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A study on financial mechanisms to develop the power system in Vietnam

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Abstract: Vietnam's commercial electricity demand grew by 9.6% per year during 2011-2020. MOIT forecasts that the average annual investment cost for the power system over 2021–2030 will be around 9.0–12.6 billion USD per year for generation sources and 1.5–1.6 billion USD for the grid. This article discusses the financial options to mobilize this capital. The private sector's appetite for 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*.

Keywords: *Energy transition; Policy; Finance; LNG; Markets*

JEL classification: *Q41, Q48*

1. Introduction

Vietnam's commercial electricity demand grew by 9.6% per year during 2011-2020 [1, Para. II.1.1.a page 5]. 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 for the central

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case. In absolute numbers, the national electricity consumption will increase from 215 TWh in 2020 to around 500 TWh in 2030 [1, Para. III.1.2 page 11].

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

MOIT estimated the average annual investment cost for the power system over 2021-2030 to be around 9.0-12.6 billion USD per year for generation sources and 1.5-1.6 billion USD for the grid [1, Para. III.2.5.a page 32]. For example, the Bac Ai pumped storage project, with the capacity to release 1 200 MW of flexible hydroelectricity, costs about 1 billion USD [2]. The investment for the Nhon Trach 3 and 4 LNG power plants, which provide 1 500 MW of dispatchable, LNG-based electricity, is about 1.4 billion USD. Renewable energy systems are even more upfront capital intensive than thermal power plants.

This article discusses the financial mechanisms to mobilize capital to develop Vietnam's power system in the coming years. Its outline is: Section 2 examines the literature on Vietnam's future energy scenarios, justifying the capital needs to expand the power system. Section 3 argues that real needs may diverge from these scenarios, as the ongoing fossil fuels prices crisis and the zero-carbon goal drive investment towards renewable electricity sources rather than thermal power plants. Section 4 discusses the mobilization of private capital for energy efficiency, and section 5 the mobilization of private capital for the power supply side. Section 6 discusses how to finance the public electricity sector, showcasing the limited role of capital-raising compared to the importance of green bonds and increasing the electricity price. Section 7 concludes with policy recommendations.

2. Existing scenarios of power system expansion

Resolution 55 [3] from February 2020 marked a turning point of the energy sector away from fossil fuels and towards renewable energy sources. At the 2021 United Nations Climate Change Conference (COP26), held in Glasgow, November 2021, Vietnam announced it adopts the target to become carbon-neutral by 2050 [4]. This requires to reform the socioeconomic development pathway and go much farther than Resolution 55. The change needed compares in scope with the economic reforms initiated in 1986 to turn towards a socialist-oriented market economy. The energy transition is a Đổi Mới 2.0 towards a circular economy. 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 [5]. Its first draft [6] was released prior to Vietnam's announcement at COP26. This draft follows the 2015 Renewable Energy Development Strategy and Resolution 55. It is constrained by the commitments already taken in the previous development plan, the revised PDP7. For example, authorizations given to thermal power projects are legally binding.

  The current PDP8 draft [1, App. II] 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 [7] caps the energy sector emissions (including electricity production, fuel, industry) to 457 MtCO2eq by 2030, a reduction by 32.6% compared to the business as usual scenario. In 2050, the energy sector should emit less than 101 MtCO2e. At that date, land use and forestry sector should absorb at least 185 MtCO2eq per year. The supporting technical study show that greenhouse gas emissions shall peak in 2035. It notes that a solar PV option is lower cost than using carbon capture and storage in the long run, but would require 500 thousand ha for installing fixed solar panels[2]. The climate change strategy recommends to consider nuclear and to research carbon capture and storage. It does not call for large scale investment in these technologies before 2030.

- The draft Vietnam Energy Masterplan [8] proposes a scenario where the total primary energy supply reaches 154 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,

2 According to General Statistics Office, Vietnam area is 33,134 thousand ha, of which 3, 931 thousand ha is non-agricultural land, 786 thousand ha is water surface land for fishing, and only 191 thousand ha is unused flat land. Online data for 31/12/2020, https://www.gso.gov.vn/en/px-web/?pxid=E0102, accessed 2022-10-20.

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 [9] 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 large majority of solar is utility-scale (838 GW installed in 2050). Floating PV and rooftop are subsidiary. For wind, 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, a variety of existing scenarios from other sources [10]–[15] explore at a variety of 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 receive little attention compared to 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 sensitive to price levels, but does not go as far as recommend policies to answer the prices level seen today.

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

In the mid 2021, a strong economic recovery after the Covid 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 shown 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 uncertainty are common. Within these predictability

limits, we argue that three forces are pushing the market prices to remain relatively high in the forthcoming three years : project development inertia, geopolitical uncertainty and climate policy.

- Project development inertia: The oil and gas industry uses large industrial facilities that takes 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 [16, p. 35] 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 crisis, crude oil prices rebounded to more than $100 per barrel during the strong recovery year 2021. Any hopes of a restoration to pre-crisis levels were crushed by the Russia-Ukraine war. Iran and Russia's oil and gas exports 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+ cartel, which has an incentive to keep prices high.
- Climate policy : From a physical perspective, no new fossil fuel infrastructure is admissible. The amount of carbon in fossil fuel reserves already in exploitation exceeds what is compatible with a 1.5 ◦C global warming [17]. 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 entreprises. As the IEA (op.cit.,

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

page 35) summarizes: "*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 45 USD/MMBTU as Figure 1 shows. IEA notes that markets expect this situation to persist during all 2023 [16, p. 70]. 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 15 USD/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 9 months of 2022, the general average consumer prices index was up only 2.73% in Vietnam compared to the same period in 2021 [18].

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 [1, Para. V.i page 36], 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 8 - 9 UScent/kWh, the input LNG price must be around 12 USD/MMBTU. If the LNG price is up to 40 - 50 USD/MMBTU, then the electricity selling price cannot be below 20 UScent/kWh [19]. While long-term supply contracts offer better conditions than the spot market, their prices have risen in 2022, especially for contracts starting before 2026 [20].

The first liquefied natural gas 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 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 7 UScent/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 2025.

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 [21]. The policy response to avoid power shortage was to install renewable energy sources. The case of the Vĩnh Tân power centre illustrates the story. It was initially planned with four thermal coal power plants projects. Only three were built. The Vĩnh Tân 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 projects[3]. The tariff was reduced three years later to UScent 7.09/kWh, except for rooftop solar power projects[4] 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 offshore[5].

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 kWh[6]. 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 the 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 2017-2018 the sector is mature in Vietnam, and the industry has made five years of technical progress. According to [22], « *the global weighted-average levelized 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 levelized 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 in 2017-2020. For example, bids from solar farm investors around 1.3 UScent/kWh have been seen at auctions in Abu Dhabi, in Portugal and in Chile.

Thus, evolution of the global economy since 2019 now makes it easier to attract investment for solar and wind farms than for thermal power plants. Mobilizing private capital to install renewable

3 Decision 11/QĐ-TTg dated 11/4/2017.

4 Decision 13/QĐ-TTg dated 6/4/2020.

5 Decision 39/QĐ-TTg dated 10/9/2018.

6 Decision 648/QĐ-BCT dated 20/3/2019.

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 a) sufficient transmission and distribution networks, b) backup capacities for the times when the renewable power sources are not available, and c) flexibility solutions to compensate for the short-term variability of solar and wind.

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

Limiting the increase in electricity consumption reduces the need to find fund 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 organizations, 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 realized 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, spread 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 organizations 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 the 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 synthesize 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 mobilization of billions of dollars each year. We're talking about new power lines and transformers, hydroelectric dams, interconnectors to neighboring 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 fully State-managed, 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.

The needs of an electric system operator are classified into three types: energy needs, capacity needs, and ancillary services needs. Deregulation tries to meet some of these demands through private firms motivated by market profits. The fundamental mechanism of markets is that prices realize 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 center 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 garanteed capable to restart without external power, in case of a blackout. Some facilities must regulate the frequency of the grid, finetuning their production to match the demand in real time. Other ancillary services include voltage control and maintaining ready an operating reserve in case another component of the system suddenly goes offline.
- In a *capacity* market, the producers are paid in advance proportionally to the maximum level of electric power they promise supply at a certain point in time in the future. If the system

operator determines the need to have 93 GW between 14h and 17h in the summer of 2030, it could pay companies to provide guarantees that the supply will be available.

Energy markets are the most straightforward of these three. Vietnam has 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 [23]. 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 are 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 two examples:

- Adding a two-hours 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 to the limits of markets. Many EVN or PetroVietnam projects use joint ventures to bring in outside equity and technical expertise. This allows 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. Partnerships cannot make a project profitable if the technical and economic conditions are not favourable. One can worry that the Son My project's financial close, which was expected for 2022 when the joint venture agreement was signed, appears now delayed into 2023.

More recently, the electricity law has been recently modified to allow for 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 has to 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 build by the Trung Nam group in Nhinh Thuan demonstrates the opportunities as well as the difficulties of private investment in power transmission infrastructure.

Nowadays the government does not mints coins or issues 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 a domestic private bank issue 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 actually have 8% of the amount they loan in their own capital. If a bank has 1.5 billion USD of capital (e.g. *Techcombank*, one of the largest in Vietnam), it cannot have more than 18.75 billion USD 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 capital 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 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.

Text 1: Monetary creation and banks lending limits

6. Financing the state-owned sector

Having exhausted the ways to mobilize 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 require 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.

a) Equity means bringing new capital. In the early stages of economic development, the State 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 divest[7], that is sell the shares owned by the State.

b) 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. 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 US$85.5 million equity investment from PetroVietnam; US$80 million loan from three foreign banks HSBC (UK), Mega Bank and Taipei Fubon Bank (Taiwan); and US$81.2 million loan from two Vietnamese banks, Southeast Asia Commercial Joint Stock Bank and Vietnam Export Import Bank. Text 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 stock holder, 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 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 mobilizing money will really use 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 is developing exponentially on the international scene since 2007. Green bond issuance in the world reached $620 billion in 2021, more than doubling from the previous year [24]. They are a key instrument of international climate finance.

Yet Vietnam banks issued only $216 million in green bonds over the last five years (op. cit.). Vietnam's bond market is young: the Government issued its first long-term bonds in 2015, and the

7 Quyết định 26/2019/QĐ-TTg ngày 15/08/2019

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 [25], [26].

c) Capitalization. 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 loosing money if does not pass its full costs to the consumers. As [27] 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 necessary for the energy transition.

Regarding investment in the grid infrastructure, Nguyen et al. [28] argued that the current transmission fee, which is 86.25 VND/kWh[8], was comparably low at it represented less than 5% of the electricity price, and would need to be gradually increased up to 168.79 VND/kWh by 2025, in order to cover EVN investment needs in the national power transmission system.

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 an 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 1675 VND/kWh. Bigger consumers pay higher rates, up to 2927 VND for each kWh above 400 kWh in the month. Even if the average tariff increases, it is possible to increase the redistribution towards to poor by keeping the low tariffs unchanged, or even decreasing them.

Since 2003 the electricity tariff have 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 1,720 VND / kWh (7.4 UScent/kWh) to 1,864 VND / kWh (8 UScent/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 236 VND/kWh. The increase is significantly more than a doubling of the previously

8 Quyết định 1769/QĐ-BCT ngày 5/7/2020 updated by Quyết định 1052/QĐ-BCT ngày 3/5/2022

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 and hydro 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 UScents/kWh by 2030 [1, Para. 2.5.b], and 10.2-10.5 UScents/kWh between 2021 and 2050 (in USD 2020). They would still remain low compared to the competing countries [29], 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 five 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), decentralized power generation (solar rooftops with storage), and demand side management (smart meters, internet of things).
- When supporting private investment in renewable energy sources, prioritize projects in the region with the most unmet demand and available grid capacity to reduce system costs: the North.
- Promote the Joint Venture business 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 are sufficient and on track with the net-zero objective while preserving the nation's competitiveness and energy security.

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