions include better planning to co-locate generation and demand and improving the resilience of transmission infrastructure for the short term. In the long term, enabling favorable conditions for grid expansion and energy storage would be crucial. Implementing these strategies will contribute to the successful integration of renewable energy and the development of a robust and reliable grid system in Vietnam.

[14] Nguyen, C. M. (2022, November 1). Solutions to improve the integratability of renewable energy sources into Vietnam's power system. https://drive.google.com/file/d/1_CeL3K5jLRRI5cLbTH1N-X6U1OdW8_RJ/view?usp=sharing

[15] Lu, B., Blakers, A., Stocks, M., and Do, T.N. (2021). Low-cost, low-emission 100% renewable electricity in Southeast Asia supported by pumped hydro storage. Energy, 236, 121387. https://doi.org/10.1016/j.energy.2021.121387

About Energy Transition Roundtables

The Southeast Asia Energy Transition Partnership (ETP) https://www.energytransitionpartnership.org/ is a multi-stakeholder platform that aims to accelerate the energy transition in Southeast Asia and deliver the Paris Agreement targets on climate change by bringing together Government Donors, Philanthropies and Partner Governments. The ETP offers a strategic opportunity for multiple actors from government, civil society, and the private sector actors to come together and leverage their expertise and resources to support Governments' understanding and advance a more ambitious agenda of reform to optimize the Southeast Asian energy transition.

The Energy Transition Roundtables is a two-year capacity building and networking program that aims to provide an opportunity for the region's energy transition stakeholders – in particular, mid-career policymakers from identified Southeast Asia countries (Vietnam, Indonesia and the Philippines) and regional level bodies – to engage in an intensive 24-roundtable series on the energy transition.

The roundtables are delivered by the Australian National University (ANU) and Australia-Mekong Partnership for Environmental Resources & Energy Systems (AMPERES), in partnership with the Institute for Economic and Social Research, Faculty of Economics and Business, University of Indonesia (LPEM UI), the Indonesia Research Institute for Decarbonization (IRID), Ateneo School of Government (ASOG), University of San Carlos (USC), and MOIT's Electricity & Renewable Energy Consulting, Training and Information Centre (ECTIC).

The COP Policy Dialogue organized on 2 November 2022 is a high-level strategic discussion bringing together experts from Australia and 29 COP delegates from Indonesia and Vietnam to take stock of progress made on COP 26 commitments, share insights and lessons on decarbonizing national electricity systems, and identify the strategic issues that frame the agenda for effective negotiations at COP 27. This publication summarises and continues the discussion of this event.