

A STUDY ON FINANCIAL MECHANISMS TO DEVELOP THE POWER SYSTEM IN VIETNAM

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Summary

Vietnam's commercial electricity demand grew by 9.6% per year during 2011 - 2020. The Ministry of Industry and Trade (MOIT) forecasts that the average annual investment cost for the power system over 2021 - 2030 will be around USD 9.0 billion to USD 12.6 billion per year for generation sources and USD 1.5 billion to USD 1.6 billion for the grid. This article discusses the financial options to mobilise this capital. The private sector interest in financing new thermal power projects is low for coal and uncertain for gas; the current energy price crisis suggests deferring any new LNG power plant openings until after 2026. There, the state-owned sector takes the lead. For renewable energy, private investors have shown eagerness to finance new solar and onshore/nearshore wind projects under the feed-in-tariff regime. The subsequent mechanisms will be market-based: auctions and direct power purchase agreements. Offshore wind projects allow the state-owned oil and gas industry to invest jointly with international private developers and reorient its strategy in response to the energy transition. Developing the green bond market is an opportunity for Vietnamese banks. State-owned enterprises can use them to raise money through non-sovereign debt. Finally, a gradual increase in electricity prices will improve the sector's ability to finance the necessary power system expansion.

Key words: Energy transition, power system, policy, finance, market, LNG.

1. Introduction

The commercial electricity demand of Vietnam grew by 9.6% per year during 2011 - 2020 [1]. The Ministry of Industry and Trade (MOIT) expects this growth rate to decline gradually in the coming years, to 9.09% per year in 2021 - 2025 and 7.95% per year in 2026 - 2030 in the central case. In absolute numbers, the national electricity consumption will increase from 215 TWh in 2020 to around 500 TWh in 2030 [1].

On June 21st, 2022, the national power load set a new record at 45,582 MW. On July 4th, 2022, the supply was interrupted to several substations during the noon peak in the North. Regarding the North's power consumption, on July 18th, it set a new peak record of 22,800 MW - about 4,200 MW higher than the same period last year in 2021 [2]. The Vietnam electric system is under stress and needs urgent solutions to ensure its development.

MOIT estimated the average investment cost for the power system over 2021 - 2030 to be around USD 9.0 billion to USD 12.6 billion per year for generation sources and USD 1.5 billion to USD 1.6 billion for the grid [1]. For example, the Bac Ai pumped storage project, with the capacity to release 1,200 MW of flexible hydroelectricity, costs about USD 1 billion [3]. The investment for the Nhon Trach 3 and 4 LNG power plants, which provide 1,500 MW of dispatchable, LNG-based electricity, is about USD 1.4 billion. Renewable energy systems are even more upfront capital intensive than thermal power plants.

By thoroughly studying Vietnam's future energy scenarios, capital needs to expand the power system, the influences of the ongoing fossil fuels prices crisis and the zero-carbon goals, etc., this article discusses the financial mechanisms to mobilise capital as well as proposes some policy recommendations to develop the power system in Vietnam in the coming years.

2. Existing scenarios of power system expansion

Resolution No. 55-NQ/TW [4] effective from February 2020 marked a turning point of the energy sector away



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from fossil fuels and towards renewable energy sources. In November 2021 at COP26, Vietnam announced it adopted the target to become carbon-neutral by 2050 [5]. This requires reforming the socio-economic development pathway and is more ambitious than Resolution No. 55-NQ/TW. Many official doctrine, strategy, roadmap and planning documents need to be revisited to that end.

The official adoption of the net-zero goal renewed the research interest in low-carbon development scenarios for Vietnam. Reviewing the literature provides a basis to understand the technical opportunities and policy options, which lead to different investment and financial needs for the power sector.

- The Power Development Plan 8 (PDP8) was not originally defined towards a net-zero goal [6]. Its first draft [7] was released prior to the COP26 announcement. The draft follows the 2015 Renewable Energy Development Strategy and Resolution No. 55-NQ/TW. It is constrained by the commitments already taken in the previous development plan, the revised PDP7. For example, authorisations given to thermal power projects are legally binding.

The current PDP8 draft [1] lists ongoing investment in new generation capacities during the 2021 - 2030 period as: LNG power plants (+20.4 GW), coal power plants (+11.0 GW, plus 1.3 GW with cogeneration), wind power plants onshore (+20.9 GW) and offshore (+7 GW), hydroelectricity (+8.1 GW). Investment in domestic gas power plants (+7.8 GW) assumes the development of the Lot B and Blue Whale offshore fields. Investment in utility-scale solar is limited (+3 GW), but rooftop solar is unlimited. There is also investment in electricity from biomass and other renewables (2.5 GW total capacity by 2030), in interconnectors to neighbouring countries (total capacity 5 GW by 2030), in electricity storage (2.7 GW by 2030, including two 1.2 GW pumped hydro projects and 300 MW of batteries), and in flexible thermal engines (0.3 GW).

- The Vietnam Climate Change Strategy [8] caps the energy sector emissions (including electricity production, fuel, industry) to 457 metric tons of CO₂ equivalent (MtCO₂eq) by 2030, down 32.6% compared to the business-as-usual scenario. In 2050, the energy sector should emit less than 101 MtCO₂eq. By that time,

the land use and forestry sector should absorb at least 185 MtCO₂eq per year. The supporting technical study shows that greenhouse gas emissions shall peak in 2035. It notes that a solar PV option is lower in cost than using carbon capture and storage in the long run but would require 500,000 ha for installing fixed solar panels¹. Though the climate change strategy recommends considering nuclear energy and carbon capture and storage research, it does not call for large scale investment in these technologies before 2030.

- The draft Vietnam Energy Masterplan [9] proposes a scenario where the total primary energy supply reaches 154 million tons of oil equivalent (Mtoe) in 2030 and 335 Mtoe in 2050. Of which, wind and solar roughly provide 100 Mtoe each in 2050, and fossil fuels still participate: coal for 16.8 Mtoe, oil for 17.2 Mtoe and gas for 31.1 Mtoe. The total CO₂ emissions from energy reach 401 Mt in 2030, falling to 96 Mt in 2050. The scenario rests upon energy efficiency, electrification, renewable energy, hydrogen and hydrogen-based fuels, and carbon capture and storage.

- The Vietnam Energy Outlook [10] 2021 produced three scenarios: baseline (BSL), renewable energy (RE), and net-zero. Electricity generation and storage capacity in 2050 net-zero scenario are mainly composed of: storage: (47%), solar (43%), and wind (7%). The primary sources of RE-based power production are solar-dominated compared to wind (75% vs. 21%). The majority of solar is utility-scale (838 GW installed in 2050). Floating PV and rooftop are subsidiary. For wind power, onshore and offshore are balanced. Coal and gas power generation are fully phased out in this scenario.

In addition to the four official studies enumerated above, existing scenarios from other sources [11 - 16] explore various strategies to achieve deep decarbonisation. Different scenarios call for different investment trajectories in thermal power generation, solar PV, offshore and onshore wind, grid, and electricity storage.

Net-zero scenarios agree that Vietnam's emissions should peak in 2035. They also agree that a low-carbon society entails a high rate of electrification and mainly renewable electricity sources to reduce the use of fossil fuels in all sectors.

Existing studies also have limits. Most do not achieve full net-zero from the energy sector, they keep some fossil fuels and rely on carbon sequestration in forests. Methane emissions reduction receives little attention compared to

¹According to General Statistics Office, Vietnam area is 33,134 thousand ha, of which 3,931 thousand is non-agricultural land, 786 thousand is water surface land for fishing, and only 191 thousand is unused flat land.

its urgency. They overlook the carbon market mechanism which is due to open in 2028 according to the Law on Environment, and underplay the opportunities offered by an ASEAN grid.

The reviewed literature on long-term scenarios uses technical and economic models. However, it has an overall low connection to the immediate problem of financing the sector in the next five years and providing electricity to the northern area next year. For example, the Energy Outlook notes that the optimal use of LNG is very price-sensitive but does not recommend policies to respond to the prices seen today.

3. Climate and energy crisis changed the power sector investment conditions

In the mid-2021, a strong economic recovery after the Covid-19 pandemic drove the international oil and gas prices up. By fall 2022, they remain way higher than they were during the 2015 - 2020 period, particularly for LNG prices (Figure 1).

Fossil fuels are like other commodities or stocks: analysts spend a lot of time trying to estimate their future pricing, but their efforts yield little more than the general expectation that "What goes up will eventually go down". Surprises and uncertainties are common. Within these predictability limits, we argue that three forces are pushing the market prices to remain relatively high in the forthcoming 3 years: project development inertia, geopolitical uncertainty, and climate policy.

- Project development inertia: The oil and gas industry uses large industrial facilities that take time to build. The high prices of LNG have motivated the construction of new liquefaction trains in 2021 and 2022, after investors observed a pause in 2020. Still, the IEA notes [17] that the industry record for constructing a large-scale greenfield LNG project was 29 months at the Calcasieu Pass project.

- Geopolitical uncertainty: Following the Covid-19 crisis, crude oil prices rebounded to more than USD 100 per barrel during the strong recovery year of 2021. Any hopes of a restoration to pre-crisis levels were crushed by the Russia - Ukraine war. Oil and gas exports of Iran and Russia face significant political restraints. The US shale oil industry exhibits capital restraint, slowing its rate of expansion. As a result, the crude oil market is still dominated by the OPEC+, which has an incentive to keep prices high.

- Climate policy: From a physical perspective, no new fossil fuel infrastructure is acceptable. The amount of carbon from fossil fuels being produced exceeds what is compatible with a 1.5°C global warming [18]. The economic perspective is more nuanced: as more severe climate policies bear on the use of fossil fuels, opening new fields and mines becomes less profitable, and capital moves towards other enterprises. As the IEA [17] summarises: High levels of uncertainty about the longer-term market evolution and the role of gas in the energy transition still cast a shadow over investment decisions. Less investment means less supply, translating into higher prices.

Asian spot LNG prices hit records in the third quarter of 2022, over USD 45 per MMBtu as shown in Figure 1. IEA notes that markets expect this situation to persist through 2023 [17]. China and India were able to switch back to coal for generating electricity. Japan and Korea implemented policies to restart nuclear and use more coal in the near future and were otherwise relatively protected by having robust long-term LNG contracts at around USD 15 per MMBtu. Pakistan and Bangladesh experience blackouts and macroeconomic shock due to high LNG prices. Compared to these two countries, Vietnam has done better. In the first 10 months of 2022, the general average consumer prices index was up only 2.89% in Vietnam compared to the same period in 2021 [19].

Exploiting the Block B offshore gas field would mitigate the impact of this kind of energy crisis on Vietnam's economy. Contrary to the spot market LNG prices, the domestic gas production costs will be stable. The project has stalled for years because technical and geological constraints make the cost of gas from Block B too high for baseload power. However, it may not be excessive to provide security, flexibility, and capacity services at scale.

According to MOIT [1], Vietnam plans to have 32.7 - 38.8 GW of gas-to-power generation capacity in 2030. At that scale, the domestic fuel extraction is certainly not enough to avoid importing fuels for electricity. The country will need to import gas as it is importing coal.

For an LNG power plant to sell electricity at the price of UScent 8 - 9 per kWh, the input LNG price must be around USD 12 per MMBtu. If the LNG price is up to USD 40 - 50/ MMBtu, then the electricity selling price cannot be below UScent 20 per kWh [20]. While long-term supply contracts offer better conditions than the spot market, their prices



Figure 1. Price of LNG in Asia since 2015. The JKM index spiked to over USD 50/MMBtu in March 2022 and remains well above its 2015 - 2020 levels. Source: Tradingviews.

have risen in 2022, especially for contracts starting before 2026 [21].

The first LNG import facility in Vietnam will be in Thi Vai, to feed the new Nhon Trach 3 & 4 power plants.

It is not clear who will supply the LNG and at what commercial conditions. It is not clear how many private investors will take the final investment decision for the LNG-to-power projects currently under consideration in Vietnam. For example, in 2019 the Bac Lieu LNG power project was added to the Masterplan after its investors proposed to sell electricity at UScent 7/kWh, but is not moving forward. The electricity cost now appears too optimistic. And most floating storage and regasification units, which the project planned to use, have moved to Europe. The current context is not favourable for private companies to invest in new LNG-to-power projects starting before 2026.

This is not the first time that a generation of thermal power projects get delayed in Vietnam. This was already the case a few years ago [22]. The policy response to avoid power shortage was to install renewable energy sources. The case of the Vinh Tan power centre illustrates the story. It was initially planned with four thermal coal power plants projects. Only three were built. The Vinh Tan 3 project, a 1,980 MW plant scheduled to connect in 2018, saw its main investor One Energy (Hong Kong) withdraw. Now the site is surrounded by solar farms.

Private investors financed the rush of new renewable energy capacity installation. They were attracted by incentives. In 2017 the government started the renewable

electricity boom started by giving a feed-in tariff of UScent 9.35/kWh to solar projects². The tariff was reduced three years later to UScent 7.09/kWh, except for rooftop solar power projects³ which still received UScent 8.38/kWh. In 2018, the wind industry received a tariff of UScent 8.5/kWh for onshore projects, and UScent 9.8/kWh for offshore⁴.

Feed-in-tariff worked well to start the industry but will not be continued. This way to attract investment is not sustainable. In 2022, the average retail electricity price in Vietnam is equivalent to US cent 8.3 per kWh⁵. EVN cannot thrive if it sells retail for less than it buys wholesale.

Will the costs for the next wave of solar and wind farms in Vietnam be lower than the feed-in-tariff initially given? On one hand, most best locations are already developed, and the price of PV modules and wind turbines are not declining as fast as they used to, due to general inflation in materials and shipping costs. On the other hand, compared to the 2017 - 2018 period, the sector is mature in Vietnam and the industry has made five years of technical progress. According to IRENA [23], "the global weighted-average levelised cost of electricity of onshore wind fell 56% between 2010 and 2020, from USD 0.089/kWh in 2010 to USD 0.039/kWh in 2020" and "the global weighted-average levelised cost of electricity for utility-scale PV projects fell by 85% between 2010 and 2020".

Another factor to drive down the costs of renewable electricity in Vietnam will be using competitive mechanisms: auctions and direct power purchase agreement. The results of recent solar and wind auctions in most other countries are way lower than the feed-in-tariff given in Vietnam for 2017 - 2020. For example, bids from solar farm investors around US cent 1.3/kWh have been seen at auctions in Abu Dhabi, Portugal and Chile.

Thus, the evolution of the global economy since 2019 now makes it easier to attract investment for solar and wind farms than for thermal power plants. Mobilising private capital to install renewable power generation sources solves only half of the financing problem. Developing a reliable electricity system requires much more than building plenty of renewable-based generation capacities. It requires i) sufficient transmission and distribution networks, ii) backup capacities for the times when the renewable power sources are not available, and iii) flexibility solutions to compensate for the short-term variability of solar and wind.

²Decision No. 11/QĐ-TTg dated 11/4/2017.

³Decision No. 13/QĐ-TTg dated 6/4/2020.

⁴Decision No. 39/QĐ-TTg dated 10/9/2018.

⁵Decision No. 648/QĐ-BCT dated 20/3/2019.

4. The private sector can finance demand reduction for its own benefit

Limiting the increase in electricity consumption reduces the need to find funds to finance the system's development. The main approaches to reducing power system growth are energy efficiency regulations, distributed generation such as incentives to build rooftop solar systems, and dynamic demand-side reduction:

- Improving energy efficiency typically entails purchasing newer equipment and implementing wiser energy management strategies. Energy reductions result in cost savings, which can compensate for the investment. It is up to energy consumers, whether they are private firms, individual families, or public organisations, to identify and invest in the energy-savings measures that will provide the greatest return on investment. When energy users do not take such steps, there is room for energy service firms to invest in energy efficiency improvements while receiving a portion of the realised energy savings as payment. This business strategy has shown to be successful in many nations, but is not yet widespread in Vietnam. Government intervention must be more decisive in order to expedite the adoption of energy efficiency measures.

- Rooftop solar is now the most popular distributed generation technology for reducing grid demand. The national PV rooftop capacity increased from 378 MWp in 2019 to 9.6 GWp in 2020, spreading among over 100,000 systems (see <http://solar.evn.com.vn>). Most were entirely funded by the private sector. Incentives to invest in the rooftop solar sector were reduced in 2021, but there is still a demand for carbon-neutral electricity from industrial, businesses and homeowners. There is also the possibility of equipping public sector organisations such as schools, hospitals, and governments: in a carbon-neutral society, all levels of government - central, provincial, and municipal - will provide green public services.

- Demand response management aims to lower the consumer electricity demand when the supply is tight. Demand side reduction programs are often operated by power companies. It may seem counter-intuitive to ask a company, even a state-owned one, to reduce its demand. However, there are times when power providers sell electricity at a loss, particularly when load peaks must be met by generating electricity from expensive gas turbines. In these circumstances, lowering peak demand is lucrative for the utility. It enables the avoidance of the installation of power generation capacities.

Smart appliances and the internet of things hold great potential for demand response management. Rooftop PV systems that include battery storage and a smart connected bidirectional meter can theoretically deliver more benefits to the grid than just reducing daytime demand. This will be economically significant over a 10-year time horizon.

Even if demand reduction initiatives are effective, they will not be enough to prevent the need for investment in extending Vietnam's power system. Figure 2 illustrates that a high-income country lifestyle necessitates four times the amount of electricity per capita than Vietnamese use today. Furthermore, high-income countries successfully transitioned to a falling electricity production trajectory around 2007, but as they take the lead in reducing greenhouse gas emissions, several are considering the necessity to boost their electricity output once more. Electricity will be used to replace fossil fuels wherever it is technically practicable, and it will also be used to help synthesise carbon-neutral fuels for applications where electrification is not practical.

To sum up, the bulk of investment for demand-side reduction will come from the private sector. The State can lead by example, but its essential function is to enable the markets.

5. Shaping markets to attract private sector's investments

Installing more production and transmission capacity, backup power sources, and flexibility solutions necessitates the mobilisation of billions of dollars each year. We're talking about new power lines and transformers, hydroelectric dams, interconnectors to neighbouring countries, pumped hydro storage, large batteries, internal combustion engine natural gas power plants, natural gas open or combined cycle power plants, and equipment to make coal power plants more flexible, in addition to new solar and wind farms. There is no single way to pay for all of this. A package of policies and regulations is required.

Historically, the electricity industry was managed by the State, with a vertically integrated national company providing everything from power generation to its distribution. State-owned enterprises still play a central role in Vietnam's power sector, and we will discuss how to finance them in the next section. However, as the current electricity sector policy is oriented to increase the role of the market, we start by discussing how to attract investment from the private companies.

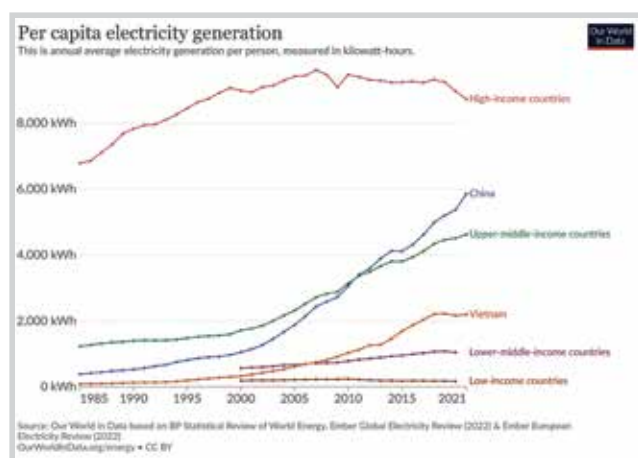


Figure 2. Electricity generation per person. High-income countries produce four times as much electricity per capita as Vietnam does. Source: Our World in Data.

The needs of an electric system operator are classified into three types: energy needs, capacity needs, and ancillary service needs. Deregulation tries to meet some of these demands through private firms motivated by market profits. The fundamental mechanism of markets is that prices realise an equilibrium between supply and demand. When there is a great demand for electricity, prices rise, attracting high-cost power producers such as those who use natural gas to generate electricity. When demand is low, only low-cost power producers compete in the market. This mechanism ensures an order-of-merit dispatch, which is economically efficient.

- In the energy market, producers are compensated in proportion to the number of kWh delivered. The load dispatch centre solicits bids from power producers and selects the most competitive ones to determine day-ahead electricity production plans.

- The ancillary services are those needed to ensure the reliable operation of the grid. Some power plants must be guaranteed to restart without external power, in case of a blackout. Some facilities must regulate the frequency of the grid, fine-tuning their production to match the demand in real time. Other ancillary services include voltage control and maintaining the operational readiness in case a component of the system suddenly goes offline.

- In a capacity market, the producers are pre-paid in advance proportionally to the maximum level of electric power they commit to supply at a certain point in time in the future. For example, if the system operator could determine a specific demand in a specific daily time in the summer of 2030 available, it could pay producers in advance to ensure that the supply will be available.

Energy markets are the most straightforward of these three. Vietnam had a competitive generation market. By mid 2022, the 108 participating power plants, half of them from the private sector, represented 30,940 MW of generation capacity [24]. Vietnam may use auxiliary services and capacity markets someday, but this is not a guarantee. In the medium term, such future prospect cannot be counted on to offer incentives to build natural gas power plants by 2030. And, while auxiliary markets are an incentive to invest in battery storage, their scale is limited - “ancillary” means “of secondary importance”.

Free-market enthusiasts argue that an unrestricted energy market works as a capacity market: if the electricity prices are allowed to climb very high during super-peak hours, then peaker plants will be profitable to build even if they run few hours per year. This idea is dangerous. The February 2021 blackouts in Texas demonstrated that the theory does not work in practice. The Enron frauds in 2000 - 2001 leading to blackouts in California also demonstrated the vulnerability of a deregulated power market to manipulation.

In Vietnam as in other countries, the renewable electricity sector was started by giving feed-in-tariffs to producers. After that, the government works on two mechanisms to attract investors:

- Public procurement auctions where solar or wind projects will bid for a selling price to EVN, with the lowest bidders winning.

- Renewable electricity generators can participate in Vietnam’s electricity market. Market dynamics may be difficult for them: the concurrent supply of solar energy during sunshine hours depresses the market. To work around this, renewable energy producers can enter a contract-for-difference directly with a third-party buyer interested in green electricity. Such direct power-purchase agreement will guarantee the solar or wind electricity company’s income level regardless of the spot market price.

Considering the limits of markets to motivate investors in grid, capacity and ancillary services, another way to involve the private sector is to bundle some system costs into the contracts binding investors in power projects. Here are 2 examples:

- Adding a two-hour battery storage component to PV projects helps shape the load curve. Such a battery could cycle almost daily to store electricity during the

afternoon production peak and to dispatch it during the evening consumption peak. It could avoid costly grid upgrades. Policy discussions in 2018 - 2019 concluded that mandating storage for PV projects in Vietnam was premature. Nowadays most new projects in California, Australia, or China include a battery storage component. In September 2022 EVN proposed to aim for 1 GW of battery storage in 2025 and 3 GW in 2030.

- New power generation projects are normally only responsible to build a medium-voltage power line to connect their site directly to the substation. In the offshore wind industry, multiple projects could connect to a common offshore platform far from the coast, and then pool their resources to build the connection cable to the national high voltage grid shore. The artificial energy island concept is taking off in Europe. Vietnam could use Phu Quy Island to the same effect. Financing high-voltage transmission cable connecting multiple wind farms could arguably be a contribution of the offshore wind industry to the national transmission network.

Public-private partnerships also remedy the limits of markets. Many EVN or Petrovietnam projects use joint ventures to bring in outside equity and technical expertise. This allows them to leverage public capital in exchange for a share of profits and some control of the project's destiny. For example, the Son My LNG terminal is led by Petrovietnam with the US company AES. Partnership cannot make a project profitable if the technical and economic conditions are not favourable.

More recently, the electricity law has been modified to allow the private sector to finance new electricity transmission lines. This is a promising mechanism but delicate to implement. The build-own-operate-transfer model is of little interest since the electricity network operation has to remain centrally operated for technical reasons. The grid operator decides which sources get to produce electricity, so it must be an independent national load dispatch centre, to ensure all power producers are treated fairly in a competitive market. Moreover the power grid is a critical security infrastructure, so it has to be owned by national entities, at least for the high-voltage backbone lines. The pilot project built by the Trung Nam group in Ninh Thuan demonstrates the opportunities as well as the difficulties of private investment in power transmission infrastructure.

⁶Decision No. 26/2019/QĐ-TTg dated 15/8/2019

6. Financing the state-owned sector

Having exhausted the ways to mobilise private capital to finance the energy transition, the remaining needs must be met through public funding. State-owned enterprises operate the public investment to ensure the country's access to reliable and affordable energy. Companies finance growth through three methods: raising equity, emitting debt and reinvesting profits.

Each of these three funding sources have different limits and require different levels of remuneration. Equity and reinvested profits are the cheapest to access but the most limited. International loans are more expensive, and the private sector requires the highest rate of returns. The cost of debt depends on the credit rating of the borrower, which is a strong argument for avoiding the state-owned enterprises making losses.

- Equity means bringing new capital. In the early stages of economic development, the government could borrow to build infrastructure through its general state budget. Vietnam could receive official development assistance loans and grants at preferential rates from partner countries. This is no longer the case. The potential for Vietnam to borrow money from other states and from financial markets to finance the energy transition is limited, as the national debt level is at the maximum permissible level. The State is not looking to inject new capital in the public energy sector companies. On the contrary, the Commission for the Management of State Capital at Enterprises (CMSC) has a mandate to divest⁶, that is to sell the shares owned by the State.

- Non-sovereign debt is created when a state-owned enterprise borrows without guarantee from the State. EVN did this for the first time in 2022, borrowing EUR 80 million from the French development agency AFD to finance the Southern power distribution grid improvement in the South. Countries have been talking about climate finance for decades. The increasing urgency of the climate chaos may at last motivate an effective mechanism to help finance the energy transition in countries like Vietnam. But that remains to be seen.

Enterprises conducting projects in the energy sector, like all others, also use commercial debt subscribed by financial institutions. For example capital for the Thi Vai LNG terminal comes from USD 85.5 million equity investment from PetroVietnam; USD 80 million loan from three foreign banks HSBC (UK), Mega Bank and Taipei

Fubon Bank (Taiwan); and USD 81.2 million loan from two Vietnamese banks, Southeast Asia Commercial Joint Stock Bank and Vietnam Export Import Bank. Text box 1 explains the financing limits of national banks.

Enterprises investing in large energy transition projects, for example energy storage or transmission network expansion to connect renewable energy sources, can raise funds directly from capital markets by emitting green bonds. Bonds allow a company to get money from numerous investors, unlike loans. Compared to a stockholder, the bond holder does not own a share of the company. It has a different risk: the issuer promises to pay dividends known in advance, and pay the capital back after a number of years. One of its advantages for the issuer is that global capital markets are very deep, so a company

Monetary creation and banks' lending limits

Nowadays the government does not mint coins or issue banknotes to pay its construction companies. But when a state-owned enterprise borrows money from the central national bank, the economic mechanism is identical: the central national bank creates money.

This monetary creation also happens when a domestic private bank issues a loan. The bank can credit the borrower's account without having to go find the same money elsewhere. Unlike normal economic agents, it can lend money it does not have.

To limit the risk, banks must have at least 8% of the amount they loan in their own capital. If a bank has USD 1.5 billion of capital (e.g., Techcombank, one of the largest in Vietnam), it cannot have more than USD 18.75 billion of outstanding loans. This is at any time, across all economic sectors, so the capacity to issue new loans to any specific sector will be a few hundred million USD per year at best. Thus, private domestic banks are limited in the capacity to finance the energy transition, which requires billions of new capitals every year.

Can't the State Bank of Vietnam just finance the energy sector by buying paper emitted by EVN and Petrovietnam, green bonds for example? After all, many central banks have been printing money generously during the Covid-19 crisis. While they accommodated governments' spending to avoid an economic crisis in 2020 and 2021, most central banks are refocusing now on their main objective: to keep inflation low. This means less monetary creation.

can borrow larger amounts with bonds than with loans. One of the disadvantages for the bond buyers is that it is difficult to assess the risk level of the investment. An individual investor cannot see if the company mobilising money really uses it for sound business.

A bond is "green" when the company promises to use the money raised to finance projects that have a positive environmental impact. Socially and environmentally responsible investors prefer to buy green bonds than bonds which finance greenhouse gases emitting industries. This form of financing has been developing exponentially on the international scene since 2007. Green bond issuance in the world reached USD 620 billion in 2021, more than doubling from the previous year [25]. They are a key instrument of international climate finance.

Yet Vietnam banks issued only USD 216 million in green bonds over the last 5 years (op. cit.). The bond market in Vietnam is young: the Government issued its first long-term bonds in 2015, and the corporate bonds sector only started growing after 2018. Structuring a robust green bonds market is a clear and present opportunity for Vietnamese banks and the government [26 - 27].

- Capitalisation. Enterprises can reinvest profits, instead of distributing dividends as contribution into the state budget. For example, Petrovietnam might have been assigned to build and operate power plants mainly because they had the financial capacities, even if it is not their core purpose.

The State regulates energy prices in Vietnam. Keeping them low benefits the consumers. However at some point EVN may start losing money if it does not pass its full costs to the consumers. As Fitch Ratings [28] writes: EVN's standalone credit profile, however, is constrained by the limited record of Vietnam's cost pass-through regulatory framework. In the years to come, increasing retail energy tariffs seem necessary to help state owned enterprises to invest in the infrastructure for the energy transition.

Regarding investment in the grid infrastructure, Nguyen et al. [29] argued that the current transmission fee, which is VND 86.25/kWh⁷, was comparably low as it represented less than 5% of the electricity price, and would need to be gradually increased up to VND 168.79/kWh by 2025, in order to cover EVN investment needs in the national power transmission system.

⁷Decision No. 1769/QĐ-BCT dated 5/7/2020 updated by Decision No. 1052/QĐ-BCT

Capital costs to invest in grid expansion, backup capacity and flexible sources are only one of the reasons pushing up the costs of electricity. Costs of operations are also increasing with the share of imported fossil fuels in the electricity mix, higher prices of fossil fuels on international markets since 2021 and a general increase in the costs of labour and all other inputs.

Only one factor may decrease the average cost of electricity: competitive auctions to procure electricity from renewable sources. This may not be enough to avoid increasing the electricity retail tariff in Vietnam.

Progressive electricity tariffs are in place to protect the low-income consumers: households consuming less than 50 kWh per month pay VND 1,675/kWh. Bigger consumers pay higher rates, up to VND 2,927 for each kWh above 400 kWh in the month. Even if the average tariff increases, it is possible to increase the redistribution towards the poor by keeping the low tariffs unchanged, or even decreasing them.

Since 2003 the electricity tariff has been used as a tool to fight against inflation and protect consumers. The last time the price rose in 2019, after a two-years freeze, they went up by 8.36% from VND

1,720/kWh (UScent 7.4/kWh) to VND 1,864/kWh (UScent 8/kWh) exclusive of VAT.

Let us consider the implications of a one-cent rise in the average tariff. This represents a 12.5% increase, or VND 236/kWh. The increase is significantly more than a doubling of the previously discussed transmission fee. EVN sold 217 billion kWh in 2020, therefore the one-cent rise raises its revenue by 2.17 billion USD. This is not only enough to reinforce the grid; there is also money left over to invest in backup capacity and flexibility sources like battery storage, which the private sector in Vietnam finds difficult to fund under current market conditions.

According to MOIT, the average retail electricity price in Vietnam could rise to roughly 8.2 - 9.0 UScent/kWh by 2030 [1], and 10.2 - 10.5 UScent/kWh between 2021 and 2050 (in USD 2020). They would remain low compared to the competing countries [30], as Figure 3 shows. Furthermore, prices will increase in other countries as well. As a result, the proposed increase in Vietnam's electricity rates will not necessarily be detrimental to the country's macroeconomic competitiveness.

7. Conclusion

The power sector development since 2019 has shown that private investors are eager to finance new solar and wind projects. Market mechanisms like auctions, direct power purchase agreements, and self-consumption will set the conditions to maintain their engagement. But solar and wind resources aren't always there, so the power system needs to invest in backup capacity and flexibility solutions to ensure a steady supply. In addition to these capital needs, a growing power system needs investments in the transmission and distribution grid. We propose 5 suggestions to finance the development of the Vietnam power system in the coming years:

- Encourage the private sector to reduce electricity use by promoting energy efficiency (industry standards, appliance labelling), decentralised power generation (solar

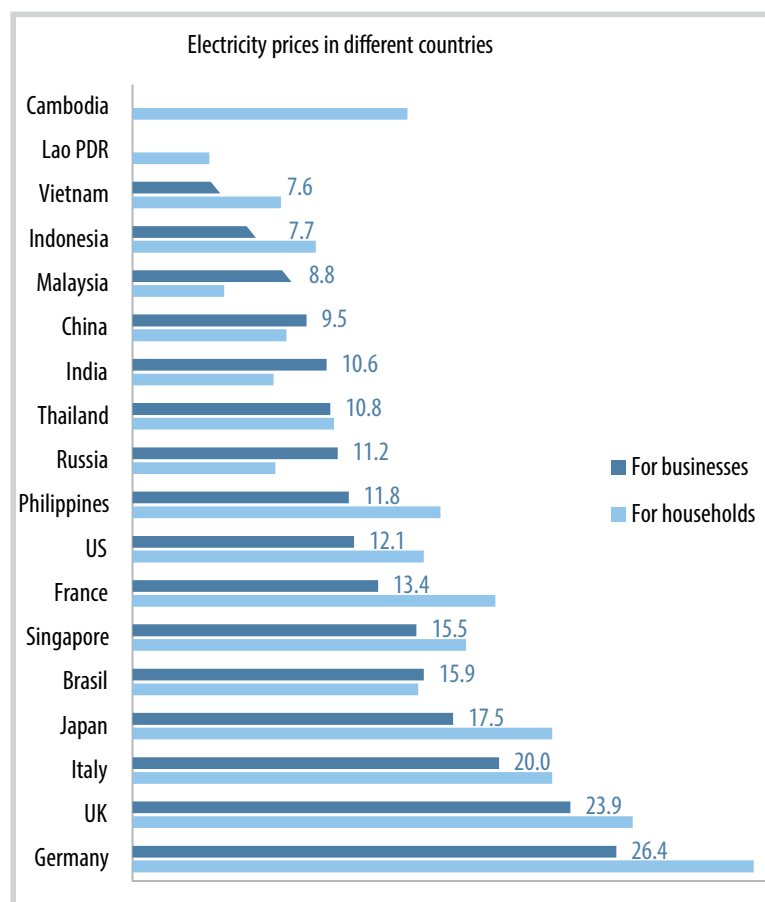


Figure 3. Prices of electricity in ASEAN and G8 countries. Vietnam has room to increase the tariff and remains competitive. Source: Author with data from globalpetrolprices.com.

rooftops with storage), and demand side management (smart meters, internet of things).

- When supporting private investment in renewable energy sources, prioritise projects in the region with the most unmet demand and available grid capacity to reduce system costs: the North.

- Promote the joint venture model for offshore wind: the offshore oil and gas industry must undergo a strategic reorientation to survive the energy transition. It has experience with leasing sea surface blocks and sharing earnings.

- Permit state-owned enterprises to acquire non-sovereign debt on financial markets to raise funds for long-term investments. Green bonds-based corporate finance is less expensive and more scalable than commercial debt-based project finance.

- Raise the retail price of electricity cautiously so that EVN can cover its generation costs and invest in the energy transition infrastructure. Take measures to lessen the burden on disadvantaged consumers and shift the energy bill to high-income households and the economic sector.

The 2022 global energy crisis is the fourth after 1973, 1979 and 2008. This time is different: electricity from solar and wind power generation capacities has become cheaper than electricity from equivalent coal- and gas-fired thermal capacity. Accounting for the social and environmental costs of greenhouse gas emissions further increases this differential. Energy storage is becoming affordable. Urgent decisions are needed to ensure investments in the power system sufficient and on track with the net-zero objective while preserving the nation's competitiveness and energy security.

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