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Technical and Financial Report

Roadmap for the Commission for Management of State Capital toward Net-Zero Emission in Energy State-Owned Enterprises in Vietnam

November 2022

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This report has been prepared for ETP managed by the United Nations Office for Project Services (UNOPS), as part of the consultancy services titled: "ROADMAP FOR THE COMMISSION FOR MANAGEMENT OF STATE CAPITAL TOWARD NET-ZERO EMISSION IN ENERGY STATE-OWNED ENTERPRISES IN VIETNAM".

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Contents

List of Acronyms

CFPP	Coal-fired Power Plant
CMSC	Commission for Management of State Capital
ETP	Energy Transition Partnership
EVN	Vietnam Electricity
(EVN)GENCO	EVN's Power Generation Corporation
GHG	Greenhouse Gases
PDP8	Power Development Plan 8
PPA	Power Purchase Agreement
PVN	PetroVietnam or Vietnam Oil and Gas Group
SOE(s)	State-owned Enterprise(s)
VINACOMIN	Vietnam National Coal-Mineral Industries Holding Corporation Limited
BOT	Build – Operate – Transfer
IPP	Independent Power Producer
NLDC	National Load Dispatch Centre
SUB	Subcritical
SC	Supercritical
USC	Ultra Supercritical
PC	Pulverized coal
CFB	Circulating fluidized bed

List of figures

List of tables

Executive Summary

Prime Minister Pham Minh Chinh's announcement at COP26 in November 2021 on a Net-zero emission (NZE) target by 2050 has concretized Vietnam's commitment to climate protection. Being an emerging economy with greenhouse gas (GHG) emissions nearly doubled from 264 $MtCO_2$ in 2010[1] to 513 $MtCO_2eq$ in 2020[2], strong actions are required in all sectors to achieve such an ambitious goal. Energy is a key sector to focus on since it accounts for the largest part of GHG emissions in 2020, with 347.5 $MtCO_2$ (68% of total emissions), of which, the power sector emitted nearly 215 $MtCO_2e$ (42% of total emissions) [2]. Since the power sector is still fossil fuel dependent (coal accounted for 32.5% of installed capacity and 46% of generation, while oil and gas accounted for 11.6% and 11%, respectively), it is crucial for Vietnam to speed up decarbonizing the power sector toward the NZE target.

The three State-owned Enterprises – SOEs in Vietnam (Electricity of Vietnam - EVN, PetroVietnam - PVN and Vietnam National Coal - Mineral Industries Holding Corporation Limited - VINACOMIN) are playing a vital role in ensuring national energy security. They also own the majority of the coal power capacity (67% of ~25 GW of existing coal power installed capacity in 2021). Therefore, they are the key factors participating in the energy transition toward Vietnam's Net-zero target.

The Commission for State Capital Management (CMSC), in charge of managing the Vietnam government's capital in these back-bone SOEs, is cooperating with the Southeast Asian Energy Transition Partnership (ETP) to support and strengthen energy SOEs towards coal transition, better governance, profitable and sustainable business while facilitating a transparent and sustainable development of energy market and renewable energy, with the initial assignment on developing a "roadmap for the Commission for Management of State Capital toward net-zero emission in energy State-owned Enterprises in Vietnam" to:

- Study and propose a suitable Roadmap for CMSC supporting SOEs in coal-fired power plants transition to meet Net-Zero emission target while ensuring the energy security of the power supply;
- Identify the legal, financial and social conditions for SOEs to realise the roadmap;
- Evaluate the impact of roadmap implementation, including the associated costs to realise the roadmap; and

[1] MONRE 2020. Vietnam Third biennial updated report to the United Nations Framework Convention on Climate Change

[2] MONRE 2022. Technical report for Developing Nationa Strategy for Climate Change

- Propose recommendations to CMSC and SOEs (as well as key stakeholders in the decision-making process) to accelerate the roadmap implementation.

In this report, the Consultants (Vietnam Initiative for Energy Transition - VIETSE, Economica, NHQuang&Associate and Carbon Trust) provide the initial findings on the assessment of the technical, financial and legal aspects of the existing coal-fired power plants (CFPPs) in Vietnam under the three SOEs.

The analyses within this report are intended to be based on the outcomes of the mission conducted by the Consultants from 13 September to 11 October 2022. The Consultants had meetings with EVN, PVN and VINACOMIN, as well as 06 selected CFPPs of the three SOEs, including site visits to:

- introduce the assignment;
- discussion on the methodology and inputs for the study, which the Consultants expected to be acquired from the SOEs and CFPPs for the analyses; the data request template has been sent to the SOEs and CFPPs prior to the meetings;
- discussion on the current technical/financial/legal circumstances of the CFPPs;
- energy transition strategy of the SOEs and CFPPs;
- difficulties and needs for technical/financial assistance to implement an energy transition strategy.

The Consultants have received detailed data from VINACOMIN Power, a company with 100% capital owned by VINACOMIN, that owns or has the majority share of 6 CFPPs. However, by the time this report is written, the Consultants have not yet received the data for CFPPs of EVN and PVN. To fill in the gaps, the Consultants have been collecting data from other sources, for example, the published financial reports, auditor's reports of the joint stock companies which are made available to the public.

The main findings from the technical, financial and legal analysis of the existing CFPPs under SOEs management are summarised below:

- ***Technical***
    - The coal fleet of Vietnam is quite young, with 47 coal units (63%) being built within the last 10 years. However, most of Vietnam's CFPPs (28/35) is deploying the Subcritical technology because Vietnamese anthracite coal has low volatile matters, is difficult to ignite and is not easy to use in higher efficiency boilers that have Supercritical technology (7 plants). Some plants have high heat rates than average, exceeding 11,000 kJ/kWh (meaning they consume more coal to produce the same unit of electricity and emit more GHG).
    - Flexibility is crucial in assessing the operation capability of power plants in the system, especially when the share of renewables is increasing. Plants with high flexibility will have a higher ramp-up/ramp-down rate and lower startup time and

minimum load. A review of the flexibility parameters from several CFPPs shows that there is significant room for improvement in their flexible operation ability.

- With the increasing capacity of renewable energy in the system, CFPPs have slightly changed their operating regime from peaking the power generation during daytime to night time. Daily increases and decreases in generation capacity impact the heat rate and equipment lifetime. However, the peak generation at night time also provides a positive effect on the plants' efficiency as the cooling water temperature is lower than in day time.
- With the domestic coal production for power generation peaking and not sufficient for all CFPPs to run, the share of imported coal in total coal consumption increases, exposing the CFPPs that use imported coal or a mixture of domestic/imported coal to the price of the international coal market. The impact of the current global energy crisis leading to off-the-chart prices and supply shortage has put significant pressure on CFPPs operation and financial situation.
- The existing CFPPs have been invested in air pollutants control measures (Electrostatics Precipitator, DeNOx and DeSOx) and monitoring systems to send data to provincial Departments of Natural Resources and Environment. So far, they have met the national standards. However, many of the CFPPs are located in cities that are being upgraded in their urban categories, hence they will face stricter regulations. That will require additional investments, which (according to the plant owners) is not yet a mechanism for them to recover these investments through electricity selling as they are not able to pass the cost to the electricity selling price.
- Currently, coal-fired power plants in Vietnam do not apply CO_2 recovery technologies because of the low readiness of these technologies in Vietnam. These technologies in the world are currently in the research, development, and testing stage with very high investment costs, so they have not been considered for application in the next ten years. There is not yet a policy mandating the plants to deploy carbon removal technologies and the carbon market will not operate before 2028.

- ***Finance***
  - Financially, EVN, VINACONMIN and PVN (SOEs) own CFPPs in one of the following three manners: (i) owning and managing CFPPs in a direct manner: (ii) owning and managing CFPPs through a company owned 100% by the SOE; and (iii) owning and managing CFPPs through a company owned partially by the SOE. As such, the SOE's decision on the investment to implement energy transition projects are different from one case to another.
  - Unlike EVN, VINACOMIN and PVN have different sources of income other than from power generation. In 2021, the total revenue of EVN was billion 426,000 VND, earning the enterprise a gross profit of VND 38,000 billion. The lion share of the revenue is from power-related business. Meanwhile, VINACONMIN had a revenue of VND 113,173 billion and with a profit of 5,288 billion. Of the revenue, VND 73,508 billion are from coal exploitation, VND 17,496 billion from mining.

Power generation (mostly coal-fired) account for 11% of the revenue. In the case of PVN, the enterprise generated a total revenue of 620,000 billion in 2021 and a before tax profit of VND 45,000 billion. Of the total revenue of PVN, only VND 25,175 billion are from power geneation (mostly by PVPower).

- Though making profit in 2021, the financial health of the three SOEs are not stable. E.g. the profit of Vinacomin fluctuated widely between 2019-2021 with many of its subsidiary companes losing money.
- The importance of CFPPs to the business strategy and financial health of three SOEs. While the business strategy and financial health of EVN are much more dependent on CFPPs, it is less important as in the case of Vinaconmin and PVN.
- All the three SOEs were making profit in 2021. CFPPs under the three SOEs were making profit as well as they were all generating power under stable sale contracts.
- The three SOEs are also heavily indebted. For example, total debt (loan and lease liability) of EVN reached VND 351,000 billion in 2021. While total debt of PVN reached more than VND 90,000 billion, and Vinacomin VND 47,070 billion.
- Financially, the three SOEs can make contribution to the phase out or phase-down of CFPPs. However, they are unable to afford the full costs for the phase out or phase down of CFPPs. The funds available by the three SOEs are not available for such plans are early retirement of CFPPs. Besides, given the indebtness of the three SOEs, borrowing to finance the early retirement of CFPPs under the three SOEs do not seem to be the feasible solutions for them.

- ***Legal assessment***
  - *Ownership*: The CFPPs are under different types of ownership structures in which the SOEs are involved. Corresponding to each CFPPs ownership structure, SOEs will directly or indirectly (through their subsidiaries/affiliates) hold, in whole or in part, the decision-making power on phasing out/phasing down the CFPPs. Among the CFPPs, there are 12 CFPPs whose phase out/phase down are under the complete impact (100%) of the SOEs, either directly or through their subsidiaries/affiliates (EVN: 09 CFPPs; PVN: 03 CFPPs); 15 CFPPs are under joint stock companies and, depending on specific regulations of their charters, the decision-making authority will be delegated to different levels of internal management (GMS or the BOD) which affects the ability of SOEs to influence phasing out/phasing down decisions correspondingly; there is 01 CFPP where the SOEs (VINACOMIN) do not have control over the decision on phasing out/phasing down the CFPPs.
  - *Commercial input and output contracts*: The Consultants focus on assessing two (02) main contracts during the CFPPs' operation which are Power Purchase Agreement - PPA (output contract) and the coal supply contract (input contract). The PPA is executed pursuant to the model PPA stipulated by 03 circulars of the Ministry of Industry and Trade, while the coal supply contract does not have by-law model contract like the PPA. SOEs and their subsidiaries may have to proceed (i) bidding procedures and/or (ii) internal approvals prior to signing the commercial contracts.

Among other basic contractual terms and conditions i.e. term, price and breach remedies, the Consultants have found that both PPA and coal supply contract stipulate some cases of early termination whose applicability needs to be carefully assessed because the phase-down/phase-out procedures potentially affect/interrupt the obligation performance of a party and lead to the possibility of early contract termination.

- *Loan/capital agreement*: Currently, most of CFPPs are supposed to be in good conditions in term of loan facilities. The interview results show that most of long-term loan contracts financing for CFPPs are paid off and terminated. Outstanding short- and medium-terms loans are all secured and being paid off before the plan to cut work volume/close CFPPs from 2030 to 2050.
- *Labor*: During the survey, the Consultants found out that CFPPs fully complied with employees' rights and interests in accordance with labor laws through the promulgation and publication of their internal labor regulations. The grassroots trade unions at all CFPPs are established and operated in accordance with the Vietnam Trade Union's Charter to ensure legitimate rights and interests of employees.
- *Properties*: In the case of CFPPs implementing energy transition plans (immediate closure, phased closure, transition on a reduced path from current all coal burning to co-firing, or other fuels, or implementation of projects to reduce emissions…), issues related to assets need to be handled by SOEs in accordance with the law.
  (i) Regarding the land use right: When a CFPP terminates its operation, within 24 months from the date of the termination, the SOE who owns such CFPP is entitled to settle CFPP's assets attached to the land. The local government will take the land where such CFPP is located. The local government can give the land to the buyer who bought the CFPP's assets attached to the land under the new lease agreement.
  (ii) Regarding other assets: EVN, PVN and VINACOMIN have the right to transfer, sell, and liquidate assets that are damaged, technically outdated, poor quality, non-ultilized, or cannot be used to recover capital according to the principles of publicity, transparency and state capital preservation. In addition, these SOEs have the right to transfer assets including electricity system, materials and equipment directly serving electricity production and business which are belonging to such SOEs fully owned enterprises to serve its production and business or its restructuring plan which is decided by the Prime Minister.
- Industrial safety (power plant dismantling) and environment: When implementing energy transition options for CFPPs such as: energy transition towards sustainable development, building a roadmap to gradually reduce coal power, or promote the development of clean energy, SOEs will need to carry out administration procedures related to safety techniques and environment.
  (i) Land use: For the energy transition plan in the direction of promoting clean energy leading to changes in the structure and operation of CFPPs, land users must fulfill the obligations of environmental restoration, improvement, and remediation in accordance with the law.

(ii) Safety techniques and environment: In case the energy transition requires dismantling CFPPs, SOEs need to comply with the regulations on construction, working safety and health (OSH), environmental protection, regulations in Regulation QCVN 18:2021/BXD on safety in construction is issued together with Circular 16/2021/TT-BXD dated December 20, 2021.

- Handling of public assets when CFPP is dismantled in accordance with an energy transition plan: (i) if the CFPP is decided to downsizing which will cause a planning change, CFPP's assets may be withdrawn by the State; (ii) if the CFPP is decided to close, the assets may be withdrawn or transferred to other state designated organizations.

- ***Difficulties in building and implementing an energy transition strategy***
  - EVN and PVN have identified energy transition (ET) as an important topic and are in the process of developing their ET strategies. PVN is currently working with 2 consulting firms on ET and emissions reduction, while EVN is sourcing for one. However, at the moment, their progress is still pending for the National Energy Master Plan and Power Development Plan to be approved for more specific orientation to base their ET strategies on.
  - PVN expressed their interest in diversifying their fields of business to include renewable energy investment. However, PVN needs to have approval from Politburo to be able to invest in Renewable energy in general, and in offshore wind in particular.
  - For EVN, finance sources for investment in new power sources will be challenging, especially in meeting the power demand for the next five years.
  - VINACOMIN does not yet have a concrete plan to develop its ET strategy. Instead, the SOE consider the orientation in the Draft PDP8 on fuel conversion in CFPPs (cofiring coal with biomass or ammonia and gradually converting them to use purely clean fuel). They mentioned the difficulties in project assessment and pre-feasibility planning for the fuel transition solutions. VINACOMIN also expressed their concern about the transition's impact on people and communities that are relying on CFPPs and the coal sector as well as energy security.
  - At the CFPPs level, the relatively young coal fleet also implies a challenge for ET.

- ***Technical assistance needs:***

From the discussions with three SOEs and 06 plants, the Consultants have synthesized the following technical assistance needs mentioned by the SOEs and CFPPs as follows:

- Technical assistance to the SOEs (or to the one which show strongest interest) in: (i) formulation of a concrete feasiblity plan for the transition of their CFPPs with both technology, financing and legal options; (ii) Assist the SOE in reaching out to potential donors, exposing them to different technology options; (iii) Assist the SOE in working on one of their CFPPs as a role model/ demonstration case.

- Improvement of the energy efficiency in existing CFPPs. This TA is expected to help CFPPs in identifying a suitable set of measures to reduce their fuel consumption, hence GHG and air pollutant emissions, while not hampering the generation output.
- Conduct pre-feasibility projects for fuel switching at some specific CFPPs. This TA is expected to help SOEs in identifying suitable CFPPs for deploying fuel switch solutions and to develop a pre-feasibility study for such projects, including detailed techno-economic assessments of the fuel switch option, alternative fuel sources, fuel price and electricity selling price as well as related incentives to make it economically viable.
- Assessment of the impacts of future climate policies (i.e. carbon market, carbon tax…) on the SOEs' financial situation.
- CFPP's operators propose that there should be a mechanism to prioritise the power plants' operators to invest in renewable energy, especially in the North of Vietnam, to address the risk of power shortage in this region.

This list is the preliminary output from the mission with SOEs and CPPs; however, to have a more comprehensive list of technical assistance activities will be developed with close collaboration with CMSC. Next steps consist of (i) developping coal abatement scenarios and coal phasing-down roadmap with technical and financial implications for CFPPs under the SOEs' management; (ii) technical and financial solutions to fill in the gap left by phased-out CFPPs; (iii) detailed recommendations for the net-zero roadmap and (iv) recommended ETP's further technical assistance and capacity building for CMSC and SOEs to realise the identified coal abatement scenarios and coal phasing-down roadmap.

1. Overview of coal power plants in Vietnam

1.1. Coal power plants in the electricity system

Vietnam's coal-fired power plants (CFPPs) have had a continuous development process for 4 decades, along with the economic development of the country.

- Period before 1975

The first coal-fired power plant in Vietnam was the "Nhà đèn Vườn hoa", built by the French in February 1894 in Hai Phong City. Then, in the North and Central regions, small coal power plants had installed capacities of less than 10 MW and low steam parameters were constructed in turn.

By October 1954, the total installed capacity in the North was about 31.5 MW with an electricity output of about 53 million kWh/year. In order to meet the electricity demand, in the years 1955 - 1960, Vietnam started construction and put into operation a number of new coal-fired power plants with small and medium installed capacity, medium pressure steam parameters (pressure/ temperature to 3.43 MPa (35 bar)/435 degrees Celsius), using chain grate and blast furnace technology.

In 1961, with the help of the Soviet Union, Vietnam started the construction of Uong Bi CFPP become the main power plant source of the North. In addition, the Ninh Binh CFPP with a capacity of 100 MW supported by China, was also put into operation in 1974. In the South, by the end of 1974, there were a number of CFPPs operating with a total installed capacity of more than 250 MW, of which the largest scale is Thu Duc Thermal Power (165 MW).

- Period 1976 – 1990

After the country's unification, Vietnam began to implement the first general electricity development plan for the first period from 1981 to 1985. In order to overcome the serious imbalance of electricity supply and demand, the North focused on pushing forward. speed up the construction of Pha Lai 1 coal-fired power plant with 4 units (4x110 MW) and repair and upgrade other plants. Due to the addition and consolidation of power generation sources, in the period 1980 - 1990, the electricity generated by coal-fired power plants always accounted for about 40% of the total output of the entire power system.

- Period 1991 – 2010

During this period, Vietnam focused on strongly exploiting hydroelectricity. During the past 20 years, Vietnam has 5 thermal power plants put into commercial operation. Therefore, the electricity from the coal-fired power plants in this period only accounts for 10-16% of the total power mix of the country.

- Period from 2011 to 2020

According to the adjustment of the National Power Development Plan for the period 2011-2020

with a vision to 2030 (Adjusted Power Master Plan VII), by 2020, the total installed capacity of coal-fired power plants will be about 26,000 MW (accounting for 42.7% of the whole system's installed capacity), producing about 131 billion kWh (accounting for 49.3% of electricity output). Accordingly, from 2011, a series of large-capacity coal-fired power plants (600 - 1,200 MW) across the country were continuously put into operation. The power system is increasingly dependent on coal-fired power sources to ensure national energy security.

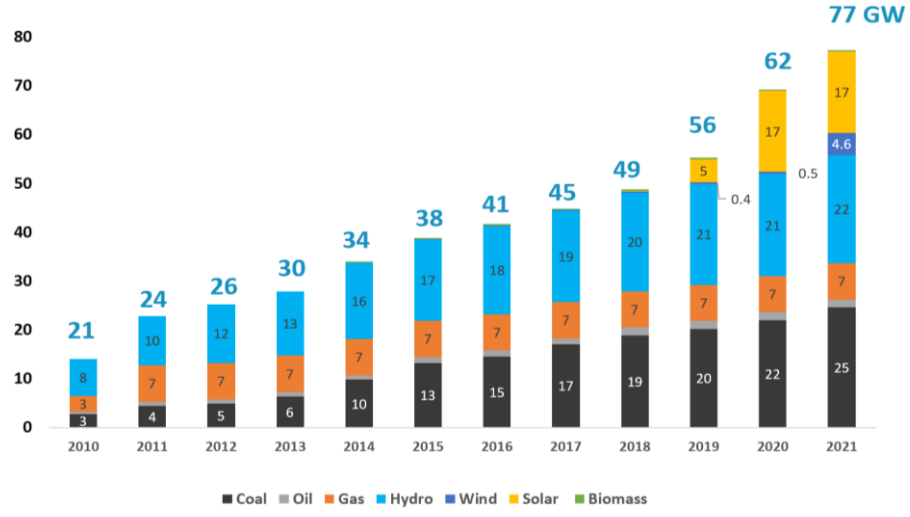
Along with the development in both the number of plants and the capacity scale, the technology of coal-fired power plants has been upgraded, allowing the operation of units to ensure high efficiency, safety, and economically. Many coal-fired power plants have been invested in spraying coal-fired technology with subcritical and supercritical steam parameters... Vietnam has also successfully applied a control and automation system for coal power plants.

In particular, coal-fired thermal power plants are invested in modern and highly efficient environmental treatment technology, such as ESP systems to filter electrostatic dust, and remove SO_x, NO_x..., meeting regulations according to Vietnam's environmental standards. The issue of environmental protection during the operation of coal power plants in Vietnam is concerned and implemented effectively.

By the end of 2021, the total installed capacity of coal power has reached about 24.6 GW, accounting for 32% of total system capacity (Figure 1). Coal power generation accounted for 46% of total output in 2021 with more than 118 TWh (Figure 2)[3].

In the last decade, the power system's capacity growth was mostly from coal power, the conventional generation technology utilising domestic fossil fuel resources. This has helped Vietnam to solve the power supply issue for development when economic growth has maintained at a high rate, accompanied by increasing electricity demand at the average rate of more than 11%/year in a 10-year period until before the Covid-19 pandemic.

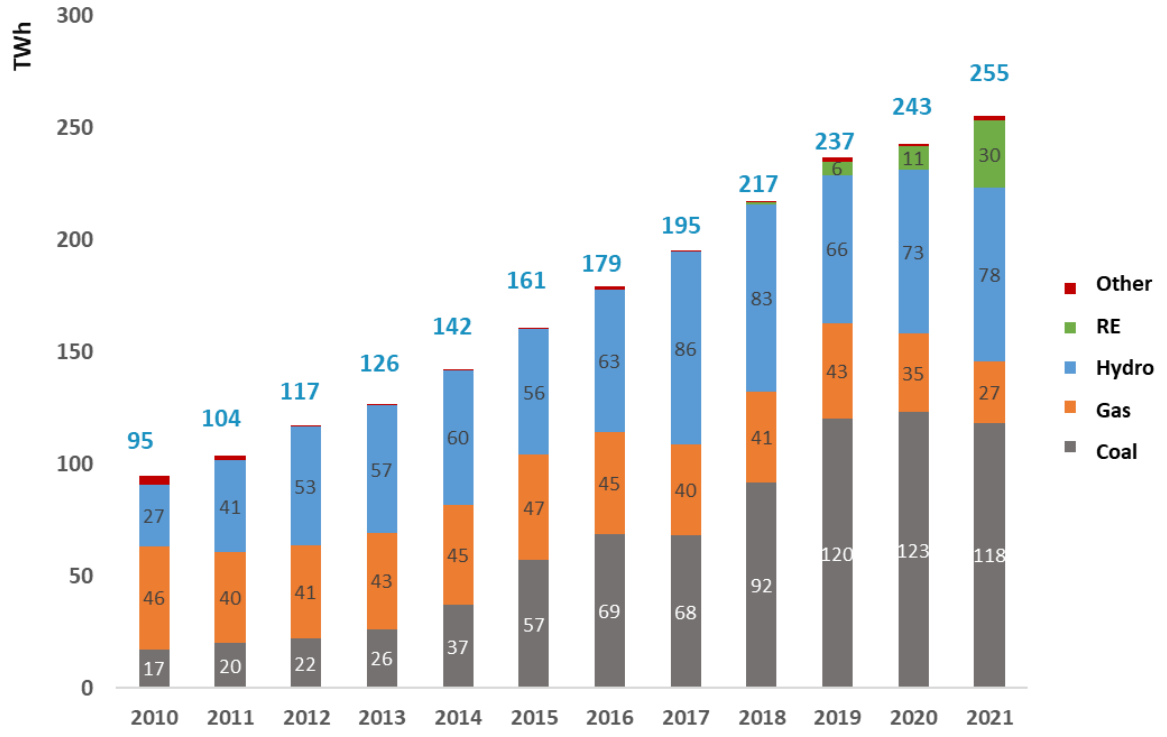
Figure 1: Installed capacity (in GW) by sources in 2010 – 2021



Source: VIET plotted based on data from EVN/NLDC

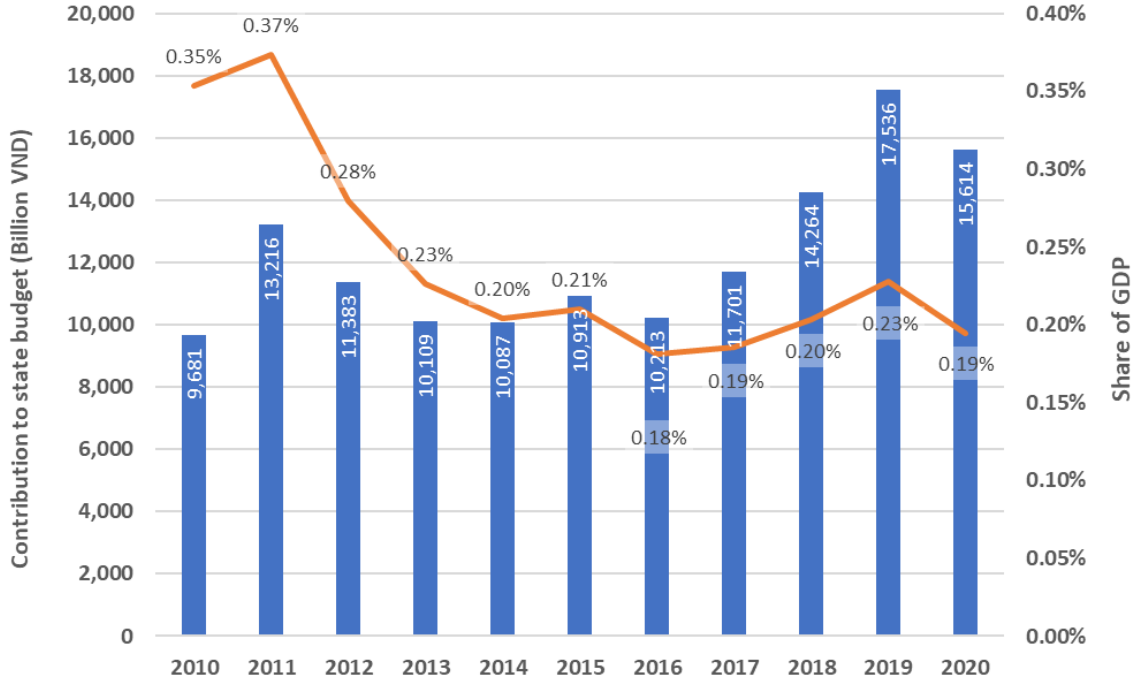
[3] 2021 Operational Report, EVN/NLDC

Figure 2: Contribution of coal power to total electricity output 2010 – 2021



Source: VIET plotted based on data from EVN/NLDC

Figure 3: Contribution of coal sector into State Budget



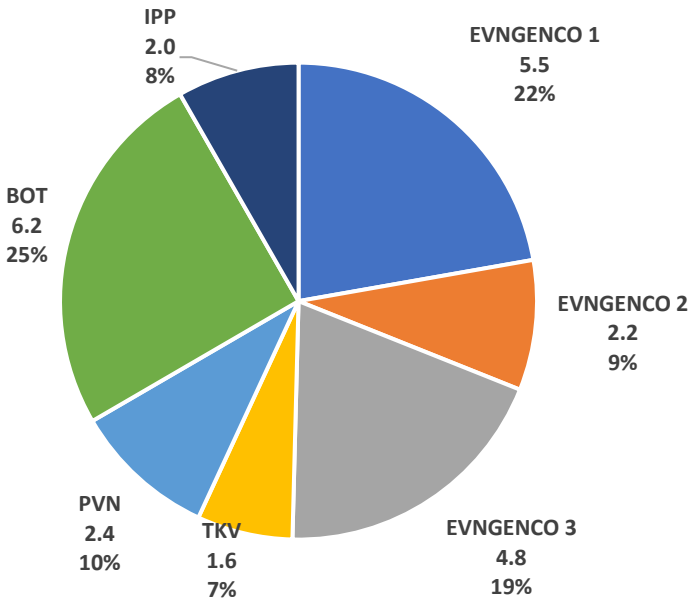
Source: VIET plotted based on data of Document 3665/TKV-KHSH-KCL dated 31/07/2020, Vinacomin

1.2. Ownership and management

The majority of coal power plants belong to the ownership of State-owned Enterprises (SOEs), including Vietnam Electricity (EVN), PetroVietnam (PVN), and Vietnam National Coal-Mineral Industries Holding Corporation Limited (TKV), as shown in Figure 4. Plants under Build – Operate – Transfer (BOT) contract or Independent Power Producer (IPP) account for 25% and 8%, respectively. Coal power plants under EVN's Power Generation Corporation (EVNGENCOs) are managed by the member power companies. These companies are in charge of the operation, management, and market participation matters.

By 2021, most coal power plants (22/35 power plants) participated directly in the competitive wholesale market, accounting for 65% of total installed capacity (Figure 5). The BOT power plants and plants in industrial parks participate indirectly in the competitive market. Ninh Binh Coal Power Plant participates as an auxiliary service provider. The plants directly participate through bidding on the generation price, based on which the power system and market operator (National Load Dispatch Center – NLDC) mobilise these plants in the order prioritised by price. The BOT plants signed Power Purchase Agreement (PPA) with EVN which has fixed and variable components. EVN pays them based on the electricity outputs as stipulated by the PPA's terms. After that, EVN sells these electricity outputs to the buyer in the spot market (hence, the power plants participate in the market indirectly). The power plants in industrial parks (Formosa Dong Nai, Formosa Ha Tinh, Vedan Vietnam) also participate in this format.

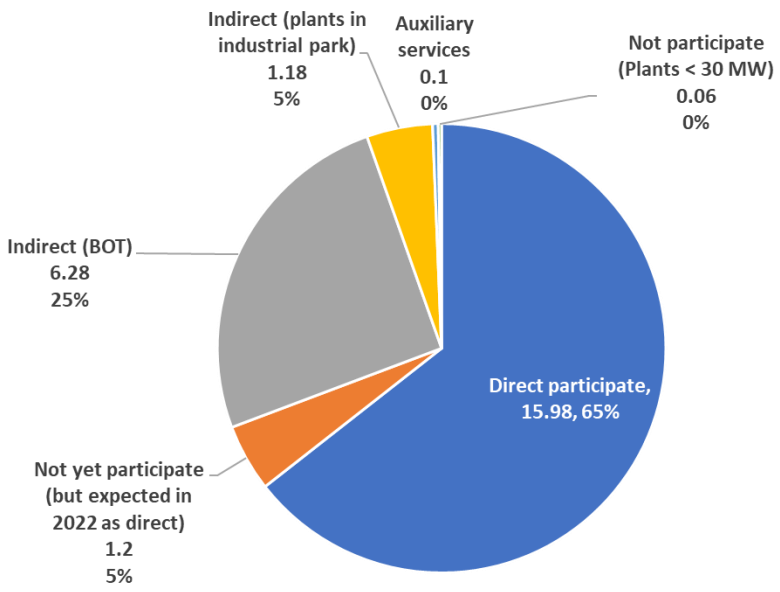
Figure 4: Coal power capacity in 2021 by ownership



Source: VIET plotted based on data from EVN/NLDC

Figure 5: Coal power plants' participation in competitive power market in 2021

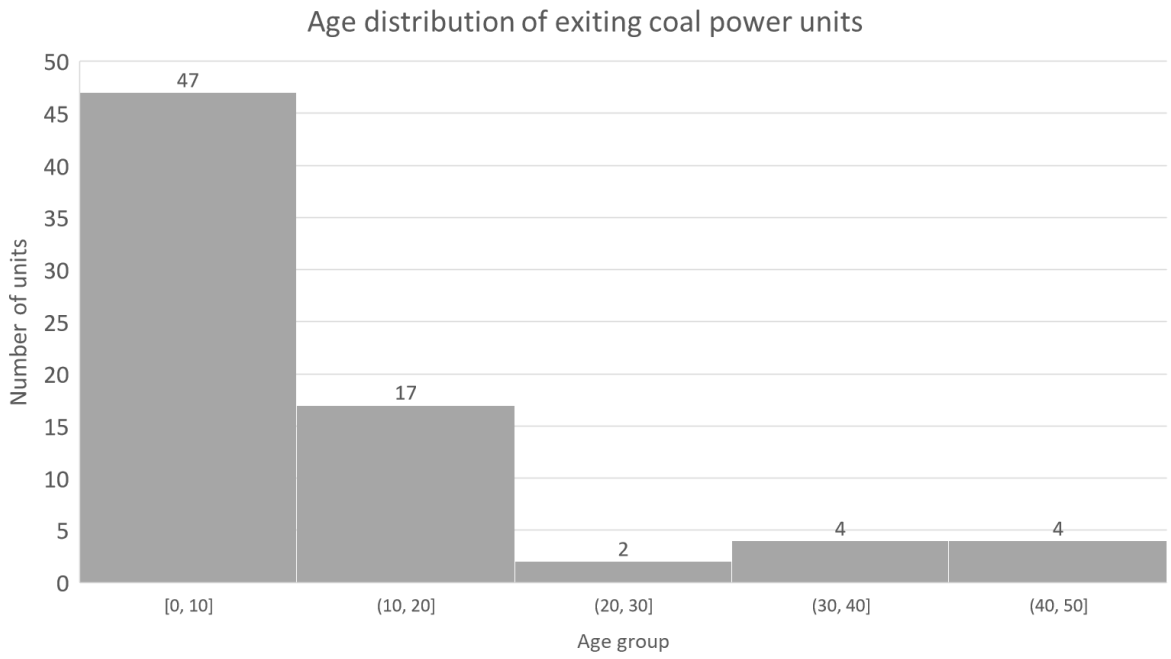
Total capacity 24.7 GW



Source: VIET plotted based on data from EVN/NLDC

The coal fleet in Vietnam is quite young, where most of coal units has been built in the last 10 years. Only 10 units are older than 20 years.

Figure 6: Coal power plants' participation in competitive power market in 2021



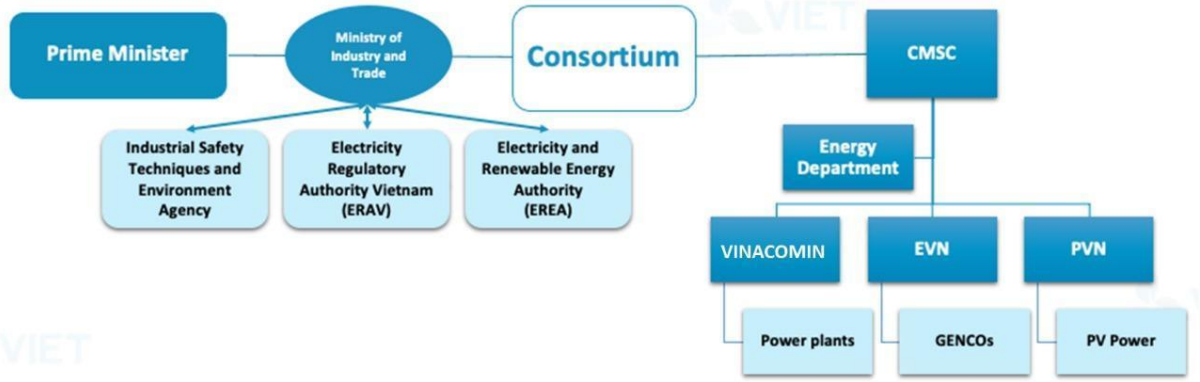
Source: VIET analysed

1.3. Key actors in coal power sector in Vietnam

Historically, the coal industry has brought many economic benefits to the country, so it has been defined as one of the main strengths of the economy. Therefore, a key aspect of any coal abatement planning will have to include changing the image of the role of coal-fired power plants as a necessary pillar for Vietnam's high-growth future.

Phasing out/down coal power plants is not only contained within the power system but also needs to be considered from the social well-being, and jobs aspects as such transition will directly affect people and communities that are benefited from coal activities. Therefore, the issue of the coal phase down/out roadmap should be exchanged and discussed among business levels such as CMSC, EVN/PVN/VINACOMIN, GENCOs, CFPPs, and various decision-making levels. A map of the Outreach strategy is shown in Figure 7. The stakeholders are described below.

Figure 7: Outreach strategy for coal transition roadmap



- **Ministry of Industry and Trade** (**MOIT**) plays the most important role at the state level regarding policies, support mechanisms for power plant in terms of development, decommissioning safety and environment, grid planning and investment, quality control.
- **Electricity and Renewable Energy Authority (EREA)** is a MoIT-managed agency that performs advisory functions, assists MoIT in the implementation of state management tasks in relation to electricity, new energy, and renewable energy.
- **Electricity Regulatory Authority of Viet Nam (ERAV)** is a MoIT-managed agency (same level as EREA). It monitors the operation of the power sector, ensures power supply security, works out price mechanisms, grants operating licenses for power projects, assists in the development of standards and certifies energy-saving products
- **Industrial Safety Techniques and Environment Agency (ATMT)** is lead responsibility for, and coordinate with ministries, branches, and localities in, managing environmental issues in coal power plants and implementing activities to respond to climate change within the scope of the ministry's state management.

- **Commission for the Management of State Capital at Enterprises (CMSC)** is designated by the Government to exercise rights and take on duties as the owner's representative to wholly state-owned enterprises such as EVN, PVN, VINACOMIN and their subsidiaries. Play the leading role and collaborate with the Ministry of Planning and Investment, the Ministry of Finance, and relevant authorities in requesting the Prime Minister to give approval for master plans for restructuring of enterprises of which CMSC acts as the owner's representative.
- **Vietnam Electricity** (**EVN)** was formed in 1995 as a vertically integrated, state-owned corporation responsible for Vietnam's power subsector. In mid-2006, EVN became a holding group. EVN is still the main actor in the power subsector with wholly owned subsidiaries: three power generation corporations (GENCOs); the National Power Transmission Corporation (NPT) responsible for power transmission; and the five-power corporation (Hanoi Power Corporation, Northern Power Corporation, Central Power Corporation, Southern Power Corporation, and Ho Chi Minh City Power Corporation) responsible for power distribution. EVN owns the National Load Dispatch Center, which serves as the system and market operator (SMO). It also owns strategic power plants, including multipurpose hydropower plants (HPPs), the Electric Power Trading Company (EPTC). It is the majority shareholder of partially privatized power plants in the Vietnam Competitive Generation Market (VCGM).
- **Power Generation Corporation (GENCO)'s** essential role in ownership, investment funding in the electricity market; There are three Power Generation Corporations companies (GENCO 1,2,3). They play an extremely important role in the country's socio-economic development and national security. EVN owns 100% capital in these big power generation corporation companies. The Power Generation Corporation 3 (GENCO 3) started to equitize in the year 2017 and GENCO 1 and 2 in 2018. The GENCOs will continue to participate in the competitive wholesale power market after their equitization.
- **Vietnam Oil and Gas Group (PetroVietnam or PVN)** is a state-owned corporation established in 1975. PetroVietnam is engaged in the energy sector, including oil and gas and renewable energy. PetroVietnam has been growing into a fully integrated business model, ranging from exploration - production, refinery – petrochemical, gas industry, gas to power/fertilizer and petroleum technical services.
- **Vietnam National Coal-Mineral Industries Holding Corporation Limited (VINACOMIN)** is a state-owned corporation established in 1994. VINACOMIN exercising rights and obligations of owners of capital shares in subsidiaries and affiliated companies in proportion to its investment capital in these enterprises. VINACOMIN is assigned by the State to perform the function of managing the mineral resources of coal, bauxite, copper, iron, gold, silver, tin, zinc and other minerals according to the provisions of law. VINACOMIN is assigned by the State to manage and use coal, bauxite and other mineral reserves in accordance with law; state capital invested in VINACOMIN; a number of infrastructure works of inter-mine and inter-regional nature.

1.4. Challenges for the coal power sector

The development of Vietnam's Power system from 2010 to 2018 was primarily based on coal power expansion, with 16.2 GW added in the period. However, with the global trend of the energy transition, the country's orientation on coal development in the following decades has been significantly adjusted. The strong commitment of Vietnam at COP26 will have a substantial impact on the coal power sector. In addition to the announcement on Net-Zero by 2050, Vietnam has signed the Global Coal to Clean Power Transition Statement, in which the signatories commit to cease unabated coal power generation by 2040, cease permit issuance for unabated coal power projects that do not have finance close.

Coal power development in the future will face many challenges from capital mobilisation, acceptance of local authorities and people, and technical issues. Especially under the context of increasing pressure on climate change and sustainable development, the perception of the role of coal in the power system is transforming drastically. The urge to reduce greenhouse gas globally is particularly clear for the power sector as the largest contributor to emissions. Many international organisations and financial institutions have announced their statements on no longer sponsoring new coal power plants[4]. The difficulty of coal power development is also reflected in the latest draft of Power Development Plan 8 (PDP8) (Letter 6328/TTr-BCT of MOIT dated 13 October 2022).

The draft PDP8 was revised with the overall objective to have cease coal power generation in the power system by 2050. In the recommended High scenario for execution, **there is a substantial decline in coal** capacity compared to the Draft PDP8 in March 2021 (before COP26) with ~13.3 GW less of by 2030 and 20.1 GW less by 2045. More specifically, in 2030, coal power is expected to account for 20.5% of total installed capacity (30.12 GW vs 146.5 GW). Coal capacity is only added to the system from 2022 until 2025 with about 4.73 GW. No more coal power is added after 2030 (Figure 8), reducing the share of coal in total capacity to only 0.9% by 2045. According to the Draft, there are 12 coal power plant projects (13.8 GW) were assigned to investors:

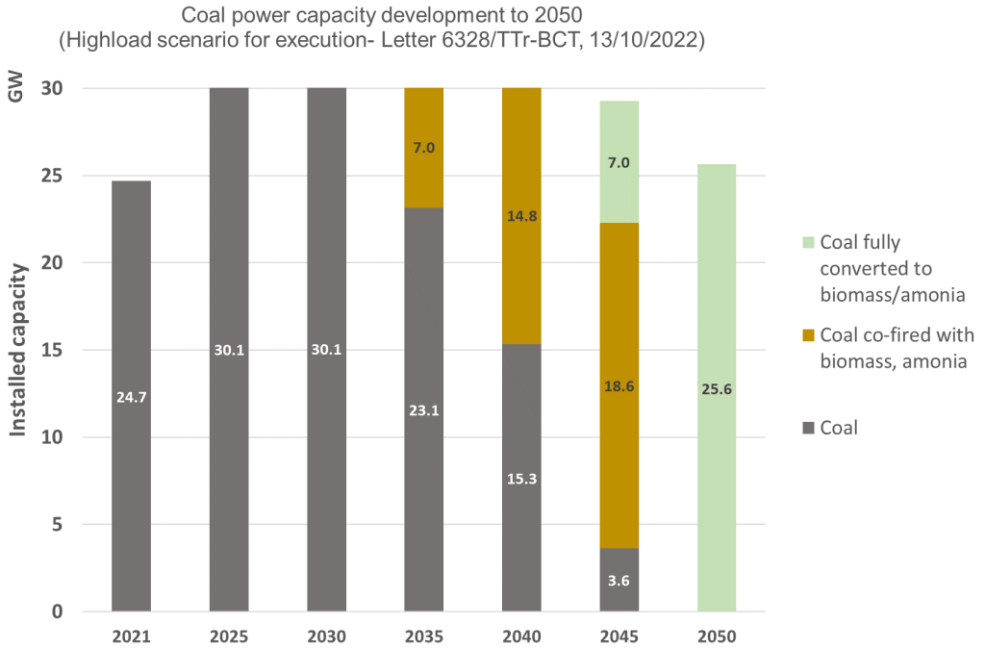
- 7 projects (7GW): including 04 projects are in construction (Thai Binh II, Quang Trach I, Van Phong I, Vung Ang II), in negotiation to continue implementing (Long Phu I), or already arranged finance from domestic loan (An Khanh Bac Giang and Na Duong II)
- 5 projects (6.8 GW) in preparation for investment but facing difficulty in finance arrangement:
    - Cong Thanh (0.6 GW): impossible to arrange financial resources. It's proposed to switch to LNG power plants with a capacity of 1500 MW.
    - Quang Tri I (1.2 GW): project stopped.

[4] IEEFA, "Over 100 Global Financial Institutions Are Exiting Coal, With More to Come." Feb. 2019.

- Song Hau II (2 GW): the investor (Toyo Ink Group Berhad - Malaysia) could not arrange the investment as committed in the BOT contract (before 24/6/2022).
- Nam Dinh I (1.2 GW): uncompleted negotiation for BOT contract, Government guarantee, PPA.
- Vinh Tan III (1.8 GW): impossible to get loan since Mitsubishi and CLP decided not to invest into CFPP.

The coal power project pipeline for 2022 - 2030 in the draft PDP8 includes 7 projects mentioned above, of which, only one unit of Vung Ang II (665 MW) is planned to operate in the 2025 - 2030 period. The other 5 projects, which were already listed in the PDP7 revised, are assessed by MOIT as very unlikely to be continued. The coal fired power plants are expected to gradually deploy co-firing technology with biomass/amonia starting from 2035 and completely switching to biomass/amonia power plants from 2050. The cofiring with biomass/amonia will be applied in the CFPPs more than 20 years old, with an initial mixing rate of 20% and gradually increasing to 100% of biomass. The total emission from this new power mix is expected to reach its maximum value in 2035 at 239 Mt, then decrease to 120 Mt in 2045 and 30 Mt in 2050, respecting the Vietnamese commitment at COP26. The fuel switching is the main strategy in the draft PDP8 to gradually phase out power generation from coal. This trajectory, however, needs further assessment to evaluate techno-economic feasibility, including the supply of alternative fuels to co-fire in such a large scale. Especially when green ammonia (produced by renewable energy sources) is required for decarbonizing the coal power sector.

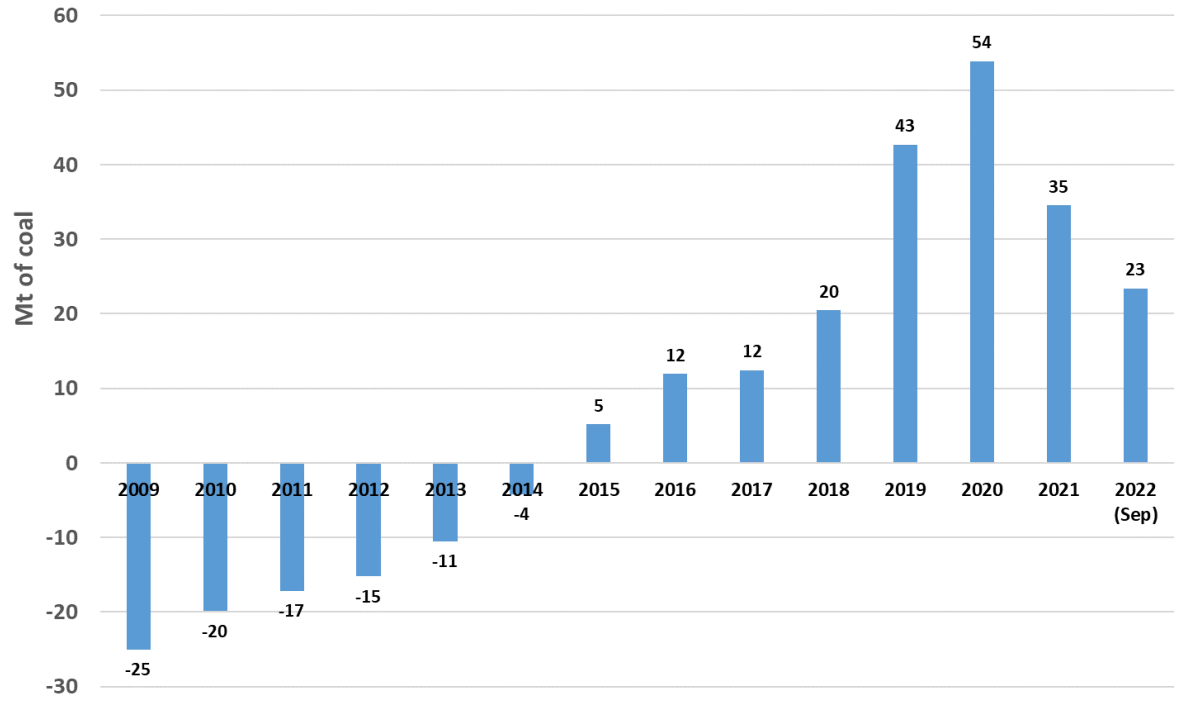
Figure 8: Status of Coal power planning in Vietnam



Source: VIETSE plotted based on Draft PDP8, Oct 2022

Operation of coal power plants is also facing challenges. First of all is the stability of coal supply. Vietnam has turned from net coal exporter to net coal importer since 2015 and the amount of coal import increasing rapidly, reaching as high as 54 Mt in 2020[5] (higher than domestic coal production that year at 44.6 Mt)[6].

Figure 9: Vietnam Net's Coal Import



Source: Custom of Vietnam (customs.gov.vn)

The world is going through an energy crisis with coal and natural gas prices soaring above the long-historical price range. This has a substantial impact on Vietnam's energy sector. The increase in coal import dependency makes the power sector more exposed to the international fuel market volatility and poses negative impacts on the national trade balance. In March 2022, MOIT has sent a document to VINACOMIN and Dong Bac Company (an enterprise under Ministry of Defence) to address the urgent issue of coal shortage for power generation[7]. In the August press release, EVN has stated that "*due to the sudden increase in the price of input fuels for power production (such*

[5] Custom of Vietnam, 2022

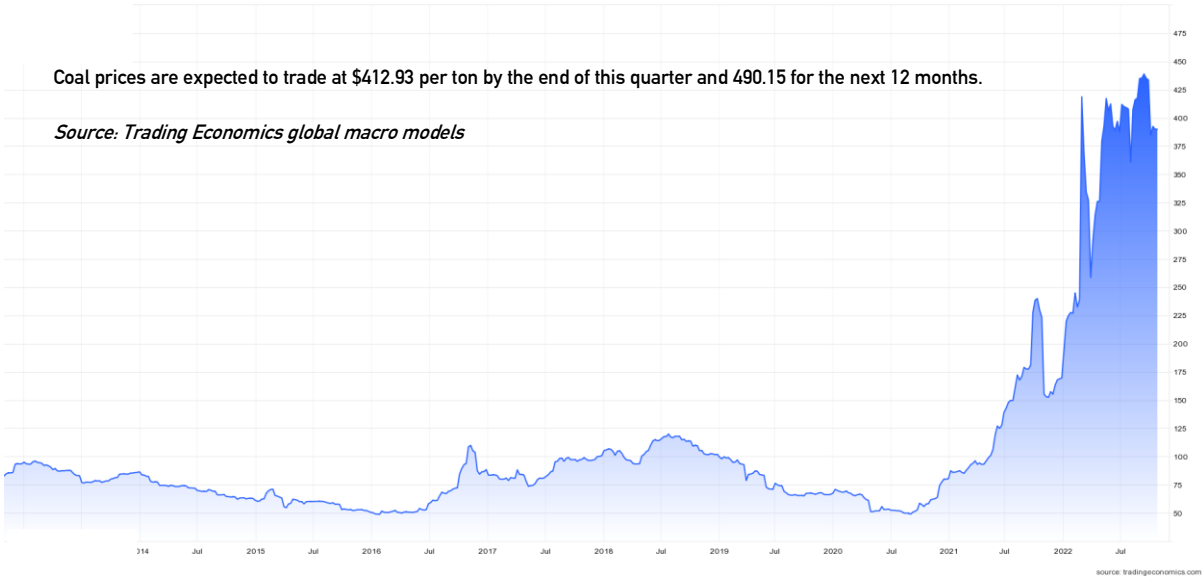
[6] Main industrial products, GSO, 2022

[7] Nguy cơ thiếu than cho sản xuất điện, Bộ Công Thương chỉ đạo khẩn, EVN, 2022

https://www.evn.com.vn/d6/news/Nguy-co-thieu-than-cho-san-xuat-dien-Bo-Cong-Thuong-chi-dao-khan-6-12-30189.aspx

as coal, oil, gas) since the beginning of the year, EVN's power production costs have increased very high, leading to many financial difficulties"[8].

Figure 10: Price of coal from 1985 – 2021



International experiences show that the rapid development of renewable energy such as wind and solar will influence coal power plants' operation regime. For example, the average operation time of coal power plants in the United States declined from about 6500 h/year in 2007 to 4700 h in 2018[9]. The working regime of coal power plants would be altered significantly, which affects the heat rate and equipment lifetime. The essential requirement is for coal power plants to increase their flexibility to adapt to the new operating regime.

The socio-economic development in each province will require improvement or increasing requirements for environmental quality. Along with that are the requirements for upgrading and renovating environmental treatment equipment and technology for coal-fired power plants. Existing environmental challenges such as requirements for handling mercury components in exhaust gases according to the United Nations Convention and constraints on the temperature of cooling water discharged into the environment are not allowing the use of SO_x treatment technology with seawater. The requirements for water environmental protection may lead to a change in technological solutions for coal-fired power plants, such as from direct cooling to tower cooling, which will reduce energy efficiency due to reduced heat exchange efficiency. Banning the

[8] Operation situation in August and work goals and tasks for September 2022, EVN, 2022 https://en.evn.com.vn/d6/news/Operation-situation-in-August-and-work-goals-and-tasks-for-September-2022-66-142-3067.aspx

[9] Graeter P, Schwartz S. Recent Changes to U.S. Coal Plant Operations and Current Compensation Practices. National Association of Regulatory Utility Commissioners; 2020.

use of seawater for SO_x treatment in flue gas will need additional investment for limestone-based SO_x removal systems and costs such as raw material costs, operating costs, and gypsum treatment costs. Especially with the climate commitments, there will be additional requirements on CO_2 removal, capture and storage during operation or early retirement of some plants.

Furthermore, the roadmap to develop a domestic carbon market in Vietnam has been issued in the Decree 06/2022/ND-CP in January 2022. According to the Degree, thermal power plants that consume more than 1000 TOE/year (which means all coal power plants) will have to conduct greenhouse gas (GHG) inventory and will be allocated GHG emissions allowances to comply with. The domestic carbon market is expected to be operating in 2028. To comply with the allocated emissions allowance, which is normally designed to gradually decrease over time, coal power plants will have to either invest in GHG emissions reduction measures or to buy more allowances/carbon credits or pay the fine. All options lead to increasing operation costs that pose a financial stress to the plants.

1.5. Future of coal power sector in the new context

The urgency of climate protection will require new directions for the coal power industry to ensure a balance between the three main pillars of sustainable development, which are socio-economic and environmental. Many studies have shown that decommissioning low-efficiency coal-fired power plants ahead of schedule, combined with increased efficiency and flexible operation of the units by renovating equipment and improving operation and maintenance, will be essential to achieving these goals[9].

Increase efficiency and flexibility of coal power plants

High efficiency will help reduce input fuel consumption (coal, oil) and reduce emissions per unit of electricity produced. For proven technologies such as PC and CFB, future trends will be to improve combustion efficiency, including reducing losses due to incomplete combustion (especially mechanical incomplete combustion), reducing heat loss to the environment, and taking advantage of the heat source from ash slag. For improving combustion efficiency, coal-fired boilers will need to improve and develop combustion devices such as nozzles, combustion chambers, optimize aerodynamics in the fire chamber, etc. to reduce the incomplete combustion of carbon in the fuel as low as possible while ensuring control of slag build-up in the incinerator. Advanced material technology, design, and operation to prolong the life of equipment, contributing to increasing the operational flexibility of the plant. In addition, it is possible to consider applying new technologies such as burning oxygen-rich fuels, co-firing biomass with coal, and CO_2 recovery measures when technical and economic conditions allow further reducing emissions from thermal power plants.

In the context of high renewable energy share, increasing the flexible operation of coal-fired power plants is a solution that helps stabilize the system. It can help these plants to revenue from the provision of ancillary services. Coal power plants can provide operational flexibility for the power

system by adjusting the generating capacity within 15 minutes, even 5 minutes, if properly renovated. There are many technical options to increase the ramp-up/ramp-down rate, reduce minimum load, and reduce the startup time of coal-fired power plants. Some solutions are optimizing control systems, upgrading/replacing some equipment, storing heat energy to initially heat the water, reducing the wall thickness of some components, etc[10]. The flexible operation does not affect plant performance, but it does stress the components, leading to reduced lifespan.

Develop a roadmap for the transition of coal power plants

Many countries have been implementing solutions to reduce coal-fired power in line with international commitments and ensure an efficient and equitable transition for all stakeholders, especially the workforce in this industry. For example, the United Kingdom has a policy to support coal-fired power plants to move when they are no longer efficient, end of their technical lifetime, or have to be upgraded to meet more stringent environmental standards. Alternative development directions often chosen by factory owners include converting the plant to a combined cycle gas turbine system, garbage power unit, storage battery, etc., to provide flexibility, or switching to biomass in a few cases[11]. The United Kingdom has succeeded in reducing the share of coal power in total electricity production to 2% in 2019 from 40% in 2009. Germany has legislated a specific roadmap to phase out coal power plants by 2038. The law requires compensating companies to close their coal power plants in regions where coal has significant economic impacts. The industry uses a lot of electricity due to the forecast that electricity prices will increase when coal power plants stop operating. The German government has had success in applying an auction mechanism for the early closure of hard coal-fired power plants. The establishment and operation of the Coal Commission, made up of representatives of key stakeholders (parliament, government, locality, business, industry, energy, environmental associations, and trade unions) to ensure a fair transition is appreciated[12].

Many international financial institutions are also establishing funding mechanisms for the transition of coal power plants. The Asian Development Bank (ADB) recently promoted the transition mechanism of high-emission coal power plants (ETM) in Southeast Asia. They proposed a technical assistance program worth $4.05 million, launched in April 2021, which funds four solutions based on the country and industry assessments, technical research to identify new business models, additional policy dialogues and training, and develop a portfolio of investment projects financed by ADB. This mechanism allows the mobilization of public and private capital sources to support coal-fired power plants to stop operating ahead of schedule and switch to other uses. This is considered a potential market mechanism when coal power project investors

[10] Agora Energiewende. Flexibility in thermal power plants - With a focus on existing coal-fired power plants. Agora Energiewende; 2017

[11] Littlecott C, Burrows L, Skillings S. Insights from the UK coal phase out experience. 2018.

[12] Agora Energiewende. The German Coal Commission: A roadmap for a Just Transition from Coal to Renewables. Agora Energiewende; 2019

face the risk of stranded assets[13]. However, more detailed assessments are needed to apply this mechanism in the context of the complex realities of Southeast Asian power markets, as these decisions will affect many related parties within the next 30 years.

The ADB's Energy Transition Mechanism (ETM) has just launched on 14 November 2022 its first deal for the early retirement of a 12-year-old coal power plant in Indonesia owned by an Independent Power Producer (IPP). The deal involves a refinancing package of 250 – 300 million USD to take the plant out of service 10 to 15 years earlier than the useful lifetime of 40-50 years. According to the deal, the plant's ownership will not change, and the owner will be compensated for the net present value of foregone profit with a low-interest concessional loan through ADB.

On 3 November 2022, the World Bank Group approved a 497 million USD project to decommission and repurpose a CFPP in South Africa using renewable energy and batteries[14]. The CFPP, in operation since 1961, has reached the end of its operation life and shut down on 31 October 2022 as required by legislation. The World Bank project will finance the plant's decommissioning with a socio-economic impact assessment and a comprehensive transition plan to support workers, creating economic opportunities for local communities. It also supports the conversion of the plant location into a renewable generation site powered with 150MW of solar, 70MW of wind and 150MW of storage batteries[15].

The World Bank is also supporting the energy transition in the East Asia and Pacific region (China, Indonesia, Philippines and Vietnam. Their activities include providing core analytics on decarbonization and coal transition and lending programs. These programs target the reduction in both coal consumption in the energy sector and coal production as well as a *Just transition for all*[16].

Recently, the France and Germany announced that they extend 600 million euros to support coal transition in South Africa. This loan (concessional financing) is provided by the French and German public development banks, AFD and KfW, directly to the South African government via its National Treasury[17], supporting the country toward the direction of reduction of coal dependance and transition to cleaner energy resources.

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[13] IEEFA. ADB Backs Coal Power Retirement in Southeast Asia New Program Targets The Right Issues, But More Solutions May Be Needed. 2021

[14] https://www.worldbank.org/en/news/press-release/2022/11/04/world-bank-approves-497-million-in-financing-to-lower-south-africa-s-greenhouse-gas-emissions-and-support-a-just-transit

[15] https://www.eskom.co.za/as-komati-coal-fired-power-station-reaches-end-of-life-renewable-energy-project-takes-shape/.

[16] Tang, "Coal Phase Out in the EAP Region," Feb. 2021. https://www.unescap.org/sites/default/d8files/event-documents/Phase_Out_of_Coal_Transition_in_EAP_World%20Bank_0.pdf

[17] https://www.afd.fr/en/actualites/communique-de-presse/france-and-germany-extend-eu600-million-financing-support-south-africas-transition-coal

2. International experiences review

This section summarises a review of the international experiences in coal phase out/phase down to provide insights for Vietnam conducted by Carbon Trust. The Consultant has based on different available research studies, such as: Carbon Trust's Multi-criteria Assessment Framework used in the ADB pre-feasibility study on Energy Transition Mechanisms for select Southeast Asian countries while also review other international leading practices on energy transition that can be beneficial for Vietnam, which listed in the Table 1.

Table 1: International best practice criteria and approaches used for coal phase out

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
(i) Financing Indonesia's Coal Phase Out[18] **(ii) A plant-by-plant strategy for high-ambition coal power phaseout in China**[19] *Both studies apply the same methodology to evaluate operating coal plants based on comprehensive technical, economic and environmental criteria and develop plant-by-plant phaseout strategies for each province.*	Age (vintage year) Size (capacity) Combustion technology	Gross profit Stranded assets value	Normalised scoring approach was applied to the plant's age, size, combustion technology and profitability, where: • **Plant age** is quantified using the vintage year and is assigned with a normalized score from 0 to 1 based on the first year of operation. • **Plant size** is categorized into four groups: <300MW, 300-600MW, 600-1000MW, and >=1000MW. The categories are based on the commonly adopted combustor sizes. The size groups are given normalised scores according to the unit sizes ranging from <300MW to >=1000MW. • **Combustion technologies** are grouped into ultra-supercritical, supercritical, subcritical, and others, ranked from the most to the least efficient with a decreasing score. • **Gross profit:** is estimated by the difference between the annual revenue and annual cost of the coal-fired power plants. Annual revenue is estimated by electricity price and amount of electricity generated; annual costs are the sum of delivered fuel cost, variable operating and Maintenance

[18] Financing Indonesia's coal phase-out, Deon Arinaldo, Fabby Tumiwa, Pamela Simamora, Raditya Wiranegara, Institute for Essential Services Reform

[19] A plant-by-plant strategy for high-ambition coal power phaseout in China, Ryna Yiyun Cui, Nathan Hultman, Diyang Cui, Haewon McJeon, Sha Yu, Morgan R. Edwards, Arijit Sen, Kaihui Song, Christina Bowman, Leon Clarke, Junjie Kang, Jiehong Lou, Fuqiang Yang, Jiahai Yuan, Weirong Zhang & Mengye Zhu, 2021

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
			(O&M) cost, fixed O&M costs, and additional costs, including environmental costs and tax A lower score of the combined metric indicates that the plant could be retired early due to poorer technical attributes, poor economic performance, and higher environmental impact, while a higher score indicates the plant could be the last to retire. Overall, plants to retire first are older, smaller, less efficient plants located in highly air polluted and water scarce regions. Other factors used to measure the economic outcomes of coal phase out, but were not incorporated in the ranking criteria were: • **Stranded asset value:** Potential costs related to stranded assets from coal plant retirements by calculating the remaining value of premature retired plants, assuming linear cost depreciation and a 30-year designed economic lifetime. • *Overnight capital cost of plant x Capacity x ((expected lifetime – retirement age)/expected lifetime)* • **Decommissioning cost:** the total retired capacity each year multiplied by the total cost per MW of the following components – employee cost, station overheads, O&M expenses, pre-demolition costs (environmental regulation/asbestos removal), demolition costs, combustion residuals cost, coal storage area clean-up costs)
(iii) A multi-criteria analysis of coal-based power generation in Bangladesh[20] *Identifies the most important challenges associated with coal-based power generation in Bangladesh and assesses these factors for their relative significance when considering large-scale*	Thermal efficiency Air emission control mechanisms Cooling water & wastewater treatment	Capital & O&M cost	The criteria were identified by conducting a systematic literature review and semi-structured interviews with experts, which was also used to determine the importance of each indicator relative to one another. The technical and financial criteria were ranked as follows (from most to least important) based on preferences from both global and local perspectives: 1. Air emission control mechanisms 2. Thermal efficiency 3. Capital cost & O&M cost 4. Cooling water & wastewater treatment

[20] A multi-criteria analysis of coal-based power generation in Bangladesh, Rafia Zaman, Thomas Brudermann, S. Kumar, Nazrul Islam, 2018

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
coal power implementation.			However, overall, it was the socio-economic aspects (human displacement/resettlement) and environmental issues (air pollution, loss of biodiversity and water pollution) that were ranked as the most important considerations for large-scale coal power transition.
(iv) Multi-criteria decision analysis of electricity sector transition policy in Korea[21] *Develops a multi-criteria decision making (MCDM) model linked to an energy-system model to assess the sustainability of different policy scenarios in the Korean electricity sector.*	Max availability factor Safety (rare accident probability and impact)	Investment cost Variable cost	The selection of the indicators within the technical and financial criteria, and weight on each indicator are based on previous literature with the survey of experts in Korea. • The '**availability'** represents the maximum technical limit of power generation technology to produce electricity in given capacity. • **Safety'** implies the risk of an accident while operating the generation technology, which is the multiplication of the probability of a rare accident and its impact, such as the number of fatalities. • The **'investment cost'** includes capital costs and fixed operations and management (O&M) costs on generation facilities. • The **'variable cost'** covers fuel and variable O&M costs.
(v) A stress test for coal in Europe under the Paris Agreement[22] *Provides a science-based shutdown schedule of the coal-fired power plant fleet in line with the Paris Agreement's long-term temperature goal*	N/A	Net Present Value (NPV) per MW	• The model in the study demonstrates that for each year in which the sum of emissions from coal plants is above levels consistent with the long-term goal in the Paris Agreement, plants need to be shut down until the emissions are at or below this level. • The order in which these plants need to be shut is based on two approaches– one that prioritises regulator preferences (emissions before cost), and the second prioritises the market perspective (cost before emissions). • For the latter, units are sorted according to their profitability (the Net Present Value (NPV) and the least-profitable units are phased-out first. • The **Net Present Value (NPV) per MW** is the present value of the anticipated future cash flows of each unit during its remaining life time, after controlling for unit size.

[21] Multi-criteria decision analysis of electricity sector transition policy in Korea, Donghyun Choi, Young-Hwan Ahn, Dong Gu Choi, 2020

[22] A stress test for coal in Europe under the Paris agreement, Climate Analytics, 2017

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
(vi) Identifying coal plants for early retirement in India[23] *Introduce multidimensional indices that identify plants for retirement based on technical and economic characteristics of plants as well as their environmental impacts*	Age Generation efficiency	Variable, operating and maintenance costs Distance to coal source	The study formulates several indices based on all possible combination of the selected parameters and ranks plants accordingly. Then they identify the worst-performing 50 GW of installed capacity for each index, noting the frequency that a plant appears in the worst-performing 50GW. Then rank plants according to their frequency of appearing on the indices. • **Age:** weighted age of the units of plant. The age of the plants reflects the efficiency and pollution intensity of the units of plant; older plants tend to be generally less efficient than newer plants and are expected to be more pollution-intensive, thus they make good candidates for early retirement. • **Variable operating and maintenance costs:** Generation costs across India range from $13.5/MWh to $46.64/MWh; on average cost of generation is equal to ~$30/MWh. • **Generation efficiency:** measured as the net electricity generated per heat input by coal, where the heat input is the calorific value of the coal consumed. • **Distance to coal source:** used to proxy the transportation costs borne by the plant. Generally, the further the plant is from the source, the more expensive and the more polluting it is to transport the coal to the plant and so it would more likely be a good candidate for early retirement.
(vii) A comprehensive multi-criteria model to rank electric energy production technologies[24] *Develop a model for decision-makers to rank various renewable and non-renewable electricity production technologies according to multiple criteria.*	Average efficiency Average capacity factor	Total overnight cost Variable O&M Fuel cost	The model ranks electric power plants using wind, solar, geothermal, biomass, hydropower, nuclear, oil, natural gas and coal in terms of four criteria: financial, technical, environmental and socio-economic-political. The model was built using the Analytic Hierarchy Process (AHP) with empirical data from government and academic sources. The technical criteria evaluates the characteristics of the technology as a power source and its production capabilities based on the **Average efficiency coefficient %** and the **Average capacity factor %.** The financial criteria evaluates the financial value of the technology and return on investment.

[23] Identifying coal plants for early retirement in India: A multidimensional analysis of technical, economic, and environmental factors, And Maamoun, Puneet Chitkara, Joonseok Yang, Gireesh Shrimali, Joshua Busby, Sarang Shidore, Yana Jin, Johannes Urpelainen, 2022

[24] A comprehensive multi-criteria model to rank electric energy production technologies, Eric W.Stein, 2013

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
			• **Total overnight cost** ($/kW) is the cost to build the power plant without accounting for the interest charges on loans and bonds • **Variable O&M** ($/kWh) fixed O&M ($/kW) indicate the variable and fixed costs to operate and maintain a power plant • **Fuel cost** ($/Mbtu)
(viii) ADB pre-feasibility study on Energy Transition Mechanisms in the Philippines, Indonesia and Vietnam[25] *The report assesses the options to initiate a secure and cost effective phase-out of coal-fired power plants (CFPP), providing a high-level prioritisation of plants to retire in the short to medium term through an Energy Transition Mechanism (ETM).*	Plant utilisation (%) Size (nameplate installed capacity) Age Carbon intensity (tCO2eq/MWh)	Historical financial performance Capital structure PPA tenor Tariff structure Operating costs	The overall ranking is developed at the plant level, calculated as the average of the unit level scores, using the scoring criteria detailed below: 1. **Security score:** This score is an assessment of how the early retirement of a unit could affect the grid's security of supply. A high score suggests that the unit will have limited to no impact to the grid's security of supply. The plant's utilisation, age and size are scored according to the role of coal in meeting demand today and in the future, and its role for the security of supply in terms of contribution to peak demand and flexibility. 2. **Cost score:** This score is an assessment of whether the unit's operations are economically viable in terms of generating strong cashflows. A high score indicates that a strong financial contribution is likely if the plant is acquired by a third party. The plant's potential for generating strong cash flows is assessed in the context of existing or forthcoming carbon taxes or fossil fuel subsidies. 3. **Carbon score:** This score is an assessment of how the removal of the unit will contribute to carbon emissions reduction. A high score indicates that the plant is highly pollutant. 4. **Total score:** This score is an assessment of how suitable a plant is for retirement taking into consideration the three scores detailed above: security, cost and carbon scores. The combination of the scores can be weighted if desired.
(ix) ACEN Corporation's ADB-inspired ETM[26]	*N/A*	*N/A*	ACEN's ETM has a coal retirement component as well as a renewables investment component.

[25] Regional: Opportunities to Accelerate Coal to Clean Power Transition in Selected Southeast Asian Developing Member Countries, ADB, 2021

[26] A private coal retirement pilot in the Philippines just reached financial close: What this means for "transition finance" in emerging markets, Lawrence Ang, Matt Carpio, Climate Smart Ventures

Study	Technical Criteria	Financial Criteria	Approach to prioritising CFPPs for phase out/phase down
To accelerate the retirement of its 246MW coal-fired power plant (CFPP) owned and operated by its subsidiary, South Luzon Thermal Energy Corporation (SLTEC) located in Batangas, Philippines			**Financial structure:** ● On the debt side, ACEN secured a PHP 13.7B (USD 249M at PHP 55 per USD 1) loan facility to (a) refinance SLTEC's outstanding Php 9.8B (USD 174M) loan facility (b) fund the partial redemption of capital in SLTEC held by ACEN, subject to regulatory approvals; and (c) finance other transaction-related expenses. ACEN, in turn, is set to use the proceeds of the equity redemption to reinvest in renewable energy projects. ● On the equity side, ACEN (through its corporate vehicle ETM Philippine Holdings, Inc. (EPHI)) partnered with a local insurance company for a total value of PHP 3.7B (USD 67M at PHP 55 per USD 1) to complete the transaction. EPHI allows financial investors to invest in energy transition by accelerating the retirement of CFPPs, and to fund the development of new clean energy technologies. Similarly, proceeds from the equity sale will be used by ACEN to invest in new renewable energy projects.

3. Technical assessment

The data request form has been sent to EVN, PVN and VINACOMIN by CMSC's document no.1382/UBQLV-NL dated 09 September 2022, followed by document no.1520/UBQLV-NL dated 30 September 2022. By 12 October 2022, the Consultant team has received the data from VINACOMIN Power for 7 CFPPs. As the detailed CFPPs data from EVN and PVN is not yet provided, the technical assessment is based mostly on the data provided by VINACOMIN Power and information received from the meetings with the three SOEs and 06 selected CFPPs:

1. Uong Bi (EVN GENCO1)
2. Hai Phong (EVN GENCO2)
3. Pha Lai 1 & 2 (EVN GENCO2)
4. Ninh Binh (EVN GENCO3)
5. Vung Ang 1 (PVN PVPOWER)
6. Cao Ngan (VINACOMIN Power)

The mission took place in the 2nd week of September and 1st week of October. Detailed discussion is provided in Annex 1.

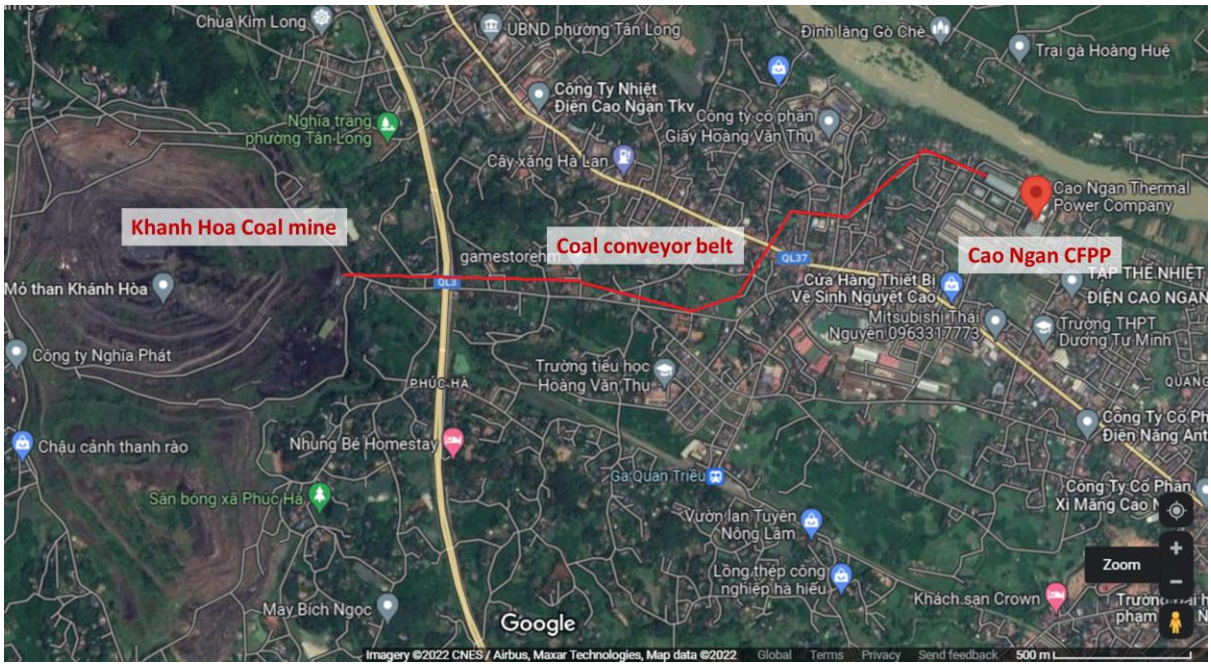
3.1. Coal power plants technologies

Coal power plants in Vietnam can be classified by technology based on two main features: combustion technology and steam parameters. Existing coal power plants in Vietnam are deploying either Pulverised Combustion (PC) or Circulating Fluidizing Bed (CFB). CBF technology was developed after PC technology. It possesses some advantages such as being suitable for various fuel types, less SO_2 and NO_x emissions, can combust low-rank coal, and fewer requirements for fuel processing compared to PC boilers. Therefore, CFB is mostly deployed in VINACOMIN's power plants to utilise the low-rank coal from nearby mines. For example, coal is supplied to the Cao Ngan CFPP from Khanh Hoa mine (a few kilometres away) via an enclosed conveyor belt (Figure 11). The PC technology can reach higher capacity and efficiency, especially with supercritical and ultra-supercritical steam, with less auxiliary consumption and a higher ability to adjust to load. Therefore, PC is still the selection for most of EVN's and TKV's power plants.

As CFB boilers have more flexibility in term of fuel use, this also make co-firing with other type of fuel (i.e. biomass). However, the first pilot study on biomass co-firing was implemented in Ninh Binh CFPPs, which as four small PC units (25 MW each). The co-firing test was done in Unit 1. The alternative fuel used was biomass pellet from forestry residues sourced from nearby area of Nho Quan. Two ways of co-firing was tested:

- Mill biomass with coal before burning in the boiler. Mixing ratios tested were15% and 20% and 30 tonnes of biomass was used.
- Separate injection of milled biomass into the boiler in parallel with coal. Mixing ratio tested were 18%, 28%, 43%. 60 tonnes of biomass were used for co-firing for 8-9 hours.

Figure 11: Location of Khanh Hoa mine for Cao Ngan CFPP



Source: Google Map

The result shows that with the tested biomass co-firing, efficiency of boiler was not affected.

Based on the steam that enters turbines, coal power plants can be classified into three types: Subcritical - SSC, Supercritical - SC, and Ultra Supercritical - USC. Higher steam parameters mean higher efficiency and lower emissions. However, most Vietnamese coal power plants use SSC technology because Vietnamese anthracite coal has low volatile matters, is difficult to ignite, and is not easy to use in SC boilers. Some coal power projects are being implemented, which propose the deployment of SC or USC technology. Such plants will use imported coal with higher heating value and volatile matters (mostly from Indonesia and Australia).

Figure 12 shows the current status of coal power plants in Vietnam, with the installed capacity of each plant grouped by boiler technology and steam parameters. PC technology with SSC steam is the most popular (16 plants with total capacity of 12.6 GW). Some plants built recently has SC steam cycle such as Vinh Tan 1, Vinh Tan 4 and 4 Extension, Duyen Hai 3 Extension, Song Hau 1 (PC boilers) and Hai Duong (CFB boiler).

Figure 12: Classification of coal power plants in Vietnam by July 2022 based on technology, steam parameters, coal type, ownership and commission year.

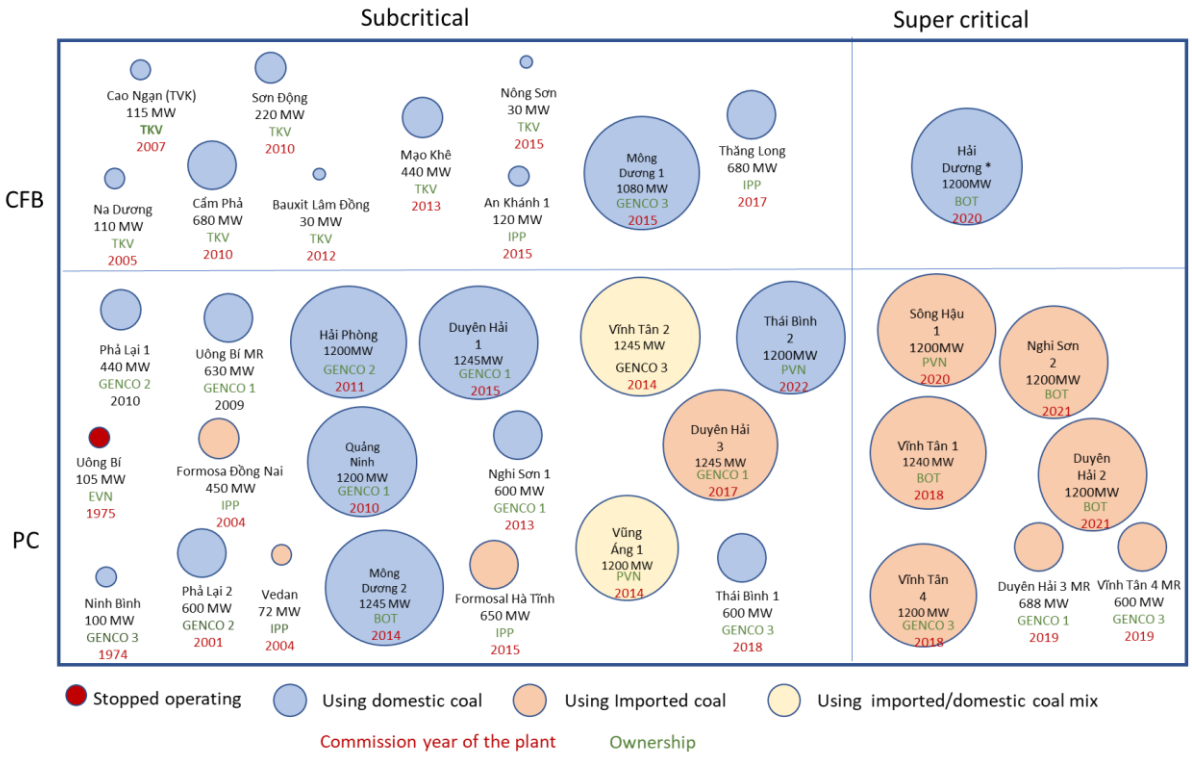
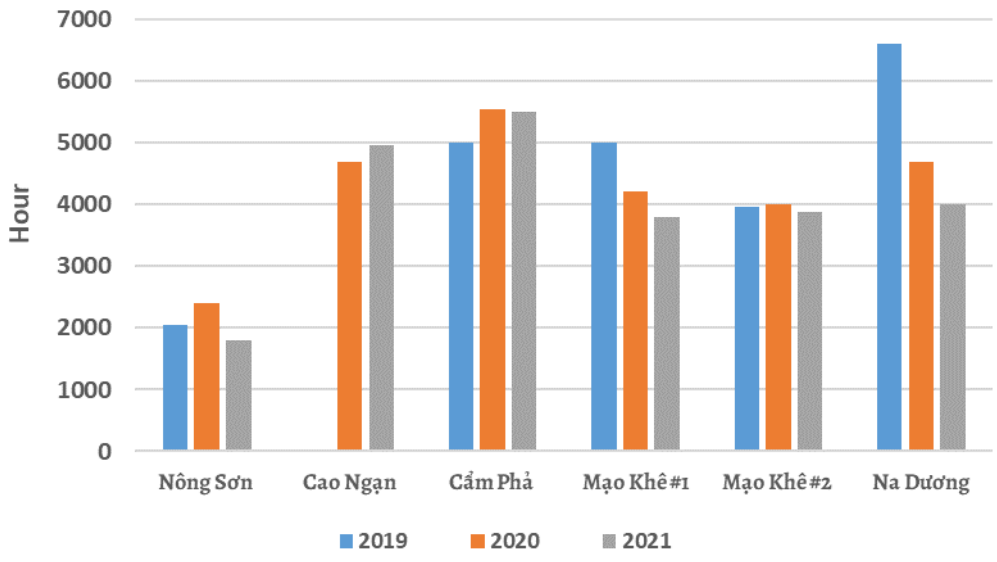


Figure 13 shows the operation hour at max capacity of TKV's coal power plants in 2019 - 2021. The operation hour of Na Duong and Mao Khe unit 1 shows decline but Cam Pha and Cao Ngan slightly increase.

Figure 13: Operation hour at max capacity of 6 CFPPs



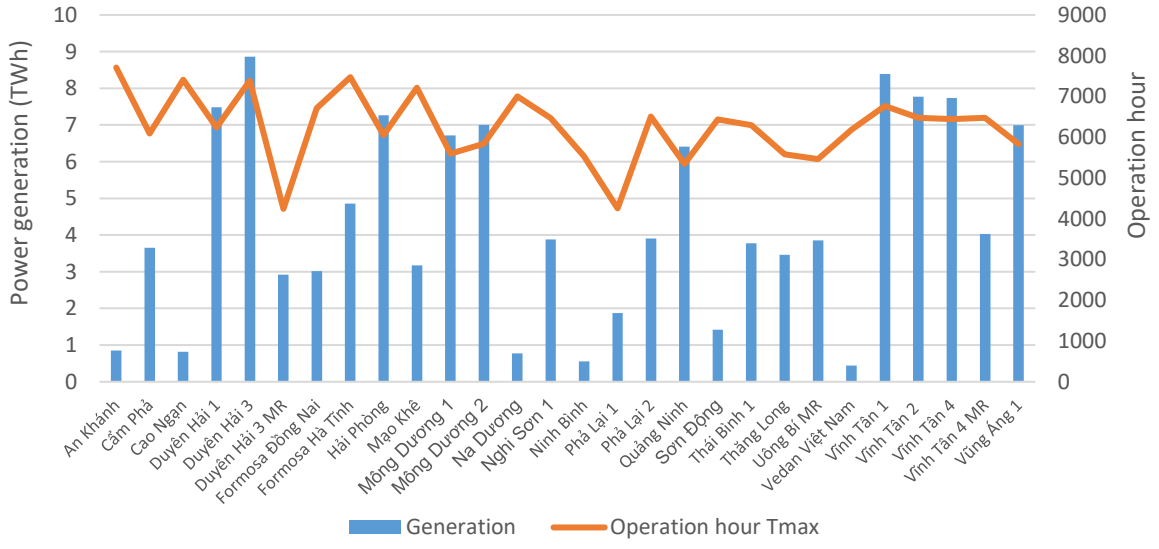
Source: VIET synthesised the data obtained via the mission

Heat rate is the parameter that indicates the amount of heat used to produce 1 kWh of electricity. Therefore, heat rate is a suitable indicator generally used to assess thermal power plants. Normally, the heat rate of Vietnamese coal power plants ranges from 9,500 – 11,000 kJ/kWh. This is comparable to some countries. For example, coal power plants in the United States have an average heat rate of 11,131 kJ/kWh in 2020[27]. However, some plants have higher heat rate than the average value such as Nong Son and Son Dong (Figure 14).

Figure 14: Heat rate of some coal power plants in Vietnam

Source: VIET synthesised the data obtained via the mission

Figure 15: Power generation and operation hours of the majority of coal power plants



Source: VIET synthesized from data of EVN/NLDC

[27] U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report," and predecessor form(s) including U.S. Energy Information Administration, Form EIA-906, "Power Plant Report;" and Form EIA-920, "Combined Heat and Power Plant Report;" Form EIA-860, "Annual Electric Generator Report."

Flexibility is crucial in assessing the operation capability of power plants in the system, especially when the share of renewables is gradually increasing. A plant's flexibility can be evaluated through the parameters such as ramp-up/ramp-down rate, startup time, and minimum load (when oil is not used). Plants with high flexibility will have a higher ramp-up/ramp-down rate and lower startup time and minimum load. These parameters for some Vietnamese coal power plants are summarised in Table 1. According to the table, new-built coal power plants using modern PC technology with SC steam cycle are more flexible compared to PC and CFB plants with SSC steam cycle.

Table 2: Summary of flexibility parameters of some Vietnamese coal power plants

Plant	Capac. (MW)	Technology	Ramp rate (MW/min)	Warm startup time (h)	Cold startup time (h)	Min load (%full load)
Mạo Khê *	440	CFB - SSC	1	4.8	10.7	85
Cao Ngạn*	115	CFB - SSC	0.5	3	8	70
Cẩm Phả*	670	CFB - SSC	1.5	6	9	75
Nông Sơn*	30	CFB - SSC	0.31	6	8	80
Na Dương*	111.2	CFB - SSC	0.61	5	10.5	63
Sơn Động*	220	CFB - SSC	0.5	4	8	70
Vĩnh Tân 4**	1200	PC - SC	12-18	≤6.33	≤9.17	40
Vĩnh Tân 4 MR **	600	PC - SC	12-18	≤6.33	≤9.17	40
Vĩnh Tân 1 **	1240	PC - SC	6.2	2.25	12.75	60
Mông Dương 1**	1080	CFB - SSC	5.4	8	14	70
An Khánh **	120	CFB - SSC	0.3	6	11.2	75
Quảng Ninh**	1200	PC - SSC	6	11	15	77
Thăng Long**	600	CFB - SSC	3	5	9	65

SSC: Subcritical technology SC: Super Critical technology

*: data provided by VINACOMIN Power

**: adopted from Vietnam Technology Catalogue

3.2. Management of operation

Currently, coal power plants in Vietnam have minor check-ups annually, a moderate check-up every two years, and a major check-up every 4 to 5 years, depending on the equipment's status. Regular maintenance of power generation units helps to increase the stability of equipment during operation. Management of operation and maintenance as of today is still facing some challenges, which need to be improved to enhance the operation reliability and increase the plants' efficiency.

The rapid development of renewable energy (RE) sources such as wind and solar, whose generation depends on weather conditions, has strongly influenced the operation mode of coal-fired power plants. The current electricity law requires the system to purchase all renewable electricity. Hence an increasing proportion of RE installed capacity needs coal power plants to change their operation regime. All the coal power plants interviewed have stated that their peak generation time is now shifted from mid-day to night time. This requires the plants to adjust their generation capacity on a daily basis, which affects thermal efficiency and equipment lifetime, especially equipment with high pressure, high temperature, and heavy-duty working in the

corrosive environment. However, one upside of the regime switching is that when peak operation at night, the cooling river water has lower temperature, which positively affect the plant's efficiency.

Each coal power plant is designed to use a specific type of coal with specific characteristics (heat value, volatile matter contents, sulphur content, etc.). The technical standards for categorising coal type used for power generation is provided in the TCVN 8910:2020 Specifications for commercial coal issued by the Ministry of Science and Technology. Most coal power plants built before 2015 are designed to use domestic coal, while the recently developed ones are using imported coal. Total coal consumption for CFPPs in 2021 was about 57 Mt. Of which, plants run on 100% domestic coal consumed 28.5 million tonnes. Plants run on 100% imported coal consumed 10.7 Mt. Coal mixture (between domestic and imported) was consumed at 18.1 Mt. The mixing ratio varies among plants and controlled by coal suppliers. The two largest coal suppliers for CFPPs in Vietnam are VINACOMIN and Dong Bac Company. They purchase and mix coal according to the specifications of the plants.

Fuel supplied to power plants lacks uniformity and stability. Currently, domestic coal sources are increasingly exploited at greater depths. The mining volume is not enough to supply to power plants, forcing the plants to buy coal in the market and process the mixing. These coal sources have high volatility, low ash content, low melting temperature of slag, and many corrosive components that require optimization of the combustion process regularly to redistribute the flame, measures to prevent slag formation at the boiler's bottom and to prevent self-ignition in the coal supply system. This requires the units to analyze regularly and take steps to limit adverse impacts actively

The import of coal has many shortcomings, usually done by trading companies. Under the pressure of price and profit, these companies will buy coal on the free market, which has potential risks in terms of quality, especially the coal moisture content and calorific value. In many cases, the coal property values are very different from the designed coal type.

Currently, there are some professional repair service companies in the country: PetroVietnam Power Technical Services Joint Stock Company (PVPS), The Northern Thermal Power Repair Service Joint Stock Company (EVNNPS), and EVNGENCO 3 Power Plant Repair Service Company (EPS). In addition, Vietnam Electricity (EVN) has just established the EVN Repair Service Center (EVNPSC), which is responsible for managing repair services for multi-purpose hydroelectric power plants and power plants of EVN. These companies have a lot of experience in the maintenance and repair of steam turbine parts for power plants, but now under the pressure of competitive bidding law, these companies have to compete fiercely with each other and with other companies, including mechanical design institutes, assembly companies, and others. This leads to reduced maintenance service costs, causing a lack of funds for professional investment in equipment, tools and training, and difficulty in retaining experienced technicians, which in the long run affects the quality of the maintenance of plant equipment. Along with that, due to the influence of price criteria in the bidding packages, the technical conditions stated in the bidding documents are difficult to control, leading to difficulty in selecting the desired maintenance service contractors.

3.3. Emissions and mitigation technologies

Environmental protection for coal-fired power plants is also paid more attention to and received appropriate investment. In the 2000-2015 period, coal-fired power plants were only invested in dust and SO_x treatment equipment. After 2015, many coal-fired power plants were invested in the NO_x treatment system. Along with that, environmental protection during the operation period is an increasing concern. Plants are equipped with automatic, continuous emission monitoring systems.

Emissions of environmental pollutants from coal-fired power plants mainly include dust, SO_2, and NO_x. The air pollutant concentration of exhausted gas must comply with QCVN 22:2009/BTNMT National Technical Regulation on Emission of Thermal Power Industry, which sets a threshold (C) for coal power plants with regards to their capacity (by setting Kp factor) and location (by setting Kv factor). The concentration threshold for a particular coal power plant is then calculated = C x Kv x Kp. Plants with higher capacity have lower Kp factors. Plants in urban areas have higher Kv factors. Coal power plants are also mandated to install monitoring systems to measure air pollutant concentration (dust, SO_2, and NO_x) that send data to the provincial's Department of Natural Resources and Environment in real-time.

Table 3: Concentration threshold for coal power plants

	Concentration threshold for coal power plants (microgram/nm3)
Dust	200
NOx	650 (for coal with volatile matter content > 10%) 1000 (for coal with volatile matter <=10%)
SO2	500
	Kp
P <=300	1
300<P<=1200	0.85
P>=1200	0.7
	Kv
Category I	0.6 Inner urban of special class and urban of grade I; special-use forest ; natural heritage, historical and cultural relics ranked; Thermal power plants have a distance of less than 05 km to the boundary of these areas.
Category II	0.8 Inner cities and urban centers of grades II, III, IV; suburban urban centers of

	Concentration threshold for coal power plants (microgram/nm3)
	special grade, urban centers of grade I with the distance to the innercity boundary greater than or equal to 05 km; Thermal power plants have a distance of less than 05 km to the boundary of these areas.
Category III	1 Industrial parks; urban grade V; suburbs and suburbs of class II, III and IV urban centers with a distance to the inner city or inner city boundary greater than or equal to 05 km; thermal power plants with a distance of less than 05 km to the boundary of these areas.
Category IV	Rural areas
Category V	Rural in mountainous areas

The current status of emission treatment technology of coal-fired power plants is summarized below.

Dust emissions

All coal power plants have installed the Electrostatic Precipitators (ESP) with a dust removal efficiency of over 99.7%. Therefore, they all met the requirements according to QCVN 22:2009/BTNMT - National Technical Regulation on Emissions of Thermal Power Industry and QCVN 05:2013/BTNMT: National Technical Regulation on Ambient Air Quality.

NO_x treatment

NO_x emits from the fuel combustion process. There are currently two technologies used to reduce NO_x: applying a hierarchical combustion system to minimise the possibility of NO_x formation (i.e., Hai Phong) or installing SCR (Selective Catalytic Reduction) system to treat NO_x with NH_3 (Vung Ang 1). The latter method also controls NO_X content to meet QCVN 22:2009/BTNMT - National Technical Regulation on Emissions of Thermal Power Industry and QCVN 05:2013/BTNMT: National Technical Regulation on Ambient Air Quality.

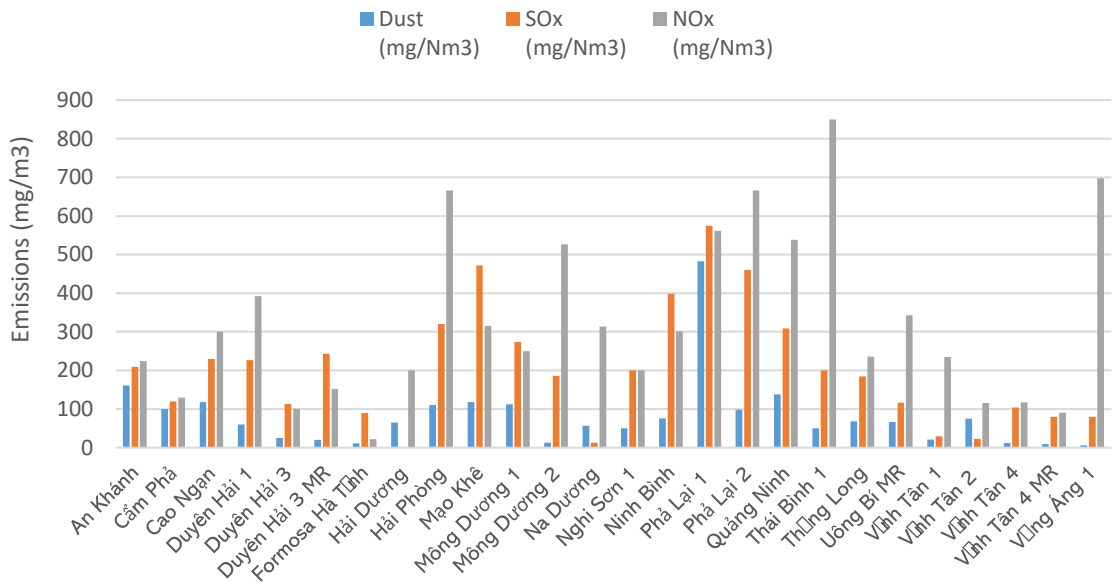
CFB plants (6 power plants of TKV) have not yet installed a NO_x treatment system because of the low temperature in the combustion chamber, which resulted in fewer NO_x emissions.

SO_2 treatment

Most plants apply SO_2 treatment technology with limestone (with fluidized bed boiler) and calcium hydroxide (with pulverized coal boiler). Some projects in the coastal area use seawater to reduce SO_2 (Vung Ang 1, Duyen Hai 1, 3, Vinh Tan 2). The by-product of a lime or limestone SO_x treatment system is artificial gypsum or ash and slag mixed with lime. Currently, two plants (Pha Lai 1 and

Ninh Binh) do not install SO_x treatment systems (there were no regulations on exhaust gas treatment at the time of construction).

Figure 16: Emissions of some CFPPs in the year of 2018



Source: VIETSE's analysed

CO_2 emissions

The level of CO_2 emission of coal power plants depends on many factors such as the type of coal used, the efficiency of the plant... According to the study on Developing control measures when greenhouses in the field of Coal Thermal Power are implemented. According to the Institute of Energy[28], the GHG emission intensity of coal-fired power plants operating before 2014 was 1123 tCO_2/GWh, higher than the world average (896 - 1050 tCO_2/GWh). Emissions from coal power plants in 2020 were 115.6 $MtCO_2eq$, equivalent to an intensity of 1161 tCO_2/GWh[29]. This accounts for 89% of emissions from power generation in 2020 and is about 25% of the estimated total national emissions for 2020 according to the Nationally Determined Contribution (528.4 $MtCO_2eq$).

[28] Nguyễn Thị Thu Huyền. Develop measures to control greenhouse gases in the field of coal-fired thermal power (investor) and propose a roadmap to apply control measures. Hanoi, Vietnam: Institute of Energy; 2016.

[29] MONRE's Develop the Emission Factor of Vietnamese power grid in 2020

Currently, coal-fired power plants in Vietnam do not apply CO_2 recovery technologies because of the low readiness of these technologies in Vietnam[30]. These technologies in the world are currently in the research, development, and testing stage with very high investment costs, so they have not been considered for application in the next ten years. The cost for carbon capture technology is still at a high level (50 – 100 \$/tCO_2 captured at power generation utilities)[31], which the existing power plants in Vietnam cannot justify economically. ADB's study[32] shows that carbon capture and storage would increase the Levelized Cost of Electricity from supercritical coal plants by 78%. There is not yet a policy mandating the plants to deploy carbon removal technologies and the carbon market will not operate before 2028. Another economic justification for carbon capture is to enhance oil recovery operations. Yet, most of the existing coal power plants are located in the north of Vietnam, while the oil fields are in the Southern Sea. ADB's study also suggests a roadmap in which a first commercial scale could be in operation in Vietnam after 2030.

[30] Nguyen-Trinh HA, Ha-Duong M. Perspective of CO2 capture & storage (CCS) development in Vietnam: Results from expert interviews. Int J Greenh Gas Control 2015;37:220–7. https://doi.org/10.1016/j.ijggc.2015.03.019

[31] Baylin-Stern and Berghout (2021), Is carbon capture too expensive? https://www.iea.org/commentaries/is-carbon-capture-too-expensive

[32] ADB (2012) Prospects for Carbon Capture and Storage in Southeast Asia

4. Economic and financial assessment

On the basis of working sessions with EVN, TKV and PVN and surveys at several factories of the three groups, a description of financial capacity and basic information about the plant will be made and presented with the substance as presented below. This will provide necessary information to serve as a basis for assessing the impact on the financial and economic aspects under the selected scenarios, as well as determining the capital and investment needs of enterprises which own coal power plants which will be converted under different scenarios.

4.1. Approaches, principles for financial analysis

The objective of the financial analysis is to describe the financial status of enterprises and CFPPs owned (in whole or in part) by three state-owned economic groups including EVN, TKV and PVN.

This description will serve as the basis for determination in the case of a plant being relocated or implementing projects and measures to contribute to the goal of reducing CO_2 emissions, what will be the financial impact on the business that owns the factory, the investment needs to implement that transition initiative (phase out, phase down or other transition scenarios), the impact of such investment capital needs on the financial situation of the enterprise that owns the factory, the economic impact of implementing such a transition initiative (in terms of labor, social security, contributions to the state budget). The description of the financial position of the enterprise will provide the necessary content and information to assess these impacts, depending on the scenario of the factory relocation that will be selected (on the basis of technical factors).

The underlying rule for financial analysis is to treat CFPPs as assets of companies. To serve the assessment and development of migration scenarios, the financial description for coal power plants will include: (i) the financial status of the enterprise that owns the plant; (ii) description the basic factory information needed for the assessment of the financial impact of the enterprise if the relocation scenario is implemented for the factory.

The process of field survey and document study on ownership relationship, governance structure, shows that coal power plants belonging to three groups EVN, TKV and PVN have the following form:

(i) The three SOEs owning CFPPs directly and managing them through management boards. In these cases, factories do not have separate financial statements and balance sheets. The factory's assets, liabilities, and business results are consolidated in the SOEs financial statements and business results.
(ii) The three SOEs owning CFPPs through subsidiary companies. In that cases, the three SOEs:

- Directly own the factory, and the factory is in the form of a branch of the SOEs: In these cases, branches implement the dependent accounting regime and do not have

separate financial statements and balance sheets. Assets, liabilities and results of production and business activities of the factory are consolidated in the financial statements and business results reports of the corporation that owns the factory.

- Owning through a joint stock company in the form of investment or association. In these cases, joint-stock companies have separate financial statements, profit and loss statement. Factories do not have separate financial statements.

On that basis, the description and analysis of the financial impact will follow the principle of describing the financial position of the unit that directly owns the plant, since this entity will be the one directly responsible for the operation of the factory. These units also have the main responsibility or have the main voice in the decisions on the scenario for the transition of the factory. This is also the unit that is responsible for arranging investment capital to implement the relocation plan, dealing with arising economic and financial issues such as redundant labor and land.

The CFPP is considered the property of the companies that own it. And because of the failure to separate revenue and expenses at the plant level in the reports of factory owners, the factory description will provide the most necessary data and information for assessing the impact of the relocation scenario of the factory on the financial, economic, labor and capital needs of the company owning the factory.

4.2. Enterprise and factory in the financial analysis

The following table show how the companies and factories will be analyzed from financial perspective: (i) the financial position of the enterprises that own the factories; and (ii) key indicators at the factory level. It is foreseen that the report will include description of the financial situation of 15 companies owning CFPPs and information about 26 CFPPs.

Table 4: Companies and factories will be analyzed from financial perspective

COMPANY OWNING CFPP	CFPP NAME	Accounting characteristics of the CFPP
EVN GROUP		
1. EVN Group	1. Vinh Tan 4 2. Vinh Tan 4 expansion 3. Quang Trach 1 4. Thai Binh 1	Factories owned by EVN
2. EVNGENCO 1	5. Duyen Hai 1 6. Duyen Hai 3 7. Duyen Hai 3 expansion 8. Nghi Son 1 9. (Expanded) Uong Bi	The factories are branches of the corporation. Dependent accounting.

COMPANY OWNING CFPP	CFPP NAME	Accounting characteristics of the CFPP
3. Quang Ninh Thermal Power Joint Stock Company (EVNGENCO1 owns 42%)	10. Quang Ninh CFPP	As an independent accounting joint stock company, in which EVNGENCO 1 owns 4 2 %)
4. Hai Phong Thermal Power Joint Stock Company (EVNGENCO2 owns 51%)	11. Hai Phong CFPP	As an independent accounting joint stock company, in which EVNGENCO2 owns 51%)
5. Pha Lai Thermal Power Joint Stock Company (EVNGENCO2 owns 51%)	12. Pha Lai 1 &2	As an independent accounting joint stock company, in which EVNGENCO2 owns 51%)
6. EVNGENCO 3	13. Mong Duong 14. Vinh Tan 2	As a branch with Dependent Accounting Corporation
7. Ninh Binh Thermal Power Joint Stock Company (EVNGENCO 3 owns 54.76%)	15. Ninh Binh	As an independent accounting joint stock company, in which EVNGENCO 3 owns 54.76%)
PVN GROUP		
8. PVN Group	16. Song Hau 1 17. Thai Binh 2- 18. Long Phu 1-(Under construction)	Dependent accounting, managed through the Management Board
9. PV POWER	19. Vung Ang	Branch with dependent accounting system
TKV GROUP		
10. TKV Group		Not directly owning or managing the factory, but in the report, there is still a brief description of the financial situation to ensure consistency and completeness.
11. Vinacomin Power	20. Cao Ngan 21. Son Dong 22. Mao Khe 23. Na Duong	Is a joint stock company dependent on Vinacomin power) As above As above As above (In Vinacomin power owns 99.27%)
12. Cam Pha thermal power joint stock company (	24. Cam Pha 1.2	As an independent accounting joint stock company, in which Vinacomin power owns 97.58%)
13. Coal - Electricity Joint Stock Company (TKV owns 88.77%)	25. Nong Son	As an independent accounting joint stock company, in which Vinacomin power owns 88.77 %)
14. Vinh Tan 1 Power Company Limited (Owned by Vinacomin Power) 5 %)	26. Vinh Tan 1	independent accounting company limited, in which Vinacomin power owns 5 %)

4.3. Initial findings

Financially, EVN, VINACONMIN and PVN (SOEs) own CFPPs in one of the following three manners: (i) owning and managing CFPPs in a direct manner: (ii) owning and managing CFPPs through a company owned 100% by the SOE; and (iii) owning and managing CFPPs through a company owned partially by the SOE. As such, the SOE's decision on the investment to implement energy transition projects are different from one case to another.

Unlike EVN, VINACOMIN and PVN have different sources of income other than from power generation. In 2021, the total revenue of EVN was billion 426,000 VND, earning the enterprise a,gross profit of VND 38,000 billion. The lion share of the revenue is from power-related business. Meanwhile, VINACONMIN had a revenue of VND 113,173 billion and with a profit of 5,288 billion. Of the revenue, VND 73,508 billion are from coal exploitation, VND 17,496 billion from mining. Power generation (mostly coal-fired) account for 11% of the revenue. In the case of PVN, the enterprise generated a total revenue of 620,000 billion in 2021 and a before tax profit of VND 45,000 billion. Of the total revenue of PVN, only VND 25,175 billion are from power geneation (mostly by PVPower).

Though making profit in 2021, the financial health of the three SOEs are not stable. E.g. the profit of Vinacomin fluctuated widely between 2019-2021 with many of its subsidiary companes losing money.

The importance of CFPPs to the business strategy and financial health of three SOEs. While the business strategy and financial health of EVN are much more dependent on CFPPs, it is less important as in the case of Vinaconmin and PVN.

All the three SOEs were making profit in 2021. CFPPs under the three SOEs were making profit as well as they were all generating power under stable sale contracts.

The three SOEs are also heavily indebted. For example, total debt (loan and lease liability) of EVN reached VND 351,000 billion in 2021. While total debt of PVN reached more than VND 90,000 billion, and Vinacomin VND 47,070 billion.

Financially, the three SOEs can make contribution to the phase out or phase-down of CFPPs. However, they are unable to afford the full costs for the phase out or phase down of CFPPs. The funds available by the three SOEs are not available for such plans are early retirement of CFPPs. Besides, given the indebtness of the three SOEs, borrowing to finance the early retirement of CFPPs under the three SOEs do not seem to be a feasible solutions for them

5. Legal assessment

5.1. Ownership

5.1.1. General description of CFPP's ownership structures

a) Overviews

The CFPPs are under different types of ownership structures in which the SOEs are involved. Corresponding to each CFPPs ownership structure, SOEs will directly or indirectly (through their subsidiaries/affiliates) hold, in whole or in part, the decision-making power on phasing out/phasing down the CFPPs.

CMSC is assigned by the Government to exercise the rights and responsibilities of the State owner's representative[33] in SOEs with 100% charter capital held by the State, and the SOEs are then organized and operated as one-member limited liability enterprises. The State has the power to decide on matters of SOEs' strategy, production and business plans, investment and development plans, and investment policies, and exercises its sole owner's rights through the members' council as the highest decision-making body in the SOEs' organizational structure. According to the SOEs' charter, the members' council is the highest internal management level, with the authority to make CFPPs phase-out/phase-down decisions. Certain highlights of the SOEs are provided below:

- EVN or Vietnam Electricity was founded under the Decision No. 562/QD-TTg of the Prime Minister dated October 10, 1994, on the basis of the reorganization of subsidiaries of the Ministry of Energy. It is organized and operated in accordance with its Charter which was promulgated along with the Government's decree. The first charter was issued in accordance with Decree No. 14/CP on January 27, 1995. Currently, EVN is operated under the new Charter which has been issued by Decree No. 26/2018/ND-CP[34].
- PVN or PetroVietnam, also called VIETNAM OIL AND GAS GROUP, is a State-owned holding company which was restructured by Prime Minister's Decision No. 199/2006/QD-TTg dated August 29, 2006 from a number of state-owned enterprises specializing in the oil and gas. The Group is given the mission of managing and conducting oil and gas activities within the territory of Vietnam and investing overseas. PVN is operated under the one-member limited liability corporation model in accordance with Decree No. 07/2018/ND-CP of the Government on approving the charter for the organization and operation of PVN on

[33] Decree 131/2018/NĐ-CP, Article 1

[34] More at https://evn.com.vn/d6/gioi-thieu-d/Tong-quan-ve-Tap-doan-Dien-luc-Viet-Nam-2-3-877.aspx Retrieved on 18/08/2022; Decree No. 26/2018/ND-CP

January 10, 2018. PVN's members' council, similar to EVN's organizational structure, is the State owner's direct representation at PVN.

- TKV or Vinacomin, also called VIETNAM NATIONAL COAL AND MINERAL INDUSTRIES HOLDING CORPORATION LIMITED, was restructured by a Prime Minister's Decision No. 345/2005/QD-TTg on December 26, 2005, with its predecessors being the Vietnam Coal Group (established as a result of the restructuring of Vietnam Coal Corporation and its constituent parts under Prime Minister Decision No. 198/2005/QD-TTg and Decision No. 199/2005/QD-TTg on August 8, 2005) and Vietnam Minerals Corporation. On June 25, 2010, the Prime Minister approved Decision No. 989/QD-TTg, transforming the holding company - Vinacomin into a one-member limited liability corporation owned and controlled by the State[35]. The latest charter of Vinacomin was promulgated on August 8, 2018, by Decree No. 105/2018/ND-CP.

Regarding SOEs' subsidiaries/affiliates, the authority to decide on phasing out/phasing down the CFPPs belongs to different management levels (members' council for a limited liability company, the general meeting of shareholders/the board of directors for a joint stock company), according to their ownership structure, company models, and charters. The determination of the SOEs' capacity to influence their subsidiaries/affiliates' internal authorization on CFPPs phasing out/phasing down will be examined in the following sections.

b) Ownership structures of CFPPs

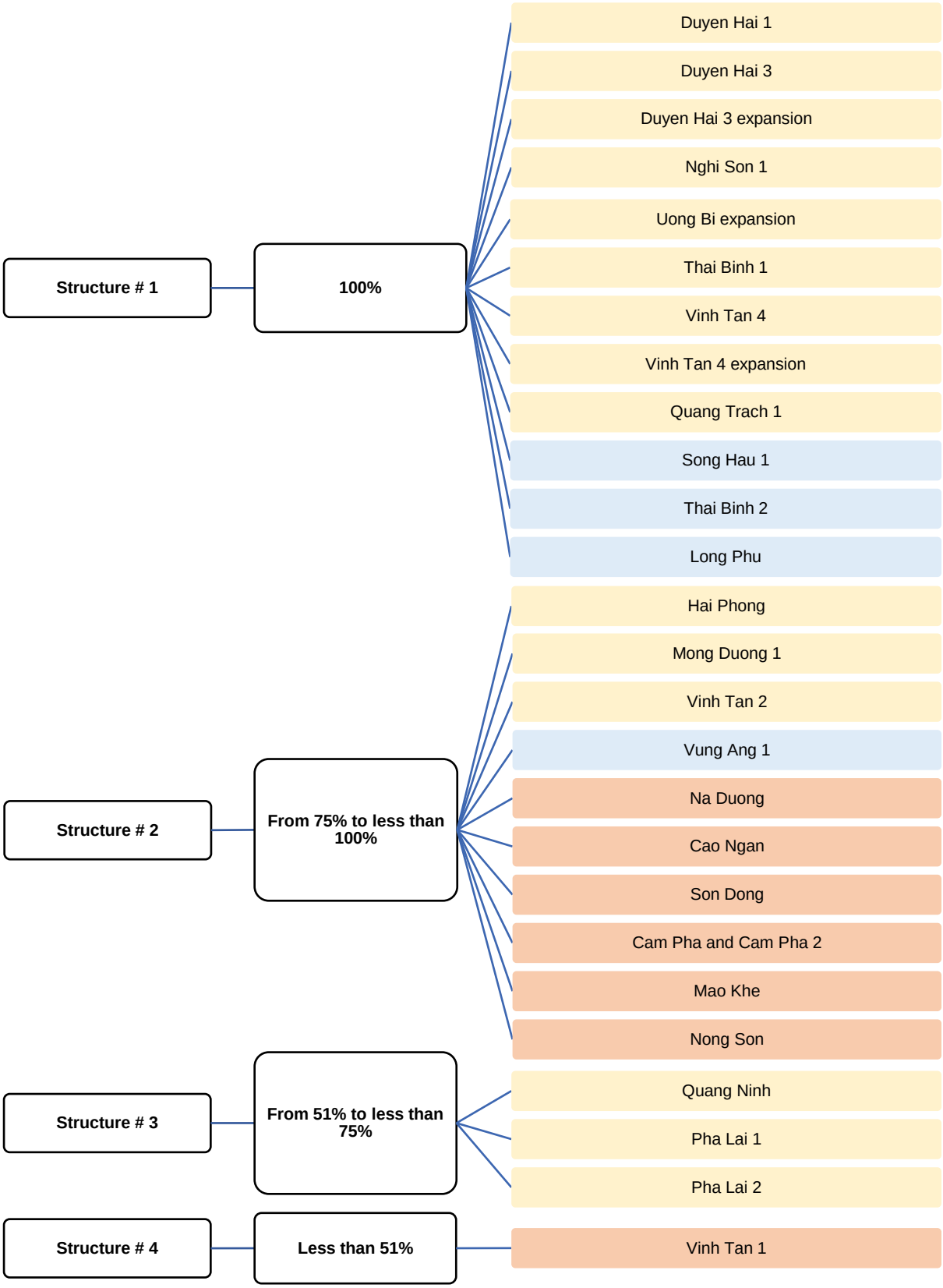
According to the research findings, all the CFPPs have a State capital amount with different proportions. The ownership structures of the CFPPs are synthesized into the four typical types as listed below:

- **Structure # 1**: CFPPs with 100% State capital in their ownership structure;
- **Structure #2**: CFPPs with 75% to less than 100% State capital ratio in their ownership structure;
- **Structure # 3**: CFPPs with State capital from 51% to less than 75% in their ownership structure; and
- **Structure # 4**: CFPPs with State capital less than 51% in their ownership structure.

For the purpose of clarification, the State capital ratio in the ownership structure of CFPPs, which is used as the classification criterion to build and divide the above four structures, is interpreted as the rate of the State's influence on CFPPs phase-out/phase-down decisions by, directly or indirectly, holding part or all of the ownership of the enterprises owning, managing, and operating the CFPPs.

[35] More at: http://www.vinacomin.vn/gioi-thieu-chung/lich-su-hinh-thanh-va-phat-trien-20150603120138935 6.htm . Retrieved on 18/08/2022.

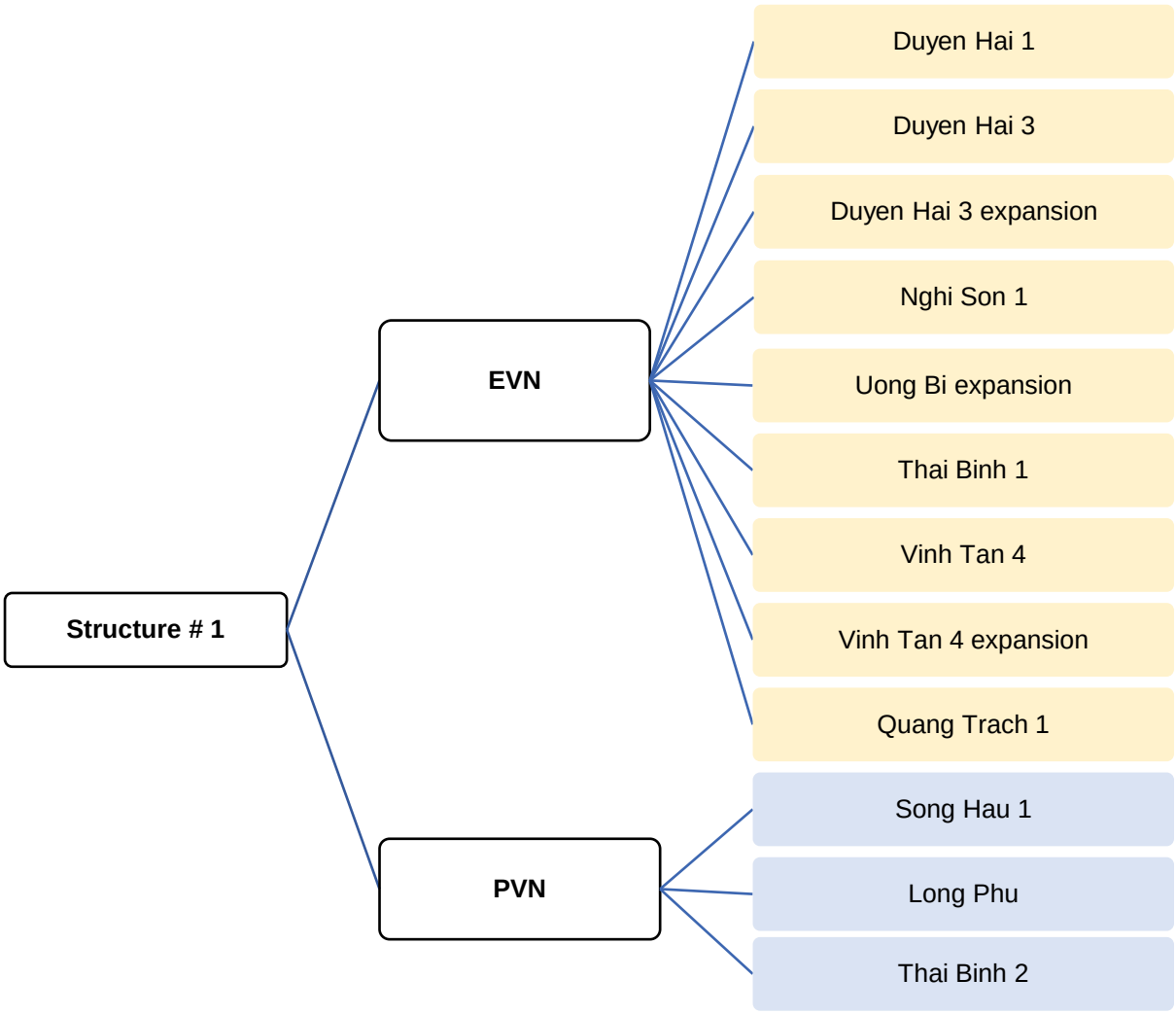
Figure 17: List of CFPPs corresponding to each ownership structure



5.1.2. Details of each ownership structure

Structure # 1

Figure 18: List of CFPPs in Structure # 1



a. Description of Structure # 1:

Structure # 1 includes CFPPs in which the State capital is dominant, up to 100% of the decisional power on CFPPs phase-out/phase-down, including (i) Capital directly from the State budget accounts for 100% of the decisional power; or capital of SOEs (in which the State owns 100% of the charter capital) accounting for 100% of the decisional power. For clarification, SOEs will be able to make decisions on phasing out/phasing down their corresponding CFPPs under this Structure # 1 without being influenced by any party. Looking more closely at the organization and management systems of the CFPPs under this Structure, two typical models are discovered:

- CFPPs are under SOEs' branches or SOE's project management boards, for example, Thai Binh 1, and Song Hau 1. These CFPPs are directly under the management and operation of the SOEs' branches or Project Management Boards, and **SOEs' Members' Councils** have complete authority over the CFPP phase-out/phase-down.

  Example: Song Hau 1 power plant was invested by PVN and implemented under specific mechanisms and policies for construction investment according to Decision No. 2414/QD-TTg dated 11/12/2013 of Prime Minister[36]. The Song Hau 1 Power Plant is managed by the branch of PVN - Song Hau 1 Project Management Board, which is registered as a branch of PVN founded on December 30, 2014, with the tax code: 0100681592-005. Accordingly, the Members' Council of PVN has full decision-making authority over this power plant phase-out/phase-down.

- CFPPs are under branches of 100% SOEs-owned subsidiaries, for example, Duyen Hai 1. Regarding this model, the CFPPs are managed and operated directly by the branches of SOEs-owned subsidiaries and the entire decision-making authority over the CFPPs will belong to the **Members' Councils of the subsidiaries**, who in essence represent the State's capital in such entities.

  Example: Duyen Hai 1 power plant is under the management of Duyen Hai Thermal Power Company - Branch of EVNGENCO1. Duyen Hai Thermal Power Company was established under EVNGENCO 1 Decision No. 27/QD – EVNGENCO1 dated January 29, 2015, with its functions as electricity generation and trade, management, and operation of CFPPs in Duyen Hai (including Duyen Hai 1 power plant)[37]. As publicized on the National Business Registration Portal, Duyen Hai Thermal Power Company – Branch of EVNGENCO1 (Enterprise No.: 5701662152-009) was registered as a branch of EVNGENCO1. The Members' Council of EVNGENCO1 accordingly has full decision-making authority over Duyen Hai 1 power plant phase-out/phase-down.

b. Overall pictures of CFPPs in Structure # 1 regarding the competence to decide to phase out/phase down the CFPPs:

- EVN: having a 100% decision-making dominance in the following 09 (nine) CFPPs: Duyen Hai 1, Duyen Hai 3, Duyen Hai 3 expansion, Nghi Son 1, Uong Bi expansion, Thai Binh 1, Vinh Tan 4, Vinh Tan 4 expansion, and Quang Trach 1, in which:
  - The total decision-making power belongs to EVN Members' Council: Thai Binh 1, Vinh Tan 4, Vinh Tan 4 expansion, and Quang Trach 1;

[36] More at: https://www.evn.com.vn/d6/news/EVN-va-PVN-ky-hop-dong-mua-ban-dien-Nha-may-Nhiet-dien-Song-Hau-1--6-12-30460.aspx Retrieved on 17/08/2022.

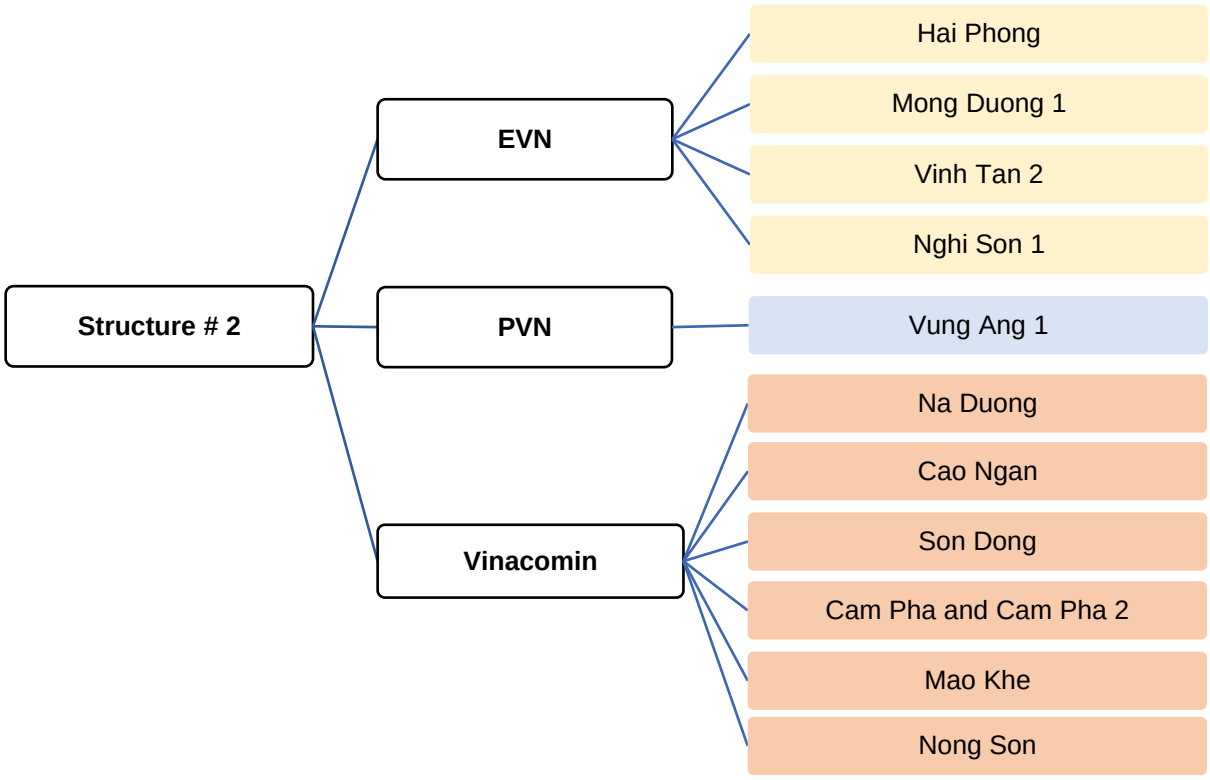
[37] More at: https://www.tpcduyenhai.com.vn/c3/vi-VN/gioi-thieu/Gioi-thieu-chung-2-520 Retrieved on 18/08/2022.

- The total decision-making power belongs to Members' Councils of EVN's subsidiaries (EVNGENCO1): Duyen Hai 1, Duyen Hai 3, Duyen Hai 3 expansion, Nghi Son 1, and Uong Bi expansion.

- PVN: having a 100% decision-making dominance in the following 03 (three) CFPPs: Song Hau 1, Thai Binh 2, and Long Phu, and the whole CFPPs are under the 100% decision-making power of PVN's members' council.
- Vinacomin: There are no CFPPs related to Vinacomin under this Structure # 1.

Structure # 2

Figure 19: List of CFPPs in Structure # 2



a. Description of Structure # 2:

According to the above diagram, there are currently 11/27 CFPPs of Structure # 2 with the State capital proportion from 75% to less than 100% related to EVN, PVN, and Vinacomin, including:

- **EVN:**
  - **Hai Phong Thermal Power Plant** under Hai Phong Thermal Power Joint Stock Company, in which, the State capital accounts for approximately 93% of the Charter capital of Hai Phong Thermal Power Joint Stock Company (in which: EVNGENCO2: 51%, SCIC: 9%, Vinacomin Power: 7.21%, Pha Lai Thermal Power Joint Stock Company: 25.97%, and other shareholders: 6.82%).

- **Mong Duong 1 Thermal Power Plant** under EVNGENCO3, in which, the State capital accounts for approximately 99.19% of the Charter capital of EVNGENCO3 (EVN: 99.19%, and other shareholders: 0.01578%).
- **Vinh Tan 2 Thermal Power Plant** under EVNGENCO3, in which, the State capital accounts for approximately 99.19% of the Charter capital of EVNGENCO3 (EVN: 99.19%, and other shareholders: 0.01578%).

- **PVN:**
  - **Vung Ang 1 Thermal Power Plant** under PV Power, in which, the State capital accounts for approximately 79.94% of the Charter capital of PV Power (PVN: 79.94%, foreign shareholders: 2.9%, and other shareholders).

- **Vinacomin:**
  - All 06 (**six**) CFPPs, including **Na Duong Thermal Power Plant, Cao Ngan Thermal Power Plant, Son Dong Thermal Power Plant, Cam Phan Thermal Power Plant, Cam Pha 2 Thermal Power Plant, and Mao Khe Thermal Power Plant are under Vinacomin Power,** in which, the State capital accounts for approximately 99.27% of the Charter capital of Vinacomin Power (Vinacomin: 99.27%, Bitexco: 0.00022%, Vietnam Industrial Construction Corporation: 0.7775%, and 02 foreign shareholders).
  - **Nong Son Thermal Power Plant under Nong Son Coal & Power Joint Stock Company**, in which, the State capital accounts for approximately 88.77% of the Charter capital of Nong Son Coal & Power Joint Stock Company (Vinacomin: 88.77%, and other shareholders: 11.23%).

b. Overall pictures of CFPPs in Structure # 2 regarding the competence to decide to phase out/phase down the CFPPs

All the CFPPs of this Structure # 2 are under the joint stock company model, in which, the State capital is significant, from 75% to less than 100%. According to the Law on Enterprises 2020, the authority to phase out/phase down the CFPPs will be subject to the General Meeting of Shareholders (**GMS**) or the Board of Directors, in particular:

- **The GMS**: has the right to decide on the investment or sale of assets with a value from at least 35% of the total asset value stated in the latest financial statement of the company with the proportion of votes to approve resolutions of the GMS being the affirmative votes of at least 65% of the total votes by all attending shareholders, unless otherwise prescribed by the company's charter (Law on Enterprises 2020, Article 138.2.(d) and Article 148.1).
- **The Board of Directors**: has the right to decide on the investment or sale of assets with a value under 35% of the total asset value stated in the latest financial statement of the company with the proportion of votes to approve resolutions of the Board of Directors being the affirmative votes by majority of the attending members of the Board of Directors, unless otherwise prescribed by the company's charter (Law on Enterprises 2020, Article 153.2.(e) and Article 157.12).

In short, to determine whether the authority to phase out/phase down the CFPPs is subject to the GMS or the Board of Directors, it is requested to identify the total current value of the CFPPs project as compared to the total asset value of the thermal power joint stock company as stated in the latest financial statement. At the same time, it is necessary to review the charter of the companies that own the CFPPs to determine the exact decision-making authority to phase out/phase down the CFPPs and the rate of approval of the resolutions of the GMS, and the Board of Directors. Pursuant to the provisions of the applicable Law on Enterprises, the authority to phase out/phase down the CFPPs is determined as follows:

- **Scenario 1:** If the value of a thermal power plant is equal to or greater than 35% of the total asset value of the thermal power joint stock company as stated in the latest financial statement, the GMS will have the authority to decide to phase out/phase down the thermal power plant. In this case, the number of votes by the enterprises representing the State capital (EVN, PVN, Vinacomin, EVNGENCO2, SCIC, or Vinacomin Power) is currently greater than 65% of the total votes at the GMS. Therefore, with the affirmative votes by the enterprises representing the State capital, the voting rate is sufficient to approve the resolution of the GMS on the CFPPs phase-out/phase-down.
- **Scenario 2:** If the value of a thermal power plant is less than 35% of the total asset value of the thermal power joint stock company as stated in the latest financial statement, the Board of Directors will have the authority to decide to phase out/phase down the thermal power plant.

Thus, if the enterprises representing the State capital (EVN, PVN, Vinacomin, EVNGENCO2, SCIC, or Vinaccomin Power) have their representatives being members of the Board of Directors occupy the majority in the Board of Directors of the thermal power joint stock company, the decision by the Board of Directors on phase-out/phase-down of the thermal power plant may be approved.

Example: Mong Duong 1 Thermal Power Plant under EVNGENCO3, the Charter of EVNGENCO3 issued in June 2022 provides that:

- The GMS has the right to "*decide on investment or sale of assets with the value from at least 35% of the total asset value stated in the latest financial statement of EVNGENCO3*[38]" with the proportion of votes to approve resolutions of the GMS being the affirmative votes of at least 65% of the total votes by all attending shareholders[39].
- The Board of Directors has the right to "*decide on investment plans or investment projects within its competence and within the limits prescribed by law*[40]" with the proportion of votes to approve resolutions of the Board of Directors being the affirmative votes by majority of the attending members of the Board of Directors. In case where the number of

[38] The Charter of EVNGENCO3, Article 15.1.(d)

[39] The Charter of EVNGENCO3, Article 21.1

[40] The Charter of EVNGENCO3, Article 27.2.(x)

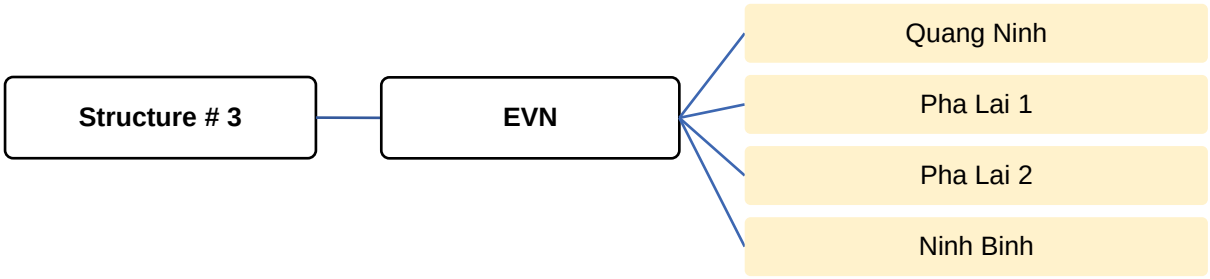
affirmative votes and negative votes are equal, the vote of the President of the Board of Directors is the decisive vote[41].

To determine the authority to phase out/phase down the CFPPs, it is requested to identify the total current value of the CFPPs project. In the case where the total current value of Mong Duong 1 Thermal Power Plant is equal to or greater than 35% of the total asset value of EVNGENCO3 as stated in the latest financial statement, the authority to phase out/phase down this power plant belongs to the GMS. Accordingly, the proportion of votes of EVN is 99,19% (greater than 65%) of the total votes at the GMS of EVNGENCO3. Therefore, with the affirmative votes by EVN, the voting rate is sufficient to approve the resolution of the GMS on this power plant phase-out/phase-down.

In the case where the total current value of Mong Duong 1 Thermal Power Plant is less than 35% of the total asset value of EVNGENCO3 as stated in the latest financial statement, the authority to phase out/phase down this power plant belongs to the Board of Directors. According to information in EVNGENCO3's Management Information dated July 26, 2022, the Board of Directors of EVNGENCO3 has 04 members. Thus, the phase-out/phase-down of Mong Duong 1 Thermal Power Plant can be approved if EVN has 02 members of the Board of Directors and one of the members holds the position of President of the Board of Directors of EVNGENCO3.

Structure # 3

Figure 20: List of CFPPs in Structure # 3



a. Description of Structure # 3:

According to the above diagram, there are currently 04/27 CFPPs of Structure # 3 with the State capital proportion from 51% to less than 75% and all of them are under EVN, including:

- Quang Ninh Thermal Power Plant under Quang Ninh Thermal Power Corporation, in which, the State capital accounts for approximately 73% of the Charter capital of Quang Ninh Thermal Power Corporation (in which, EVNGENCO 1: 42%, SCIC: 11.42% and Vinacomin Power: 10.62%).
- Pha Lai 1 Thermal Power Plant and Pha Lai 2 Thermal Power Plant under Pha Lai Thermal Power Corporation, in which, the State capital represented by EVNGENCO2 accounts for 51% of the Charter capital of Pha Lai Thermal Power Corporation.

[41] The Charter of EVNGENCO3, Article 30.13

- Ninh Binh Thermal Power Plant under Ninh Binh Thermal Power Corporation, in which the State capital represented by EVNGENCO3 accounts for approximately 54.76% of the Charter capital of Ninh Binh Thermal Power Corporation.

b. Overall pictures of CFPPs in Structure # 3 regarding the competence to decide on phase-out/phase-down CFPPs

According to the Charter of Quang Ninh Thermal Power Corporation, Pha Lai Thermal Power Corporation, and Ninh Binh Thermal Power Corporation, the authority to phase out/phase down the CFPPs will be subject to the General Meeting of Shareholders (**GMS**) or the Board of Directors, in particular:

- **General Meeting of Shareholders**: has the right to decide on investment or sale of assets with the value from at least 35% (or 20%) of the total asset value stated in the latest financial statement of the Company with the proportion of votes to approve resolutions of the GMS being the affirmative votes of at least 65% (or 75%) of the total votes by all attending shareholders.

- **The Board of Directors**: has the right to decide on investment or sale of assets with the value under 35% (or 20%) of the total asset value stated in the latest financial statement of the Company with the proportion of votes to approve resolutions of the Board of Directors being the affirmative votes by majority of the attending members of the Board of Directors.

In short, to determine whether the authority to phase out/phase down CFPPs is subject to the GMS or the Board of Directors, it is requested to identify the total current value of the CFPPs project as compared to the total asset value of the thermal power joint stock company as stated in the latest financial statement.

- **Scenario 1**: If the value of a thermal power plant is equal to or greater than 35% (or 20%) of the total asset value of the thermal power joint stock company as stated in the latest financial statement, the GMS will have the authority to decide the phase-out/phase-down of the thermal power plant. In this case, the number of votes by the enterprises representing the State capital (EVNGENCO1 or EVNGENCO2, or EVNGENCO3) is currently fewer than 65% of the total votes at the GMS. Therefore, with the affirmative votes only by the enterprises representing the State capital, the voting rate is insufficient to approve the resolution of the GMS on the phase-out/phase-down of the CFPPs.

  Consequently, besides the approval by the Shareholders being enterprises representing the State capital, it requires further approval by other shareholders in thermal power joint stock companies so that resolutions of the GMS on phase-out/phase-down of the CFPPs are adopted.

- **Scenario 2:** If the value of a thermal power plant is less than 35% (or 20%) of the total asset value of the thermal power joint stock company as stated in the latest financial statement, the Board of Directors will have the authority to decide the phase-out/phase-down of the thermal power plant.

  Thus, if the enterprises representing the state capital (EVNGENCO1 or EVNGENCO2, or EVNGENCO3) have their representatives being members of the Board of Directors who occupy the majority in the Board of Directors of the thermal power joint stock company, the decisions by the Board of Directors on phase-out/phase-down of the CFPPs may be approved.

Example: **With regard to Pha Lai 1 Thermal Power Plant and Pha Lai 2 Thermal Power Plant,** the Charter of Pha Lai Thermal Power Corporation issued in April 2021 provides that: "The GMS has the right to "decide transaction/sale of assets with the value of at least 35% of the total asset value of the Company as stated in the audited financial statement of the latest period"[42] with the rate of votes for approving resolutions of the GMS being: from 65% of the total votes by the shareholders entitled to voting being present in person or by proxy at the GMS[43].

According to the information collected from the practical survey at Pha Lai 1 Thermal Power Plant and Pha Lai 2 Thermal Power Plant, the value of Pha Lai 1 Thermal Power Plant and the value of Pha Lai 2 Thermal Power Plant is greater than 35% of the total asset value stated in the latest audited financial statement of Pha Lai Thermal Power Corporation. Therefore, the GMS of Pha Lai Thermal Power Corporation has the authority to decide the phase-out/phase-down of Pha Lai 1 Thermal Power Plant and Pha Lai 2 Thermal Power Plant. However, the votes by the shareholder namely EVNGENCO 2 only accounts for 51% (smaller than 65%) of the total votes at the GMS; thus, it is insufficient to approve the relevant resolutions of the GMS of Pha Lai Thermal Power Corporation.

Consequently, to approve the resolution of the GMS on the phase-out/phase-down of Pha Lai 1 Thermal Power Plant and Pha Lai 2 Thermal Power Plant, it further requires the approval by other shareholders holding at least 14% of the charter capital of Pha Lai Thermal Power Corporation.

[42] Charter of Pha Lai Thermal Power Corporation, Article 15.2 (l), Article 21.3

[43] It should be noted that the rate of votes for approving resolutions, decisions of the GMS is accounted based on the total affirmative votes of all shareholders attending and voting at the meeting (According to the amendment contents provided in Article 7, clause 5 Law on Amendment to the Law on Public Investment, the Law on Investment under Public-Private Partnership method, the Law on Investment, the Law on Housing, the Law on Bidding, the Law on Electricity, the Law on Enterprises, the Law on Special Consumption Tax and the Law on Civil Judgment Enforcement 2022)

Structure # 4

Figure 21: List of CFPPs in Structure # 4

a. Description of Structure # 4

According to the above diagram, there is currently 01 thermal power plant of Structure # 4 with the State capital proportion of less than 51%, which is Vinh Tan 1 Thermal Power Plant related to Vinacomin.

Vinh Tan 1 Thermal Power Plant under Vinh Tan 1 Thermal Power Limited Company, in which, the State capital proportion represented by Vinacomin Power accounts for 5% of the Charter capital of Vinh Tan 1 Thermal Power Limited Company.

b. Overall pictures of CFPPs in Structure # 4 about the authority to phase out/phase down the CFPPs

Vinh Tan 1 Thermal Power Limited Company operates in the form of a limited liability company with two or more members, therefore, the Members' Council is the authority to decide on this power plant phase-out/phase-down.

Article 55.2 and Article 59.3 of the Law on Enterprises 2022 provide that: the Members' Council has the right to "*determine the development strategy and annual business plan of the company, decide on investment and development projects of the company*", "*through the sale of assets valued from at least 50% of the total asset value as stated in the latest financial statements or a smaller percentage or value as stipulated in the company's charter*" with the proportion of affirmative votes of at least 65% (or 75%) of the total capital contributed by all the attending members.

Pursuant to the above provisions, the State capital proportion in Vinh Tan 1 Thermal Power Limited Company is less than 51% of the total contributed capital of all members, which is not enough to decide on the phase-out/phase-down of the CFPPs.

5.2. Commercial input and output contracts

5.2.1. Overview

The objective of this section is to describe the legal conditions of main commercial input and output contracts of SOEs and their subsidiaries regarding the operation of their CFPPs, such as power purchase agreement – PPA (output contract) and the coal supply contract (input contract). This description includes the necessary information as a basis for legal assessment related to the commercial input and output contracts, in case CFPPs conducts phase-down and/or phase-out plans. Legal assessment regarding these contracts shall be the assessment on the possibility of contract amendments, termination premature termination of the contract, obligations of the parties upon termination, and application of contract remedies.

Our desk research and onsite survey have discovered the general legal conditions of the commercial input and output contracts as follows:

- SOEs and their subsidiaries have two (02) main contracts during the CFPPs' operation which are PPA (output contract) and the coal supply contract (input contract). Other contracts include purchase contract of other input materials i.e. limestone, industrial chemicals; by-product sale contracts of i.e. selling ash and slag for building materials production.
- SOEs and their subsidiaries have to signed the PPA based on the model PPA stipulated by Ministry of Industry and Trade. The coal supply contract does not have by-law model contract like the PPA and hence, SOEs and their subsidiaries can agree with their coal suppliers on the contents/formality of the contract, provided that such agreement is compliance with Civil Code, Law on Commerce and relevant laws.
- Before signing the commercial contracts, SOEs and their subsidiaries may have to proceed with two procedures: **(i)** bidding and/or **(ii)** internal approvals to comply with the Law on Bidding, Law on Enterprises, the charters and other internal governance regulations of SOEs and their subsidiaries.
- The contract term varies case by case: PPA's the term is up to 25 years, while the term of the coal supply contract is up to 40 years.

5.2.2. Power Purchase Agreement (PPA)

Up to present, PPA form has been regulated by 03 circulars of the Ministry of Industry and Trade in different periods:

- *From January 28, 2011 to February 3, 2015:* PPA form is governed by Circular 41/2010/TT-BCT issued on December 14, 2010
- *From February 3, 2015 to February 21, 2021:* the form is governed by Circular 56/2014/TT-BCT issued on December 19, 2014
- *From February 22, 2021 up to now:* the form is governed by Circular 57/2020/TT-BCT issued on December 31, 2020.

The model contract is mandatory and applicable to power purchase transactions among power plants between power generating units and Vietnam Electricity Group. Before January 28, 2011, EVN and the power generation companies/plants negotiated and drafted Power Purchase Agreements as agreed between the parties. The PPAs signed before the effective date of Circular 41/2020/TT-BCT must be converted into PPA under the mandatory model within 09 months from the date of effectiveness of Circular 41/2010/TT-BCT[44]. Therefore, up to present, the PPAs between the power generating companies/plants and EVN are established under one of the model contracts issued in accordance with the above-mentioned circulars.

Main contractual terms and conditions

Term of contract: Depending on each model PPA, the term of contract may vary as follows:

- For the model PPA issued under Circular 41/2010/TT-BCT and Circular 56/2014/TT-BCT, the term of the PPA will be calculated from the effective date of the PPA to the later in the following two dates (i) The day of ending the operation of the Competitive Power Generation Market, as decided by competent state agency; or (ii) 10-year anniversary of the commercial operation date of the Power Plant, excluding the periods of force majeure events[45].
- For the model PPA issued under Circular 57/2020/TT-BCT, the term of the PPA will be calculated from the effective date of the contract to the 25-year anniversary of the commercial operation date of the CFPP[46].

The electricity selling price will be agreed upon by the parties and determined following each method specified in the Circulars of the Ministry of Industry and Trade promulgating the PPA form.

The average power output of multiple years under the contract term will be specified in the PPA. The annual and monthly power output will be confirmed by the Buyer and the Seller's signatures in accordance with the regulations of the competitive electricity market. Currently, in PPAs, there are no detailed provisions on adjusting power output in case the CFPP cuts capacity.

The provision on compensation for damage as established in the model PPAs regulate similarly that the violating Party is responsible for compensating the aggrieved Party for damage caused by the violating Party's acts in accordance with the provisions of the applicable Civil Code[47].

Early termination of the PPA: Except for the expiration of the PPA's Term, both parties have the right to agree in writing on early termination of the PPA.

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[44] Circular No. 41/2010/TT-BTC, Article 19 Clause 3

[45] Model PPA model contract issued under Circular 41/2010/TT-BCT and Circular 56/2014/TT-BCT, Article 2 Clause 2

[46] Mode PPA issued under Circular 57/2020/TT-BCT, Article 2 Clause 2

[47] Mode PPA issued under Circular 41/2010/TT-BCT, Article 11 Clause 2; Mode PPA issued under Circular 56/2014/TT-BCT and Circular 57/2020/TT-BCT, Article11

Unilateral termination of the PPA: The model PPAs all provide 03 cases of unilateral termination of the PPA before the due date as follows:

- If one party is dissolved or bankrupt or insolvent and the aforementioned event lasts for a long time, affecting one of the Contracting parties, the affected party will have the right to unilaterally terminate the PPA after 90 days from the date of sending the notice to the other party; or
- If either party seriously violates the obligations under the PPA and such breach is not remedied within 90 days from the date of notice of the aggrieved Party of such act, the breached Party has the right to unilaterally terminate the PPA after 30 days from the date of sending the notice; or
- When a force majeure event occurs and this event lasts for 180 days or more, the other party has the right to unilaterally terminate the PPA after 30 days from the date of sending the notice.

The provision on unilateral termination of the PPA is one of the important provisions to keep in mind as CFPPs make reductions or entire plant closures to avoid breach of obligations in the PPA.

5.2.3. Coal supply contract

SOEs and their subsidiaries owning the CFPPs have executed the coal supply contracts pursuant to the Directive No. 29/CT-TTg on continuing to strengthen the State management of coal production, business and supply for power production, particularly[48]:

- *For the use of domestic coal*: The plant investor buys coal from Vinacomin, Dong Bac Corporation or from other enterprises with legitimate coal origin according to regulations, ensure the competitive and efficient coal prices.
- *For imported and blended coal*: The plant investor directly imports or purchase coal products from Vinacomin, Dong Bac Corporation or other enterprises, ensuring the legitimacy of the coal sources and competitive and effective coal prices.

SOEs and their subsidiaries mainly signed the coal supply contract with two main coal suppliers in Viet Nam which are Vinacomin and Dong Bac Corporation for supplying domestic coal. Regarding imported coal, SOEs and their subsidiaries signed with Dan Ka[49], supplier consortium[50] or other suppliers.

[48] Directive No. 29/CT-TTg, Section 12 https://thuvienphapluat.vn/van-ban/Dau-tu/Chi-thi-29-CT-TTg-2019-quan-ly-hoat-dong-san-xuat-kinh-doanh-than-va-cung-cap-than-san-xuat-dien-430108.aspx

[49] https://baodauthau.vn/khoang-san-dan-ka-nha-thau-khung-trong-linh-vuc-cung-cap-than-post121578.html

[50] https://nangluongsachvietnam.vn/d6/vi-VN/news/Ky-hop-dong-cung-cap-nhien-lieu-than-cho-Nha-may-nhiet-dien-Song-Hau-1-6-166-15636

Main contractual terms and conditions

The contract term: The contract term varies depending on several elements of the transactions i.e. the regimes/needs of each companies/CFPPs, the capacity of the coal suppliers from time to time. During our desk research and onsite survey, we observed the following agreed contract terms: 01 year, 5 years, 10 years, 40 years.

Material rights and obligations: The seller is obliged to supply coal with, among other conditions, volume/type/supply schedule and other conditions in accordance with the contract, while the buyer is obliged to (i) make payment for the coal and (ii) guarantee the minimum coal consumption (e.g. 80% agreed coal volume). If (i) the seller does *not* guarantee the supply volume or (ii) the buyer does *not* guarantee the consumption of the minimum volume which is not due to the fault of the other party, the breaching party is liable to pay the breached party an amount equal to 8% of the value of the breached contract. [51]This payable amount is in compliance with the regulation of Vietnamese Commercial Law[52].

Cases of contract amendment: The contract may be amended if there is any change arisen during the contract implementation i.e. change of coal price/types, change of coal volume which exceeds the scope of contract. Pursuant to majority of coal supply contract, a party has to notify the remaining party of any change arisen and both parties agree in writing i.e. by signing the contract annex. in order for such change to come into effect.

Cases of early termination: The coal supply contract may be terminated before the end of agreed contract term due to the following events:

1. Force Majeure prevent a party from performing its obligation in certain period e.g. 90 consecutive days[53];
2. Decision of the state competent authorities[54];
3. A party is dissolved, bankrupt or ceased to operate under a decision of a competent authority[55].
4. The seller or the buyer has the right to unilaterally terminate the contract without paying any costs by giving a written notice and sending it to the other party in one of the following cases[56]:

[51] Contract No. 29/HĐHD/ĐB-ĐLTKV signed on 11/12/2021

[52] Vietnamese Commercial Law, Article 301

[53] Contract No. 246HĐ/TKV-ĐLTKV signed on 29/12/2021

[54] Contract No. 29/HĐHD/ĐB-ĐLTKV signed on 11/12/2021

[55] Contract No. 29/HĐHD/ĐB-ĐLTKV signed on 11/12/2021

[56] Contract No. 29/HĐHD/ĐB-ĐLTKV signed on 11/12/2021

- The buyer fails to purchase the full volume registered in the annual sales contract for two (02) consecutive years, unless the other party accepts.
- The buyer or the seller fails to remedy the breach of contract within 45 days from the date of the other party's written request.

The obligation performance of a party may be affected/interrupted by a phase-down/phase-out procedures leading to the possibility of early contract termination. It is very important to carefully consider the applicability of an early termination clause in order to avoid a breach for terminating contrary to the contract.

Collected information of coal supply contracts

a. Structure #1 (100% state capital)

EVN (Thai Binh 1, Vinh Tan 4, Vinh Tan 4 Expansion, Quang Trach 1)

On April 23, 2022, EVN has negotiated and signed the coal supply coordination minutes with Vinacomin, in which both parties agreed to perform the following main commitments[57]:

- Vinacomin will supply EVN undelivered coal in the first quarter of 2022 (about 800,000 tons) in the remaining quarters of 2022. In the remaining months of 2022, Vinacomin will supply and EVN commits to receive sufficient coal volume the same under the signed coal supple contract.
- 02 Parties shall **(i)** coordinate frequently on the coal supply to EVN's thermal power plants in 2022, **(ii)** together handle any issue arising in the coal supply process; **(iii)** discuss and agree on other relevant contractual contents and jointly report to competent state authorities on matters beyond their competence.

The above information shows that EVN and Vinacomin have re-scheduled the coal delivery schedule of their signed coal supply contract to match the actual coal supply situation.

PVN (Song Hau 1, Thai Binh 2, Long Phu 1)

Song Hau 1: PVN Branch - Song Hau 1 Project Management Board and DVS Supplier Consortium consisting of **(i)** Dan Ka Minerals, **(ii)** Viet Phat Import-Export Trading Investment Joint Stock Company and **(iii)** SUEK AG Company (a Russian mining company) have signed a contract to supply coal on March 14, 2022, the contract performance period is 365 days[58]. The Contractor Consortium is selected by PVN Branch - Song Hau 1 Project Management Board to implement the bidding package to supply coal for the commercial

[57] https://www.evn.com.vn/d6/news/EVN-va-TKV-ky-bien-ban-phoi-hop-dam-bao-cung-ung-nang-luong-cho-phat-trien-kinh-te-0-12-30407.aspx

[58] https://nangluongsachvietnam.vn/d6/vi-VN/news/Ky-hop-dong-cung-cap-nhien-lieu-than-cho-Nha-may-nhiet-dien-Song-Hau-1-6-166-15636

operation of Song Hau 1 Thermal Power Plant in 2022 with the winning price of more than 11.965 billion VND[59].

b. Structure #2 (75% - under 100% state capital)

EVNGENCO1 (Duyen Hai 1, Duyen Hai 3, Duyen Hai 3 Expansion, Nghi Son 1, Uong Bi Expansion)

On 26/08/2019, EVNGENCO1 has signed coal supply contracts with Dong Bac Corporation to supply coal to Duyen Hai 1 in the period of 2020 - 2045[60].

EVNGENCO3 (Mong Duong 1, Vinh Tan 2)

EVNGENCO3 has signed long-term coal supply contracts with Vinacomin and Dong Bac Corporation, in which:

- Regarding Vinh Tan 2, the total committed coal supply volume is 02 million tons/year[29].
- Regarding Mong Duong 1, Vinacomin' committed coal supply volume 03 million tons/year and Dong Bac's coal supply volume shall be 500,000 – 800,000 tons[61].

Hai Phong Thermal Power JSC (Hai Phong)

- *Domestic coal supplier*: Hai Phong Thermal Power JSC has signed coal supply contracts with Vinacomin and Dong Bac Corporation. The contract term with Vinacomin is 40 years, while contract term with Dong Bac Corporation is 05 years[62] due to Dong Bac Corporation's distinctive characteristic i.e. its smilitary peculiarities[63].
- *Imported coal supplier*: In 2020, Dan Ka Minerals won the bidding to supply imported coal in 2020 for Hai Phong Thermal Power JSC (415.58 billion VND)[64].

[59] https://baodauthau.vn/khoang-san-dan-ka-nha-thau-khung-trong-linh-vuc-cung-cap-than-post121578.html

[60] http://evngenco1.com.vn/d6/vi-VN/news/Ky-hop-dong-cung-cap-than-dai-han-cho-NMND-Duyen-Hai-1-giai-doan-2020-2045--6-1322-514

[61] https://www.genco3.com/tin-tuc/tin-tuc-evngenco-3/evngenco-3-cam-ket-dam-bao-cung-cap-du-dien-trong-nam-2020-va-2021

[62] KS Securities's Report on Hai Phong Thermal Power JSC https://www.kbsec.com.vn/pic/Service/KBSV_HND_Baocaocapnhat_20201020.pdf

[63] Dong Bac Corporation is the company operated under the Ministry of National Defense of Viet Nam

[64] https://baodauthau.vn/khoang-san-dan-ka-nha-thau-khung-trong-linh-vuc-cung-cap-than-post121578.html

PV Power (Vung Ang 1)

- PV Power has signed with Vinacomin the coal supply contract No. 03 HĐ/TKV-PVPower since 04/01/2018. While the agreed coal supply volume in the contract is 2,200,000 tons, Vinacomin provided PV Power with 2,331,934.8 tons (achieving 106% the agreed coal supply volume)[65].
- Dan Ka Minerals won (i) the bidding to supply 200,000 coal tons for Vung Ang 1's operation in 2020 (for 455.18 billion VND) and (ii) the bidding to supply 450,000 coal tons for Vung Ang 1's operation in 2021 (for 1,061 billion VND)[66].

Vinacomin Power (Na Duong, Cao Ngan, Son Dong, Cam Pha & Cam Pha 2, Mao Khe, Nong Son)

Vinacomin Power has signed the coal supply contracts with Vinacomin (its major shareholder) and Dong Bac Corporation to supply coal for its CFPPs[67]. Majority of the supply contracts has short contract term from 07 months to 01 year. A coal supply contract may include the coal supply for various CFPPs[68].

c. Structure #3 (51% - under 75% state capital)

Quang Ninh Thermal Power JSC (Quang Ninh)

Quang Ninh Thermal Power JSC has signed with Vinacomin and Dong Bac Corporation long-term coal supply contracts with the average coal price ranging from 1.6-1.8 million VND/ton[69].

Pha Lai Thermal Power JSC (Pha Lai & Pha Lai 2)

Pha Lai Thermal Power JSC has signed with Vinacomin the coal supply contract with the contract term of 10 years to ensure the stable CFPP's operation[70].

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[65] PV Power's annual report 2018, https://www.pvpower.vn/wp-content/uploads/2019/04/190411-bao-cao-thuong-nien-pow-2018-final.pdf

[66] https://baodauthau.vn/khoang-san-dan-ka-nha-thau-khung-trong-linh-vuc-cung-cap-than-post121578.html

[67] Vinacomin Power's prospectus on dated 07/12/2021, page 32

http://www.nhietdiencampha.com.vn/userfiles/B%E1%BA%A3n%20c%C3%A1o%20b%E1%BA%A1ch%20(1).pdf

[68] Coal supply contract No. 12HĐ/TKV-ĐLTKV (Contract term from 22/01/2021 to 31/12/2021) for supplying coal to Na Duong, Cao Ngan, Dong Trieu, Cam Pha.

[69] Report of KB Securities dated 01/08/2022, page 4

https://www.kbsec.com.vn/pic/Service/KBSV_QTP_Update_01082022.pdf

[70] Report of KIS Vietnam Securities Corporation on 10/10/2019

https://kisvn.vn/wp-content/uploads/2020/02/PPC_Full_Vie_20191010.pdf

Ninh Binh Thermal Power JSC (Ninh Binh)

Ninh Binh Thermal Power JSC has signed a long-term coal supply contract with Vinacomin and Dong Bac Corporation to supply coal for Ninh Binh, the total committed coal volume is 300,000 tons per year[71].

d. Structure #4 (under 51% state capital)

Vinh Tan 1 Power Company Limited (Vinh Tan 1)

Vinh Tan 1 Power Company Limited has signed a coal supply contract with Vinacomin since the end of 2013[72].

5.3. Loan/capital agreement

From our desk research and in-dept interview, the long-term loans between CFPPs and domestic and foreign commercial banks have a term of 10-17 years and they are secured by the machines and equipment which are financed by the loans. EVN, PVN and Vinacomin or their SOEs arrange the loan and authorize CFPPs to execute and to carry out the loan contracts. So far, most long-term loan contracts are paid off and terminated. In addition, CFPPs also have a number of short- and medium-term loans used for the purpose of renovating and repairing machinery and equipment. These short- and medium-term loans are being paid paid off by 2024.

For example, Hai Phong CFPP is financed through the e following loan contracts[73]:

- Financing loan contract No. BLA 05135 with total loan value of USD 278,034,200 plus 85% of export credit insurance premium value of China Export Credit Insurance Company. The loan is used to pay off the completed work volume for Hai Phong 1 Thermal Power Plant. The term of the loan is 166 months, with a grace period of 46 months. This loan is unsecured.
- Foreign currency loan (JPY), on-call loan between EVN and Japan Bank for International Cooperation with a total loan value of JPY 7,740,469,321. The loan is used to pay for the completed work volume of Hai Phong 1 Thermal Power Plant. The principal repayment period is 11 years and 6 months from August 20, 2009. This loan is secured.
- Foreign currency loan (JPY), on-call loan between EVN and Japan Bank for International Cooperation with a total loan value of 7,319,484,004 JPY. The loan is used to pay for the completed work volume of Hai Phong 2 Thermal Power Plant. The principal repayment period is 11 years and 6 months from December 20, 2010.

[71] https://www.genco3.com/tin-tuc/tin-tuc-evngenco-3/evngenco-3-cam-ket-dam-bao-cung-cap-du-dien-trong-nam-2020-va-2021

[72] https://vneconomy.vn/khong-de-thieu-than-cho-san-xuat-dien.htm

[73] Audited Financial Statement 2021 of Hai Phong Thermal Power JSC, More at: https://static2.vietstock.vn/data/UPCOM/2021/BCTC/VN/NAM/HND_Baocaotaichinh_2021_Kiemtoan.pdf , Page 29

- Credit contract dated September 24, 2009 with Vietcombank Hoan Kiem Branch. The credit line is 900 billion, and it is used to pay the construction investment costs of Hai Phong 2 Thermal Power Plant. The grace period is 36 months from the date of investment disbursement and the principal repayment period is 120 months from May 31, 2013.

It is expected that by 2024, Hai Phong CFPP's loans will be fully paid off.

According to the plan to cut work volume/close CFPPs from 2030 to 2050, it is likely that the loans of CFPPs shall have been fully paid off and do not bring risks to CFPP managing units as well as parent companies.

5.4. Labor

Currently, CFPPs mainly use two types of labor contracts (i) Indefinite-term contracts and (ii) Definite-term contracts. Of which, a definite-term contract has a duration of up to 36 months from the date of its conclusion, including seasonal labor contract. Some CFPPs do not use seasonal labor contracts such as Cao Ngan, Uong Bi, Cam Pha... During the survey, we found out that CFPPs fully complied with employees' rights and interests in accordance with labor laws through the promulgation and publication of their labor regulation. The grassroots trade unions at CFPPs are established and operate in accordance with the Vietnam Trade Union Charter to ensure legitimate rights and interests of employees.

Employees are enrolled in social insurance, health insurance and unemployment insurance fully in accordance with the law. At some CFPPs such as Vung Ang 1, employees are enrolled in PVI Insurance's high liability insurance.

Thus, CFPPs all comply with and ensure the rights and interests of employees in accordance with labor laws.

5.5. Properties

5.5.1. Overviews

In the case of CFPPs implementing energy transition plans (immediate closure, phased closure, transition on a reduced path from current all coal burning to co-firing, or other fuels, or implementation of projects to reduce emissions...), issues related to assets need to be handled by SOEs in accordance with the law. For each asset disposal plan, there will be legal issues to comply with as follows:

For the land use rights

According to point e, Clause 2, Article 10 of the Land Law 2013, land for energy facilities belongs to the type of land used for public purposes. According to Clause 2, Article 155 of the Land Law "*For land used for public purposes, a detailed construction master plan must be formulated which clearly defines the functional areas used for public purposes involving non-commercial purpose and functional areas used for public purposes involving commercial purpose. The land used for functional areas for non-commercial purposes shall be allocated by the State without land use levy under Article 54 of this Law. The land used for functional areas for commercial purpose shall be leased by the State under Article 56 of this Law*". At point dd, Clause 1, Article 56 of Land Law 2013, the State may lease land and collect an annual land rental or full one-off rental payment for the entire lease period in case economic organizations use land to construct public facilities for commercial purpose.

Term of land use: i) For land in functional areas without commercial purposes, it can be used for a long and stable term[74]; ii) For land in functional areas with commercial purposes, the land lease term shall not exceed 70 years[75].

Land expropriation in case of termination of operation of an investment project in accordance with the law on investment[76] shall be carried out as follows:

- In case land is leased by the State with full one-off rental payment for the entire lease period, land expropriation shall be handled as follows:

  "a) The investor can continue using the land area in 24 months from the date that the investment project terminates pursuant to the legislation on investment;
  b) In 24 months from the date of termination of the investment project as per regulations, the investment can transfer the land use right and sell legitimate properties on the land area to another investor as per the laws.
  If the investor fails to transfer the land use right and sell its legitimate properties on the land area to another investor after the 24-month extension of land use, the government shall expropriate the land area pursuant to Point i, Section 1, Article 64 of the Land Law."

- If the government leases the land area and collects the rent on annual basis, land expropriation shall proceed in the following manner:

  "a) The investor can continue using the land area in 24 months from the date that the investment project terminates pursuant to the legislation on investment;
  b) In 24 months from the date of termination of the investment project as per regulations, the investment can sell legitimate properties on the land area to another investor as per the laws.

[74] Land Law 2013, Article 125 clause 9

[75] Land Law 2013, Article 126 clause 6

[76] Document 04/VBHN-BTNMT of the Ministry of Natural Resources and Environment dated May 4, 2021 detailing the implementation of a number of Articles of the Land Law (Document 04/VNHN-BTNMT), Article 15b

The government shall expropriate the land area from the seller of the properties on the land area and lease it to the buyer of such properties;
c) If the investor fails to sell its legitimate properties on the land area to another investor after the 24-month extension of land use, the government shall expropriate the land area pursuant to Point i, Section 1, Article 64 of the Land Law."

- In case the land user does not have the right to transfer the land use right and has no assets attached to the land, the State shall expropriate the land.

Thus, when the CFPP terminates its operation, within 24 months from the date on which the investment project ceases to operate in accordance with the provisions of law[77], the SOE who owns such CFPP is entitled to settle CFPP's assets attached to the land as prescribed by law. The State expropriates the land from the seller of the asset attached to the leased land to lease it to the buyer. Upon the expiry of the 24-month time limit for extending the land use schedule, but the investor fails to sell his/her lawful asset attached to the land to another investor, the State shall expropriate the land. Therefore, for CFPPs whose project implementation period is about to expire but has not yet been extended, SOEs should pay attention to this legal aspect.

For other assets

- Transfer, sale, liquidation

EVN has the right to actively transfer, sell, and liquidate assets that are damaged, technically outdated, poor quality, non-ultilized or cannot be used to recover capital on the principle of public disclosure, transparency and capital preservation. In case of transfer, sale or liquidation of assets formed from the Government's on-lent loan or government-guaranteed loan when the loan has outstanding balance, the approval of the Donor (for the on-lent loan) or of the Lender (for the government-guaranteed loan) must be obtained and opinion of the Ministry of Finance must be given before the transfer, sale or liquidation[78].

PVN has the right to take the initiative and responsibility to transfer, sell and liquidate fixed assets that are damaged, technically outdated, non-ultilized or cannot be used to recover capital on the principle of public disclosure, transparency and capital preservation in accordance with current regulation of law[79].

VINACOMIN has the right to actively transfer, sell and liquidate assets that are damaged or technically outdated, non-ultilized or cannot be used to recover capital on the principle of public

[77] Investment Law 2020, Article 48

[78] Decree 10/2017/ND-CP of the Government dated December 9, 2017 promulgating the Regulation on Financial Management of EVN (Decree 10/2017/ND-CP), Article 17, Clause 1

[79] Decree 36/2021/ND-CP of the Government dated March 29, 2021 promulgating the Regulation on Financial Management of the Parent Company - PVN (Decree 36/2021/ND-CP), Article 13, Clause 1

disclosure, transparency, and capital preservation. In case of transfer, sale or liquidation of assets formed from the Government's on-lent loan or the government-guaranteed loan when the loan has outstanding balance, the approval of the Donor (for the on-lent loan) or of the Lender (for the government-guaranteed loan) must be obtained and the opinion of the Ministry of Finance must be given before the transfer, sale or liquidation[80].

For the transfer of intellectual property rights, such as: rights to utility solutions, rights to inventions, trademarks, property rights that are the subject of copyright, etc., SOEs register at the Intellectual Property Office of the Ministry of Science and Technology and the Copyright Office of the Ministry of Culture, Sports and Tourism.

- Transfer of assets by method of increasing or decreasing charter capital (without payment)

EVN has the right to transfer assets including electricity system, supplies and equipment directly serving electricity production and business which are belonging to EVN fully owned enterprises to serve its production and business or its restructuring plan which is decided by the Prime Minister. The transfer of these assets shall be done in the form of an increase or decrease in the owner's investment capital. In case of transferring assets formed from the Government's on-lent loan or the government-guaranteed loan when the loan has outstanding balance, the approval of the Donor (for the on-lent loans) or of the Lender (for the government-guaranteed loan) must be obtained before complying with the terms committed with the lender and transferring the debt to the receiver of the asset[81].

PVN has the right to supplement and transfer assets between PVN and subsidiaries in which PVN holds 100% of their charter capital according to the principle of capital increase and decrease, but must ensure its ability to repay debts and not affect the company's production, business and financial situation[82].

VINACOMIN is also entitled to transfer the assets of a subsidiary with 100% of charter capital held by VINACOMIN, but must be responsible for compensation if it causes damage to the subsidiary[83].

[80] Decision No. 406/QD-UBQLV of the Commission for The Management of State Capital (CMSC) dated September 8, 2021 promulgating the Regulations on Financial Management of the Parent Company - VINACOMIN (Decision 406/QD-UBQLV), Article 17, Clause 1

[81] Decree 10/2017/ND-CP, Article 12, Clause 3

[82] Decree 07/2018/ND-CP dated January 10, 2018 of the Government promulgating the Charter of PVN's organization and operation (Decree 07/2018/ND-CP), Article 12, Clause 8

[83] Decree 105/2018/ND-CP of the Government dated August 8, 2018 promulgating the Charter on organization and operation of VINACOMIN (Decree 105/2018/ND-CP), Article 19, Clause 2, Point b;

5.5.2. Current status of survey and research

Through the survey of 06 typical CFPPs (*see information in the table below*), the Research Team found that the majority of SOEs own CFPPs in general and the assets of CFPPs in particular. The legal form of CFPPs is a branch with a dependent accounting regime. Therefore, CFPPs do not identify assets separately. The assets of the CFPPs are completely statistically controlled and managed by the SOEs.

Table 5: Legal information of 06 typical CFPPs

No.	Name of plant	Source of capital	Commercial operation date	Current operating status of the plant	Assets (Movable, immovable, intangible)	Condition of the asset
1	Uong Bi thermal power plant	100% state capital	2009	Active	N/A[84]	N/A
2	Hai Phong thermal power plant	About 93% state capital	2011	Active	N/A	N/A
3	Ninh Binh thermal power plant	About 56,3% state capital	1976	Active	N/A	N/A
4	Vung Ang 1 thermal power plant	About 79,94% state capital	9/2015	Active	N/A	N/A
5	Cao Ngan thermal power plant	About 99% state capital	3/2007	Active	Data from Vinacomin	
6	Pha Lai 1 & Pha Lai 2 thermal power plant	About 52,55% state capital	Pha Lai 1: 1986 Pha Lai 2: 2001	Active	N/A	N/A

- **Conclusion**

In the case of CFPPs transiting energy under different scenarios, the entity that exercises the rights and obligations to the assets of the CFPPs is the SOEs. Based on the publicly available information and through the field survey at the above mentioned CFPPs, the Research Team will continue to analyze and evaluate in more detail the asset disposal procedure and its impact on the energy transition scenarios of CFPPs.

[84] Not available

5.6. Industrial safety (power plant dismantling) and environment

- **Overviews**

When implementing energy transition options for CFPPs such as: energy transition towards sustainable development, building a roadmap to gradually reduce coal power, or promote the development of clean energy, SOEs will need to carry out administration procedures related to safety techniques and environment. Energy transition options for CFPPs will need to address the following legal issues:

Land use

According to the Land Law 2013 (amended and supplemented in 2018) (**Land Law**), land used for CFPPs is non-agricultural land[85]. The forms of land use for CFPPs investment projects are lease of land with annual rental payment, or lease of land with one-off rental payment for the entire lease period in case economic organizations use land for construction of public facilities for commercial purpose. Regarding the obligation in the case of leasing land for commercial purpose, the land renter shall take measures to protect the land; comply with regulations on environmental protection and not to cause damage to the lawful benefits of related land users[86].

For the energy transition plan in the direction of promoting clean energy leading to changes in the structure and operation of CFPPs, land users must fulfill the obligations of environmental restoration, improvement and remediation in accordance with the law. In which, restoration is understood as the return to the current state of the environment before there are activities for production and business purposes. Environmental restoration includes many activities such as leveling, improvement and remediation of the environment. Environmental renovation and restoration are activities to bring the environment and ecosystem in the effected environmental area closer to the original state of the environment or achievement of standards and regulations on safety, environment in service of purposes useful to human being[87].

Safety techniques and environment

In case the energy transition requires dismantling CFPPs, SOEs need to comply with the regulations on construction, occupational safety and health (OSH), environmental protection, regulations in Regulation QCVN 18:2021/BXD on safety in construction is issued together with Circular 16/2021/TT-BXD dated December 20, 2021.

[85] Land Law, Article 10, clause 2, point 2

[86] Land Law, Article 170

[87] Decree 19/2015/ND-CP on detailing the implementation of a number of articles of the Law on Environmental protection (expired)

According to the regulations, the dismantling of CFPPs must ensure safety and environmental protection and be carried out according to the following procedures[88]:

- Develop a demolition plan or solutions. If the work is subject to a demolition decision or coerced demolition, such demolition decision or coerced demolition decision is required when carrying out the demolition;
- Verify and approve the demolition plan or solutions in case of demolition of the construction work significantly affecting the community safety and interests
- Organize the demolition of the construction work;
- Organize supervision and acceptance test of the demolition results.

In addition, the demolition of CFPPs must ensure safety and hygiene for workers and the employer's responsibilities in ensuring safety and hygiene for workers.

For construction works that have great impacts on the safety and benefits of the community in accordance with the law on construction project management, for a period of at least 12 months before each construction work expires, the owner or the manager or the user of the construction work must report to the competent state authority[89] on the expiry date of the construction work and the action plan for the expired construction work[90]. According to Section II.5 Appendix X Decree 15/2021/ND-CP, energy works of class III or higher are works with great impact on community safety and interests. Thus, for CFPPs at the end of life, the owner or manager must report to the competent state authority on the expiry date of the construction work and the action plan for the expired construction work at least 12 months in advance.

The subjects responsible for demolition of CFPPs including owners or managers or users of construction works shall undertake the demolition of construction works in accordance with the law on construction and regulations of other relevant laws[91]. In case investors, owners or managers or users of the construction works fail to fulfill their responsibilities for the demolition of construction works, Presidents of provincial-level People's Committees, Presidents of district-level People's Committees or competent state authorities decide to enforce the demolition and conduct the demolition of construction works[92].

Handling of public property when demolishing CFPP

According to the Law on Management and use of public property No. 15/2017/QH14 on June 21, 2017, amended and suppled in 2020 (**Law on Management and Use of Public Property**), power

[88] Law on Construction 2014 amending and supplementing in 2020 (Law on Construction), Article 118, Clause 2, and Article 1, Clause 44

[89] Decree 06/2021/ND-CP, Article 39, clause 4

[90] Decree 06/2021/ND-CP, Article 41, clause 2

[91] Decree 06/2021/ND-CP, Article 42, clause 2, point a

[92] Decree 06/2021/ND-CP, Article 42, clause 2, point b

supply infrastructure work is public property[93]. For the demolition of construction works that are public property, in addition to complying with the provisions of Decree 06/2021/ND-CP, regulations of the law on management and use of public property must be observed[94]. Thus, the demolition of power plants must follow the regulations on the law on management and use of public property.

Thus, in case that CFPP is dismantled in accordance with an energy transition plan: (i) if the CFPP is decided to downsizing which will cause a planning change, CFPP's assets may be withdrawn by the State; (ii) if the CFPP is decided to close, the assets may be withdrawn or transferred to other state designated organizations[95].

- ## Current status of survey and research

By surveying the current status of some CFPPs and searching for published information on the internet, the Research Team found that currently CFPPs are implementing a transition roadmap based on the current technological change from coal burning to co-firing or other fuels to reduce emissions. For Ninh Binh Thermal Power Plant, this change has been carried out since 2015. The plant has used DO oil fuel to replace FO oil during the furnace start-up process and burned with oil when operating at a low level, keeping the performance of the electrostatic precipitator more stable because the plate is free from oil soot. As a result, the plant's emission status has been improved, and there is no longer black smoke when starting up. At the same time, the plant has researched and tested coal-firing of coal and Biomass technologies to reduce carbon emissions.

Regarding Vung Ang 1 Thermal Power Plant, this plant has applied the technology of using compressing air to convert the oil from flowing liquid state to mist state in order to save fuel oil; the initiative of adjusting the flame temperature at the fuel injectors for the coal-fired boiler with a downward jet stream in order to save coal. With this technology, the start-up time of the oil burner will be reduced as well as significantly reducing the amount of black smoke that affects the environment, the combustion efficiency is low, the burning oil is not exhausted.

Thus, through surveying the current status, the Research Team found that CFPPs will follow the path of net zero emission reduction in the direction of changing technology that does not pollute the environment but still uses coal as fuel.

Below is some information related to the environmental commitment of some CFPPs through field surveys at the plants and desk research of the provided information.

[93] Law on Management and use of public property, Article 4, clause 2

[94] Decree 06/2021/ND-CP, Article 42, clause 5

[95] Law on Management and use of public property, Article 88, Article 89

Table 6 : Environmental commitment of some CFPPs

No.	Plant Name	Capital Source	Commercial operation time	Operation term of the plant	Current operating status of the plant	Environmental Commitment
1	Uong Bi Thermal Power Plant	100% of State capital	2009	N/A	Operating	The emission parameters must be periodically sent to the Department of Natural Resources and Environment for assessment of compliance with National Technical Regulation QCVN 22:2009/BTNMT on thermal power industry emissions.
2	Hai Phong Thermal Power Plant	about 93% of state capital	2011	N/A	Operating	The emission parameters must be periodically sent to the Department of Natural Resources and Environment for assessment of compliance with National Technical Regulation QCVN 22:2009/BTNMT on thermal power industry emissions. Currently there is information about the review and amendment of QCVN 22:2009/BTNMT, the plant is concerned that it will face difficulties in upgrading infrastructure costs to comply with new technical regulations.
3	Ninh Binh Thermal Power Plant	about 56.3% of state capital	1976	N/A	Operating	The emission parameters must be periodically sent to the Department of Natural Resources and Environment for assessment of compliance with National Technical Regulation QCVN 22:2009/BTNMT on thermal power industry emissions.
4	Vung Ang 1 Thermal Power Plant	about 79.94% of state capital	Unit 1: December 2014 Unit 2: May 2015	N/A	Operating	The emission parameters must be periodically sent to the Department of Natural Resources and Environment for assessment of compliance with National Technical Regulation QCVN 22:2009/BTNMT on thermal power industry emissions. Reuse of ash and slag as building materials. Ash and slag of Vung Ang 1 Thermal Power Plant have been standardized and managed as a construction material commodity, ensuring safety when used. The reuse of ash and slag from thermal power plants is to reduce reservoir pressure for Vung Ang 1 Thermal Power Plant, contributing to environmental protection, saving natural resources and developing the economy in a sustainable way.

No.	Plant Name	Capital Source	Commercial operation time	Operation term of the plant	Current operating status of the plant	Environmental Commitment
						Environmental treatment according to strict standards. Vung Ang 1 Thermal Power Plant uses G7's direct injection coal burning technology. The application of advanced, direct injection coal combustion technology and electrostatic precipitator system has been confirmed by the company for environmental protection. There are solutions to save coal and fuel oil in the process of starting and operating the plant. Strict environmental monitoring system. The management and use of chemicals is carried out methodically, in accordance with regulations and meets the environmental standards of Vietnamese law. The plant has completed the environmental impact assessment (EIA) of the entire project and been (i) registered for hazardous waste source owners by Ha Tinh Department of Natural Resources and Environment and (ii) obtained wastewater discharge permit, permit for seawater exploitation by the Ministry of Natural Resources and Environment, etc. The slag disposal site of the plant has been approved by the Ministry of Natural Resources and Environment.
5	Cao Ngan Thermal Power Plant	about 99% of state capital	2007	Decision No. 126/QD-TTg dated 12/02/1999 of the Prime Minister on investment in Cao Ngan Thermal Power Plant	Operating	Certificate of Certification No. 1001/MTg dated October 10, 1998 of the Department of Environment confirming the registration of meeting environmental standards of Cao Ngan Thermal Power Plant Project, Thai Nguyen. With the goal of controlling waste gas, dust and saving maximum resources... Cao Ngan Thermal Power Company has used CFB circulating fluidized bed technology to operate 2 units. The advantage of this technology is to take advantage of bad quality coal with low calorific value.
6	Pha Lai 1 & Pha Lai 2	about 52.55%	Pha Lai 1: 1986 Pha Lai 2: 2001	N/A	Operating	N/A

No.	Plant Name	Capital Source	Commercial operation time	Operation term of the plant	Current operating status of the plant	Environmental Commitment
	Thermal Power Plant	of state capital				
7	Thai Binh 1 Thermal Power Plant		2018	N/A	Operating	Currently, the Company has signed a contract with Minh Phong Investment Joint Stock Company to collect, transport and consume all of the plant's fly ash, kiln slag and FGD gypsum, reaching nearly 656,100 tons/year. At the time of inspection, the amount of ash, slag and gypsum remaining in the dump only accounted for about 30% of the ash and slag storage capacity.
8	Cam Pha Thermal Power Plant	about 99% of state capital		25	Operating	N/A
9	Mao Khe Thermal Power Plant	about 99% of state capital		50 years from June 30, 2010	Operating	N/A
10	Nong Son Thermal Power Plant	about 88.77% of state capital	April 2015	50 years from March 16, 2009	Operating	There is no information about the commitment to environmental restoration and improvement in the approved environmental impact assessment report of the plant.

• Conclusion

Through the current status of the field survey and information research, the Research Team found that CFPPs are implementing the environmental commitments as prescribed by the Department of Natural Resources and Environment according to the energy transition roadmap. For the current environmental commitment, the dismantling of CFPPs will be a future activity according to the roadmap that Vietnam has committed to net zero emissions (Net Zero) by 2050 at COP26.

6. Key stakeholders in coal power transition

6.1. Identified key stakeholders

International experience and literature on the transition of coal power plants have identified key stakeholders relevant to the process. According to research[96], the stakeholders who influence the political decisions in the coal power sector can be classified into three categories: Political actors, economic actors, and other societal actors. The first group is actively involved in making political decisions, while the latter two are outside the formal decision-making structure. The economic actors operate in the market while the societal actors are not. Key stakeholders are also identified based on the impacts imposed on them by the transition process. In many cases, the most affected group in the coal transition process is workers in the coal sector. For example, the number of employees in German's coal sector (including mining and power generation) shrank from about 6 million in 1990 to less than 100 thousand in 2020[97]. In the United Kingdom, employment in coal production plummeted from 49 thousand in 1990 to 500 in 2018.

Key stakeholders in Vietnam who influence the political decision of the coal power transition and who are adversely affected by the transition are presented in Figure 22.

Some initial data collected and analyzed for the key affected stakeholders are presented below. Figure 23 illustrates the age and capacity distribution of existing coal power plants in Vietnam by 2021. It can be seen that most operating coal power plants have been built from 2010 until now, especially the large 1200 MW plants. As coal power plants normally have a technical lifetime of 30 years for the economic calculation, the owners of these plants would expect them to run 20-30 more years so that they can recover the costs and generate profits.

Figure 24 shows the distribution of the number of employees against the installed capacity for some existing coal power plants, which indicates no correlation between the two values: the number of staff does not grow proportionally with capacity. However, when the number of employees per MW of installed capacity is plotted against plants' age (Figure 25), it demonstrates a relation. Old plants require more labor per MW of installed capacity. Plants operated after 2010 tend to have less than one staff for 1 MW of installed capacity. Figure 26 shows the number of

[96] Ohlendorf N, Jakob M, Steckel JC. The political economy of coal phaseout: Exploring the actors, objectives, and contextual factors shaping policies in eight major coal countries. Energy Res Soc Sci 2022;90:102590. https://doi.org/10.1016/j.erss.2022.102590.

[97] Oei P-Y, Hermann H, Herpich P, Holtemöller O, Lünenbürger B, Schult C. Coal phase-out in Germany – Implications and policies for affected regions. Energy 2020;196:117004. https://doi.org/10.1016/j.energy.2020.117004

employees/MW of some coal power plants in Vietnam, of which Ninh Binh, Na Duong, Cao Ngan, Song Dong, and Vedan (all commissioned before 2010) have the highest value. Regarding gender distribution of these plants, the woman employee ratio ranges from 6 to 33%. The age distribution is shown in Figure 27. Old plants like Ninh Binh and Pha Lai 1&2 have a much higher share of workers at age higher than 40.

Figure 22: Key actors influence the political decisions of coal power transition and potentially affected stakeholders

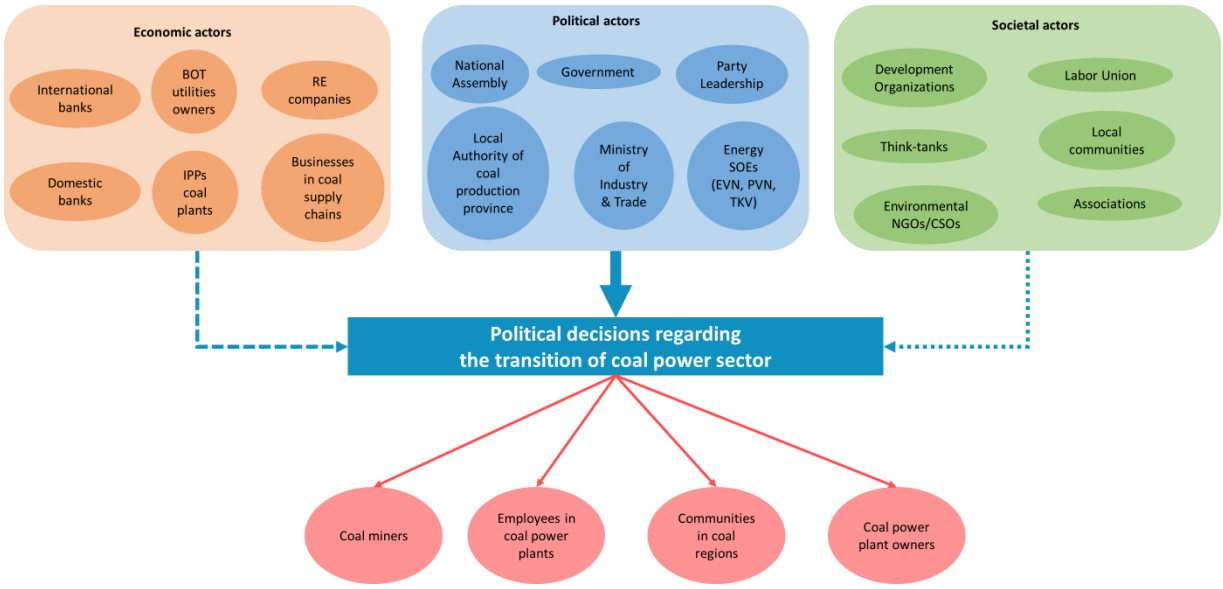
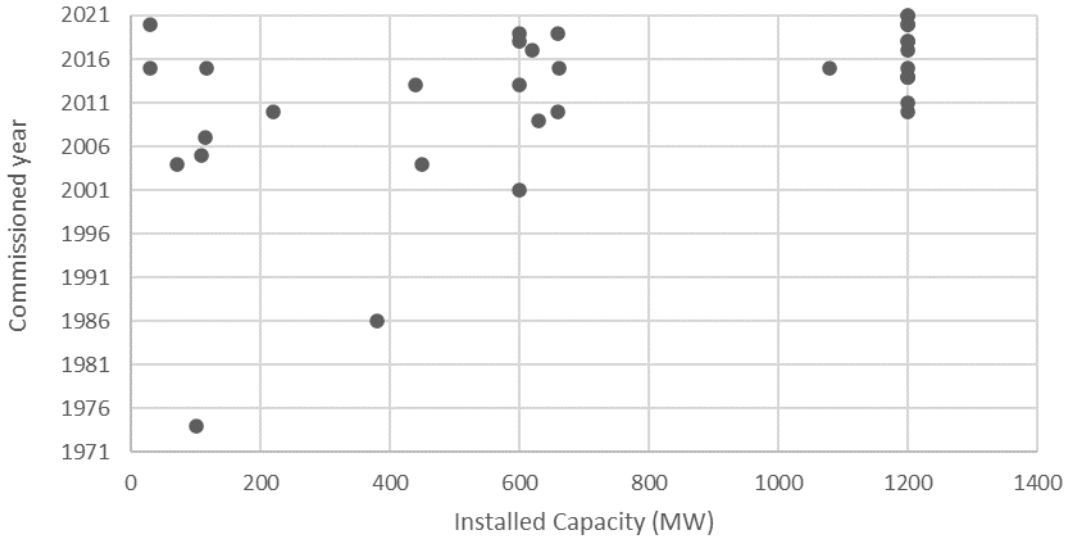
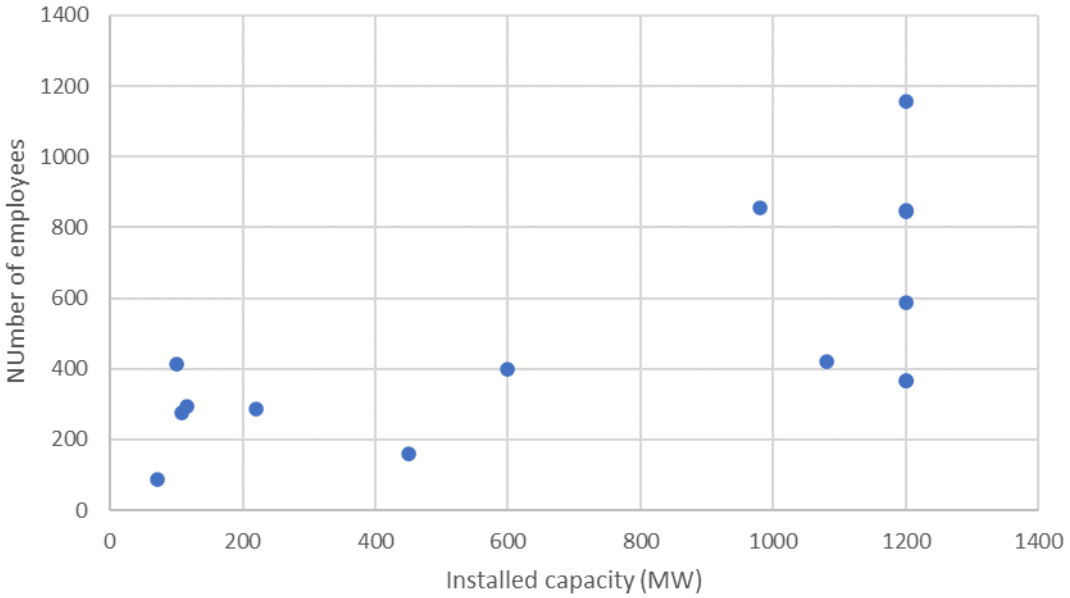


Figure 23: Age distribution and capacity of existing coal power plants in Vietnam



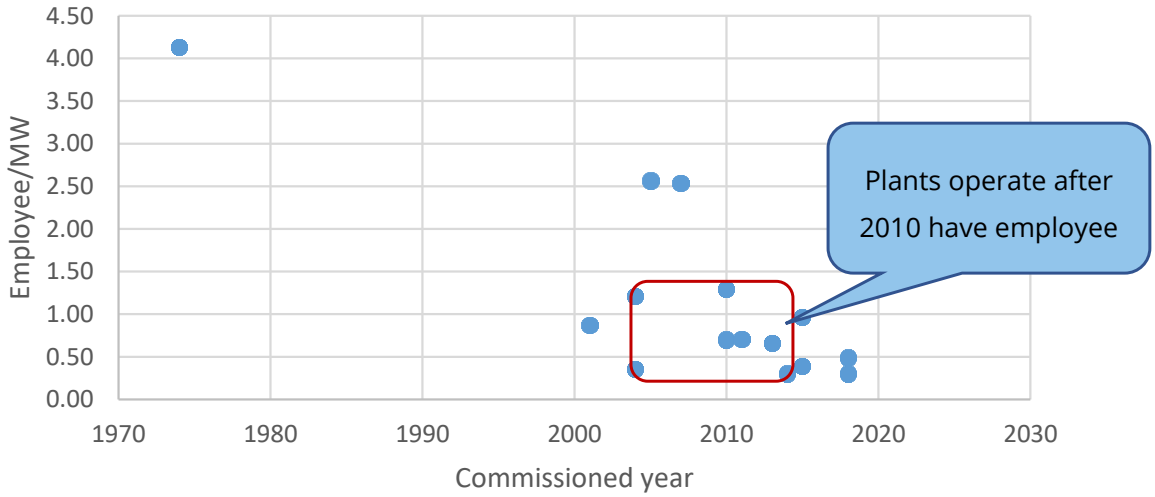
Source: VIETSE's experts synthesized from EVN's data

Figure 24: Distribution of number of employees and installed capacity of some coal power plants in Vietnam



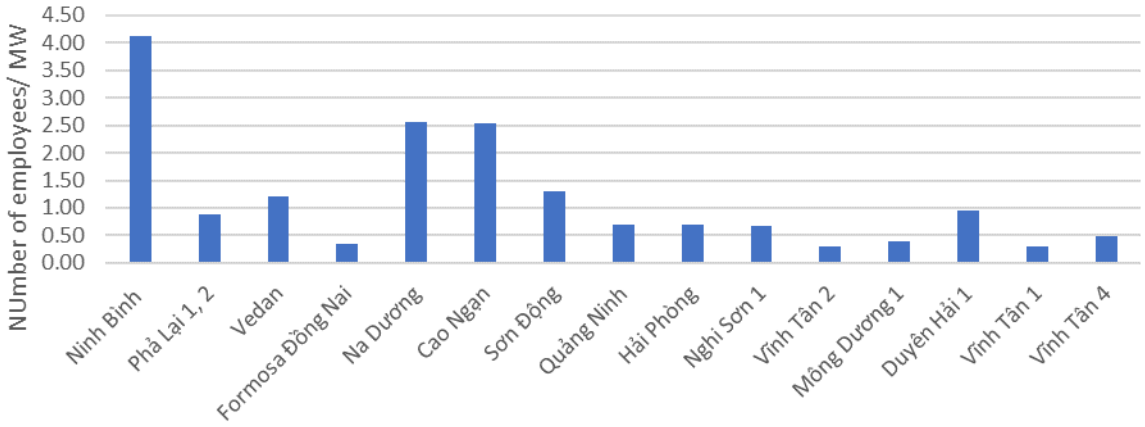
Source: VIETSE's experts synthesized from EVN's data

Figure 25: Number of employee/MW versus commissioned year



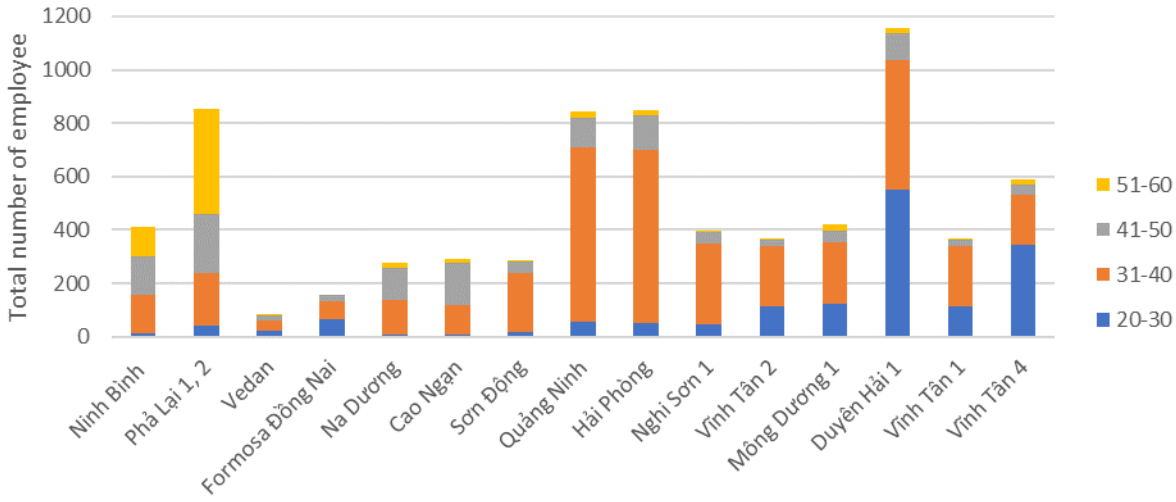
Source: VIETSE's experts synthesized from EVN's data

Figure 26: Number of employees/MW of some coal power plants



Source: VIETSE's experts synthesized from EVN's data

Figure 27 : Employee's age distribution in some coal power plants



Source: VIETSE's experts synthesized from EVN's data

6.2. Potential impacts from a coal transition

Coal transition provides many benefits from climate, environment, national energy security, and national trade balance. However, decommissioning coal power plants at the end of their lifetime, and the early retirement of coal power plants also pose socio-economic impacts. At the national level, reducing coal capacity means the power system must deploy alternative sources to compensate for ensuring the security of supply. This implies additional investment capital for these new power sources and associated infrastructures, especially when the alternative is renewable energy. A higher share of renewable energy requires reinforcement of transmission grids and increasing power system flexibility, and both need substantial investment.

Communities in coal regions are both positively and negatively affected. The downside is their economy depends on coal mining and coal power generation. Reducing coal exploitation and usage could hamper their income in the short term. Quang Ninh is the major coal region of Vietnam, where 99% of hard coal (47.8 Mt) is produced[98]. Most 95 thousand employees of Vinacomin (71,6 thousands in coal sector), are in Quang Ninh province. However, coal miners are not the most affected group by the transition of coal power plants in the short term. Coal production will be stabilized at around 40 million tonnes/year in the next ten years, according to the latest draft of the National Energy Master Plan (February 2021). The growing coal demand in the future (mostly for power generation) would be met by imported coal instead. On the other hand, the local living environment would be improved in terms of air quality and health.

The most impacted group would be coal power plants owners and employees. Coal power plants owners would have their profit reduced, and their coal assets would lose value. An effective and well-design transition with proper incentives and supporting mechanisms would help them to avoid the risk of stranded assets. Coal power plants' employees will lose their jobs when the plants are decommissioned or early retired. More details about managing these impacts are provided in the next section.

6.3. International experiences in coal transition

To this date, the impacts of a coal transition are not yet studied thoroughly in Vietnam as a transition roadmap is not yet developed and issued by the government. However, Vietnam can benefit from rich and diverse international experience in the coal transition to have a just,

[98] Statistics Office of Quang Ninh. Một số chỉ tiêu phổ biến thông tin thống kê tháng 12 năm 2021 2022. https://www.quangninh.gov.vn/bannganh/cucthongke/Trang/ChiTietTinTuc.aspx?nid=358 (accessed April 15, 2022).

inclusive, and effective roadmap. Table 7 lists some measures deployed in countries that have advancements in coal transition.

Table 7: Measures to manage impacts from coal transition – lessons learned

Affected group	Measures	Example
Coal power plants' workers	Provide training and job transition for workers or compensate for early retirement depending on their age and skills	In Germany, the Coal phase-out law allocates €4.81bn in "adaptation payments" for older workers who lost their job[99]. In the UK, plant operators seek to redeploy staff to other roles in the company (i.e., management of site closure and demolition) or offer retirement/ retraining packages[11].
Plants owners	Auction for early retirement of coal power plant Compensation (by negotiation with plant owners) Incentives for plants' owners to repurpose the plants	To phase-down hard coal power plants, Germany has organized auction rounds. A relatively high maximum bidding price in the beginning and decreasing over time give plants operator at least some compensation if they take early action. Germany estimates an amount of €4.35bn in compensation to shutdown lignite[99]. The UK government prefers to continue operating existing coal plants until this becomes uneconomic due to market performance, age, and the need for significant upgrades to meet environmental regulations. In most cases, coal plants pursued closure with considering new developments on-site (i.e., to CCGT, waste fuel units, small scale gas generation, battery storage… to provide flexibility). Minority cases convert existing plants to use alternative fuel (biomass)[11].
Affected communities	Involvement of stakeholders, especially affected groups, in the transition roadmap development Economic incentives to ensure a just transition for regions heavily depend on coal industry	German government has established the Commission on Growth, Structural Change, and Employment (the Coal Commission), consisting of 31 representatives of key stakeholders (parliament, administration, regions, business and industry, energy industry, environmental associations, and trade union)[12]. German Coal phaseout law allocates €40bn in structural aid for infrastructure, economic development, and other projects, which is paid to the affected regions in several federal states[99].

[99] Fortum. The German Coal Phaseout Law 2020

7. Conclusion

Accelerating the energy transition is an act of emission reduction efforts to prevent the irreversible effects of climate change, as the Prime Minister pledged at COP26. During the transition, in addition to strengthening the development of renewable energy projects and advanced green energy technologies, initiatives and solutions for the efficient operation of existing coal-fired power plants are necessary. The issues of coal-fired power plants need to consider many solutions from technical, policy, and social perspectives to financial mechanisms and international lessons learned to balance between ensuring energy security and contributing to the global climate goals. Solutions that can be considered include technical improvement, technology upgrade to increase efficiency, increase flexible operation; improve operation mode, maintenance procedures; research and apply CO_2 capture technology, develop a roadmap and appropriate mechanism for transferring coal-fired power plants to ensure a just transition for all stakeholders.

From the analysis of the current situation and prospects of the coal power sector in Vietnam in a new climate protection context, as well as existing international experiences on coal transition, we have drawn the following conclusions and recommendations for a just, inclusive, and effective coal transition:

- The coal power sector has played an important role in supplying for Vietnam's socio-economic development in the past decades until now. Any coal transition roadmap must balance the need for the security of supply and climate protection as well as the techno-economic circumstances.
- Most of Vietnam's coal power capacity is built after 2010, and its technical lifetime is about 30 years. Therefore, a coal transition roadmap must take into account the economic impacts on these plants' owners and their workers. Such impacts should be systematically and scientifically evaluated to provide fact-based inputs for informing policy-makers and other relevant stakeholders.
- Various instruments can be used to mitigate the economic impacts on affected groups, including both market-based such as auctioning the early retirement of coal power plants, or non-market-based, such as compensation. However, the legal framework must be in place for auction, and compensation must be carefully considered based on economic evidence.
- A just transition must involve all relevant stakeholders through transparent and clearly communicated processes.

This technical and financial report provides the first analysis of technical and financial conditions of the existing and planned CFPPs under the SOEs' management. Next steps consists of (i) developping coal abatement scenarios and coal phasing-down roadmap with technical and financial implications for CFPPs under the SOEs' management; (ii) technical and financial solutions to fill in the gap left by phased-out CFPPs; (iii) detailed recommendations for the net-zero roadmap and (iv) recommended ETP's further technical assistance and capacity building for CMSC and SOEs to realise the identified coal abatement scenarios and coal phasing-down roadmap.

8. Annexes

Annex 1: Report on Missions with EVN, PVN, VINACOMIN and 06 selected coal power plants

1) Introduction of mission, mission team and working agenda
2) Meeting with EVN
3) Meeting with PVN
4) Meeting with Vinacomin
5) Meeting with Uong Bi CFPP
6) Meeting with Hai Phong CFPP
7) Meeting with Ninh Binh CFPP
8) Meeting with Vung Ang 1 CFPP
9) Meeting with Cao Ngan CFPP
10) Meeting with Pha Lai 1 & 2 CFPP

WORKING AGENDA WITH ENERGY SOES AND SELECTED CFPP

Project "Roadmap for the Commission for Management of State Capital toward Net-Zero Emission in Energy State-Owned Enterprises"
between the Commission for Management of State capital at Enterprises (CMSC)
and the Southeast Asian Energy Transition Partnership (ETP)

1. Introduction of the technical consulting activities

The energy sector plays a significant role in the continued development of Viet Nam, and access to affordable and reliable energy will be critical for sustained economic growth. The Party Politburo's Resolution No 55-NQ/TW dated 11 February 2020 on Orientations of the Viet Nam's National Energy Development Strategy to 2030 and outlook to 2045 prioritize fast and sustainable energy development while aiming to foster favorable conditions for all economic sectors to participate in energy development..

In November 2021 at COP26, Prime Minister Pham Minh Chinh announced strong commitments to tackle climate change. In which, the commitment to net-zero emissions by 2050 and joining the methane commitment sent a strong signal to the international community, opening the door for global finance for low-emission development, which is also an opportunity for Vietnam's development.

Currently, Electricity of Vietnam (EVN), Vietnam National Coal and Mineral Industries Holding Corporation Limited (VINACOMIN) and PetroVietnam (PVN) are three large energy state-owned enterprises managed by CMSC which play the key roles in ensuring national energy security. These SOEs are considered to be the key stakeholders involved in the energy transition, towards achieving Vietnam's "zero" net emissions target by 2050.

In the context of implementing emissions reduction commitments, the current energy sector governance and policy framework as well as the financial costs and investment needs in the energy sector, CMSC and ETP cooperate with the purpose to support and strengthen energy state-owned enterprises towards coal transition, better governance, profitable and sustainable business while facilitating a transparent and reliable development of clean energy market.

Objectives of consulting activities:

- Research and propose a roadmap for CMSC to support EVN, VINACOMIN and PVN ("SOEs") in the transition of CFPPs to meet the target of Zero Net Emissions while ensuring the security of power supply;
- Identify the legal, financial and social requirements for SOEs to implement the roadmap;
- Assess the impacts of the roadmap's implementation, including calculating the costs required to implement the roadmap;
- Propose the recommendations to CMSC and SOEs (as well as key stakeholders in the decision-making process) to promote the implementation of the roadmap.

2. Introduction of the consulting consortium implementing the mission

The consulting consortium was established with 4 members: leading by the Vietnam Initiative for Energy Transition (VIETSE), Economic Management Advisory Joint Stock Company (Economica., JSC.), NHQuang & Associates Law Office (NHQ&Associates) specializing in legal advice on corporate and public activities, and Carbon Trust Singapore

3. Working plan with SOEs and some typical coal power plants

To conduct the research and analysis within the framework of this technical consultancy, the consulting consortium proposes a working plan with EVN, PVN and VINACOMIN and 06 typical coal power plants over a period of time from September 13 to September 29, 2022 with specific content in Table 8.

Table 8: Working plan of the consulting consortium with SOEs and some typical coal power plants

Day	Time	Object	Working content	Location	Participant
Tuesday **13/9/2022**	9:00 – 11:00	Electricity of Vietnam (EVN)	Introduce about ETP Introduce about the technical consultancy Discuss the research methods: - Methodology	11 Cửa Bắc, Hà Nội	Representatives of: - CMSC

Day	Time	Object	Working content	Location	Participant
			- Input data Discuss the current status of CFPPs under the management of EVN and GENCOs: - Ownership and management of EVN, GENCOs in coal power plants - Operational status, technical parameters - Contracts and agreements applied to the plants - Current status of labor, property, environmental and industrial safety - Financial situation - The role of CFPPs in the power system and for the financial picture of GENCOs and EVN Strategy of EVN and GENCOs in energy transition, contributing to the net zero emissions target Difficulties and requirements for technical & financial support to implement energy transition goals		- EVN - ETP and consulting consortium
Tuesday **13/9/2022**	14:00 – 16:00	PetroVietnam (PVN)	Introduce about ETP Introduce about the technical consultancy Discuss the research methods: - Methodology - Input data Discuss the current status of CFPPs under the management of PVN and PV Power:	18 Láng Hạ, Hà Nội	Representatives of: - CMSC - EVN - ETP and consulting consortium

Day	Time	Object	Working content	Location	Participant
			- Ownership and management of PVN and unit members in coal power plants - Operational status, technical parameters - Contracts and agreements applied to the plants - Current status of labor, property, environmental and industrial safety - Financial situation - The role of CFPPs in the power system and for the financial picture of PVN and PV Power Strategy of PVN and PV Power in energy transition, contributing to the net zero emissions target Difficulties and requirements for technical & financial support to implement energy transition goals		
Wednesday **14/9/2022**	9:00 – 11:00	VINAMCOMIN	Introduce about ETP Introduce about the technical consultancy Discuss the research methods: - Methodology - Input data Discuss the current status of CFPPs under the management of VINACOMIN: - Ownership and management of VINACOMIN and unit members in coal power plants - Operational status, technical parameters - Contracts and agreements applied to the plants	226 Lê Duẩn, Hà Nội	Representatives of: - CMSC - EVN - ETP and consulting consortium

Day	Time	Object	Working content	Location	Participant
			- Current status of labor, property, environmental and industrial safety - Financial situation - The role of CFPPs in the power system and for the financial picture of VINACOMIN Strategy of VINACOMIN in energy transition Difficulties and requirements for technical & financial support to implement energy transition goals		
Wednesday **5/10/2022**	9:30 – 11:30	Uong Bi coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation The energy transition strategy of GENCO1 Difficulties and requirements for technical & financial support to implement energy transition goals in the plant as well as GENCO1	39 Lê Chân, Uông Bí, Quảng Ninh	Representatives of: - CMSC - EVN - ETP and consulting consortium

Day	Time	Object	Working content	Location	Participant
Wednesday **5/10/2022**	14:30 – 16:30	Hai Phong coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation Difficulties and requirements for technical & financial support to implement energy transition goals in the plant	Tam Hưng, Thủy Nguyên, Hải Phòng	Representatives of: - CMSC - EVN - ETP and consulting consortium
Thursday 6/10/2022	9:30 – 11:30	Ninh Binh coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation The energy transition strategy of GENCO3 Difficulties and requirements for technical & financial support to implement energy transition goals in the plant	Số 1 Hoàng Diệu, Vân Gia, Ninh Bình	Representatives of: - CMSC - EVN - ETP and consulting consortium
Friday 7/10/2022	9:30 – 11:30	Vung Ang 1 coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation The energy transition strategy of PV Power	Kỳ Lợi, Kỳ Anh, Hà Tĩnh	Representatives of: - CMSC - EVN - ETP and consulting consortium

Day	Time	Object	Working content	Location	Participant
			Difficulties and requirements for technical & financial support to implement energy transition goals in the plant		
Tuesday 11/10/2022	9:00 – 11:00	Cao Ngan coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation Difficulties and requirements for technical & financial support to implement energy transition goals in the plant	Quán Triều, Thái Nguyên	Representatives of: - CMSC - EVN - ETP and consulting consortium
Tuesday 11/10/2022	14:30 – 16:30	Pha Lai coal power plant	Introduce about the technical consultancy Discuss the current status of the plant: - Operational status, technical parameters - Contracts and agreements applied to the plant - Current status of labor, property, environmental and industrial safety - Financial situation The energy transition strategy of GENCO2 Difficulties and requirements for technical & financial support to implement energy transition goals in the plant as well as GENCO2	Phả Lại, Chí Linh, Hải Dương	Representatives of: - CMSC - EVN - ETP and consulting consortium

1. Meeting with EVN

Organisation	EVN
Venue	No 11 Cua Bac, Truc Bach ward, Ba Dinh district, Hanoi
Participants	Le Duc Duy, Planning Dept, EVN Ta Thi Huyen Linh and Dao Thi Hien, Science – Tech - Environment Dept, EVN Pham Quang Chinh, HR Dept, EVN Mr. Thanh and Mr Kien, Strategy Dept, EVN Ms. Tran Thi Thu Hien, Ms. Pham Thanh Ha, Finance Dept, EVN Mr. Luu Van Vinh, CMSC Ms. Nguyen Thi Minh Tam, CMSC
Consortium	Ms. Ngo Thi To Nhien, Executive Director, VIETSE Ms. Truong An Ha – Analyst, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Le Duy Bình, Executive Director, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Mr. Nguyen Hung Quang – Executive Director, Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	13 September 2022 (9:00 – 11:00)
Content	• The representative of CMSC introduced the consortium, and then Ms. Ngo To Nhien on behalf of the consortium delivered a presentation on project background and methodology which consists of 3 phases: i) Synthesizing preliminary analysis of operation techniques, stakeholder engagement to describe technical and financial conditions of CFPPs managed by EVN; ii) Modelling and providing detailed analysis and proposing net-zero emission reduction roadmap for these plants; iii) Providing recommendations on next steps. • The consortium also introduced the method of data collection to EVN, and emphasized that data from EVN are important input for the report, which will be the basis for EVN to negotiate with international development partners supporting Vietnam in energy transition

process, coal power in particular. Vietnam is being considered the model on energy transition in the region, net-zero will be the poke for growth motivation and international funding attraction.

- The consortium expected to work with GENCOs and CFPPs to collect information to develop the case studies of the research. The consortium hoped to interview 4 CFPPs under EVN management, which are potential plants for transition. Based on collected data, the consortium will re-zone the scope of research and organize consultation workshops with EVN's parties. Before publishing the research report, the consortium will send the draft to CMSC, EVN, and relevant stakeholders for verification. The consortium is aware of the importance of security in business and state secret, thereby based on the information provided by EVN, meetings to discuss the information processing and publishing will be conducted.

Key findings

- EVN shared its situation, activities, and strategy on energy transition (ET). The SOE itself is on process of chosing consultants for ET roadmap, but so far there has been no specific direction due to PDP8 and overall national energy plan.
- EVN is managing 15 CFPPs. The consortium needs some information on CFPP operation to analyze the role of plants in power system. Most important CFPPs are dependent accounting (directly operated by EVN). Source investment in the future will be challenging, especially power shortage during the period 2024 - 2025 is projected and all CFPPs are important.
- EVN clearly pointed out difficulties on data providing due to they just received the letter from CMSC one day earlier, all departments on process of reviewing which information is suitable to provide. EVN would send data to CMSC then CMSC pass to the consortium. Some CFPPs of EVN are not independent accounting, leading to challenges in providing too detailed data. EVN also clarified with the consortium on some specific requests in information collection forms in order to work most efficiently and easily.

Conclusion

- EVN agreed to send letters to CFPPs to support the consortium and will assign staff to join the fieldtrips. EVN and the consortium designated contact points for next steps. The consortium will be active to contact EVN for logistic tasks. The two sides agreed to delay scheduled fieldtrips, thereby stakeholders would have more time for preparation.

2. Meeting with PVN

Organisation	PVN
Venue	18 Lang Ha, Dong Da district, Hanoi
Participants	Mr. Ngoc Anh, PV Power, PVN Mr. Diep, Production Safety Dept, PVN Mr Huy, Technology and Environmental Safety Dept, PVN Mr Ha, Power and RE Dept., PVN Mr. Duc, Power and RE Dept, PVN Mr. Luu Van Vinh, CMSC Ms. Nguyen Thi Minh Tam, CMSC
Consortium	Ms. Truong An Ha – Leader, Analyst, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Le Duy Bình, Executive Director, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Mr. Nguyen Hung Quang – Executive Director, Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	13 September 2022 (14:30 – 16:30)
Content	• The representative of CMSC introduced the consortium, and then Ms. Truong An Ha on behalf of the consortium delivered a presentation on project background and methodology which consists of 3 phases: i) Synthesizing preliminary analysis of operation techniques, stakeholder engagement to describe technical and financial conditions of CFPPs managed by PVN; ii) Modelling and providing detailed analysis and proposing net-zero emission reduction roadmap for these plants; iii) Providing recommendations on next steps. • The consortium also introduced the method of data collection to PVN, and emphasized that data from PVN are important input for the report, which will be the basis for PVN to negotiate with international development partners supporting

	Vietnam in energy transition process, coal power in particular. Vietnam is being considered the model on energy transition in the region, net-zero will be the poke for growth motivation and international funding attraction. • The consortium expected to work with the CFPP to collect information to develop the case studies of the research. The consortium hoped to interview 1 CFPP under PVN management, which are potential plants for transition. Based on collected data, the consortium will re-zone the scope of research and organize consultation workshops with PVN's parties. Before publishing the research report, the consortium will send the draft to CMSC, PVN, and relevant stakeholders for verification. The consortium is aware of the importance of security in business and state secret, thereby based on the information provided by PVN, meetings to discuss the information processing and publishing will be conducted.
Key findings • PVN is currently building a complete oil and gas industry system, synchronous and closed chain of activities from prospecting, exploration, exploitation to storage, transportation and processing in 5 fields: ▪ Oil and gas prospection, exploration and production ▪ Gas industry ▪ Petroleum processing ▪ Electrical industry and renewable energy ▪ High-quality petroleum technical service • PVN has these power plants in operation: Hua Na, Dak Drinh (hydropower), Ca Mau 1-2 and Nhon Trach 1-2 (gas power), Song Hau 1, Vung Ang 1 (coal firing power). The Electricity Regulatory Authority (Ministry of Industry and Trade) recognises the efficiency of these power plants of the group. • PVN also identified energy transition (ET) as an important topic in which more resources are of worthy investment. Once the policy of ET has been verified, PVN has established a steering committee on energy transition and incorporated it into PVN's strategy and is now developing the energy efficiency strategy. There is monthly meeting among the group leaders and relevant departments to update about ET. PVN is working with 2 consulting firms on ET and emission reduction. The concerned topic is of carbon capture on storage (CSS).	

- PVN has just received the document requesting data from CMSC, so it has not yet well prepared. PVN will provide authorised and verified data only. For confidential data, the consortium needs to sign an NDA, especially data related to PVPower's contracts. EVN shared its situation, activities, and strategy on energy transition (ET). The SOE itself is in process of choosing consultants for ET roadmap, but so far there has been no specific direction due to PDP8 and overall national energy plan.

Conclusion

- Vung Ang 1 is a subsidiary of PVN and will support the consortium to conduct field trip as well as providing data. PVN agreed to send letter to CFPP to support the consortium and will assign staff to join the field trip. PVN and the consortium designated contact points for next steps. The consortium will be active to contact PVN for logistic tasks. The two sides agreed to delay scheduled field trip, thereby stakeholders would have more time for preparation.

3. Meeting with VINACOMIN

Organisation	VINACOMIN
Venue	226 Le Duan Str, Dong Da Dist., Hanoi
Participants	Mr. Tran Minh Nghia, Head of Envi Dept, VINACOMIN Mr. Tran Van Giang, Power Dept, VINACOMIN Mr. Khuc Kim Cuong, Power Dept, VINACOMIN Mr. Va Tuan Anh, Strategy Dept, VINACOMIN Mr. Nguyen Khanh Toan, Finance Dept, VINACOMIN Mr. Luu Van Vinh, CMSC Ms. Nguyen Thi Minh Tam, CMSC
Consortium	Ms. Ngo Thi To Nhien, Executive Director, VIETSE Ms. Truong An Ha – Analyst, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Le Duy Bình, Executive Director, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Mr. Nguyen Hung Quang – Executive Director, Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	14 September 2022 (9:30 – 11:30)
Content	• The representative of CMSC introduced the consortium, and then Ms. Ngo To Nhien on behalf of the consortium delivered a presentation on project background and methodology which consists of 3 phases: i) Synthesizing preliminary analysis of operation techniques, stakeholder engagement to describe technical and financial conditions of CFPPs managed by VINACOMIN; ii) Modelling and providing detailed analysis and proposing net-zero emission reduction roadmap for these plants; iii) Providing recommendations on next steps. • The consortium also introduced the method of data collection to VINACOMIN, and emphasized that data from VINACOMIN are important input for the report, which will be the basis for VINACOMIN to negotiate with international development partners supporting Vietnam in energy transition process, coal power in particular. Vietnam is being

	considered the model for energy transition in the region, net-zero will be the poke for growth motivation and international funding attraction. • The consortium expected to work with the CFPP to collect information to develop the case studies of the research. The consortium hoped to interview 1 CFPP under VINACOMIN management, which are potential plants for transition. Based on collected data, the consortium will re-zone the scope of research and organize consultation workshops with VINACOMIN's parties. Before publishing the research report, the consortium will send the draft to CMSC, VINACOMIN, and relevant stakeholders for verification. The consortium is aware of the importance of security in business and state secret, thereby based on the information provided by VINACOMIN, meetings to discuss the information processing and publishing will be conducted.
Key findings	• VINACOMIN clarifies further technical issues. Currently, the group operates in 4 fields: coal, thermal power, chemicals, mining and has 7 power plants (6 subcritical coal plants, 1 hydropower plant), with a total capacity of over 1,700 MW. The group's CFPPs all use circulating fluidized bed boilers, located near the mines to take advantage of low quality coal, so the plants are limited in terms of cooling water. The treatment method of VINACOMIN is desulfurization in the furnace (process and spray limestone into the boiler to desulfurize). • Regarding the net-zero program: VINACOMIN is 1 among 3 SOEs but accounts for 3% of the total installed capacity. According to PDP7 A, the group was assigned to invest in Quynh Lap 1 (2x600 MW), Hai Phong (1200 MW), Cam Pha 3 (440 MW), Na Duong 2 (110 MW), but to be in line with Netzero in PDP8, only Na Duong 2 is planned to deploy. Accordingly, there will be 7 thermal power plants and 1 hydropower plant under the management of VINACOMIN. • According to the ET scenario, Cao Ngan thermal power plant must be completely converted to clean energy by 2036 and start co-firing from 2028. Na Duong will co-fire 20% from 2028, and will have fully clean fuels from 2035, Son Dong will co-fire from 2030. • VINACOMIN realizes that it's high time to implement this roadmap, however the group encounters many difficulties. The group has identified the technologies of co-firing, starting with biomass, yet this technology has not been implemented by any plants within the group, then will gradually switch to ammonia and hydrogen. The group is updating technology from Japan, China, and the UK. Another difficulty is finance for ET while electricity prices do not reflect the actual investment. • These are difficulties in project assessment and pre-feasibility planning. Moreover, there is no legal framework for ET in plants.

- VINACOMIN believes that ET under COP26 will have many impacts on people and social security. Currently, the group maintains annual exploitation of 40-45 million tons of coal, creating jobs for hundreds of thousands of people. But after 2030 coal mining will be reduced, by 2045 to 10 million tons, by 2050 it will be fully stopped. To invest in the development of a new mine, it takes 12-15 years for a mine of 1 million tons and the mine must operate for more than 20 years to be feasible for investment. If following the above roadmap, it will be difficult for the corporation to determine investment in exploration and construction of new mines which will have a great impact on energy security.
- Technical support activities that VINACOMIN needs:
  - Connect with international stakeholders on technology transfer
  - Connect with sponsors
  - Support to conduct pre-feasibility projects for ET at some specific plants

Conclusion

- VINACOMIN and the consortium designated contact points for next steps. The consortium will be active to contact VINACOMIN for logistic tasks. The two sides agreed to delay scheduled fieldtrips, thereby stakeholders would have more time for preparation.

4. Visit Uong Bi Coal Power Plant

Organisation	EVN – GENCO1 – Uong Bi Thermal Power Joint-stock Company.
Venue	39 Le Chan str, Uong Bi City, Quang Ninh
• **Participants**	Mr. Pham Duc Loc, Head of Tech Dept Mr. Do Van Cham, Head of Production Dept Ms. Tran Thi Thuy, Head of Finance Dept Reprentatives from Labour Dept. Mr. Chi Kien, Expert, Planning Dept., EVN Ms. Nguyen Thi Minh Tam, CMSC
ETP	Mr. Do Manh Toan
Consortium	Ms. Truong An Ha, Leader, Analyst, VIETSE Mr. Duong Viet Duc, Energy Expert, VIETSE Ms. Tran Hong Van, Comm. Specialist, VIETSE Mr. Duong Van Tho, Comm. Specialist, VIETSE Mr. Le Duy Binh, Executive Director, Econamica Mr. Pham Tien Dung, Senior Advisor, Economica Mr. Nguyen Manh Hung, Senior Advisor, Economica Ms. Tran Thanh Huyen, Partner, Lawyer, NHQuang&Associates Mr. Luu Tue Dang, Lawyer, NHQuang&Associates
Date	5 October 2022 (9:30 – 11:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps
Key findings PRODUCTION CAPACITY • Production capacity is variable, depends on the request of EVN • The plant has operated for a long time, and been one of oldest CFPP in Vietnam.	

- Consumes 1.7 million tons of coal annually
- Use pulverized coal (5a4 and 5b0), blend domestic and import coal, therefore the plant has been impacted by high price of coal in global market. EVN send the request to the Prime Minister for asking VINACOMIN not to increase the coal price.
- The plant uses circulating fluidized bed boiler to generate power. Subcritical technology.
- Pmin at day, Pmax at night per request from EVN.
- The plant follows dependent accounting regime (expenses and revenue are controlled by GENCO1), its budget is based on assigned tasks per year.

ENERGY TRANSITION:

- The boiler's efficiency of the plant is 85%.
- The plant has been operating 1 unit, another unit stopped operating as planned. The area is assigned to the plant is enough only for 2 units.
- The transition is up to request from EVN and MOIT, the plant will follow.
- When the plant starts a unit, it emits dark smoke (every 2 month)
- EVN representative said that EVN has been developing overall transition strategy, base on the Government's documents, PDP8, and other regulations. The factors that affect its transition are carbon market, carbon tax… and EVN will have to assess th financial impacts.
- All of GENCOs will follow a equitization roadmap. And EVN proposes the government to issue favorable mechanism for CFPPs investing in RE, especially in the North. EVN has policy to encourage the plants to invest in RE projects, but the barrier is electricity price.

INVESTMENT:

- Investments are processed by GENCO1 per requests from the plants, based on actual situation.

LABOUR:

- 700 staffs. Before 2015, the staff were 1700 but decreased after 2 units stopped as request from MOIT. All ousted staff were compensated and supported with re-training or early retirement (with budget from GENCO1)
- Mostly are skilled and local labour (only 27 staff are from other provinces)
- Staff are fully covered with social and health insurance
- Work safety incidents rarely happen.
- Average income is 22.5 million VND (29.5 million in 2022)
- 100% are labor union member, and women union is established.
- In case of transition, the plant will re-train its staff based on their capacity.

CONTRACT:

- Coal buying contracts, PPA, and commodities buying contracts are on annual basis, and conducted by GENCO1.
- Land contract is paid on annual basis, and also by GENCO1.
- Beside contract for coal buying, the plant conducts several short-term contracts, and for facility replacement. The current biggest contract is to replace turbine number 4 (by Chinese contractor).
- Power purchase agreement and auxiliary service agreement are negotiated anually.
- All loans are processed by GENCO1, not bu the plant.

Remarks

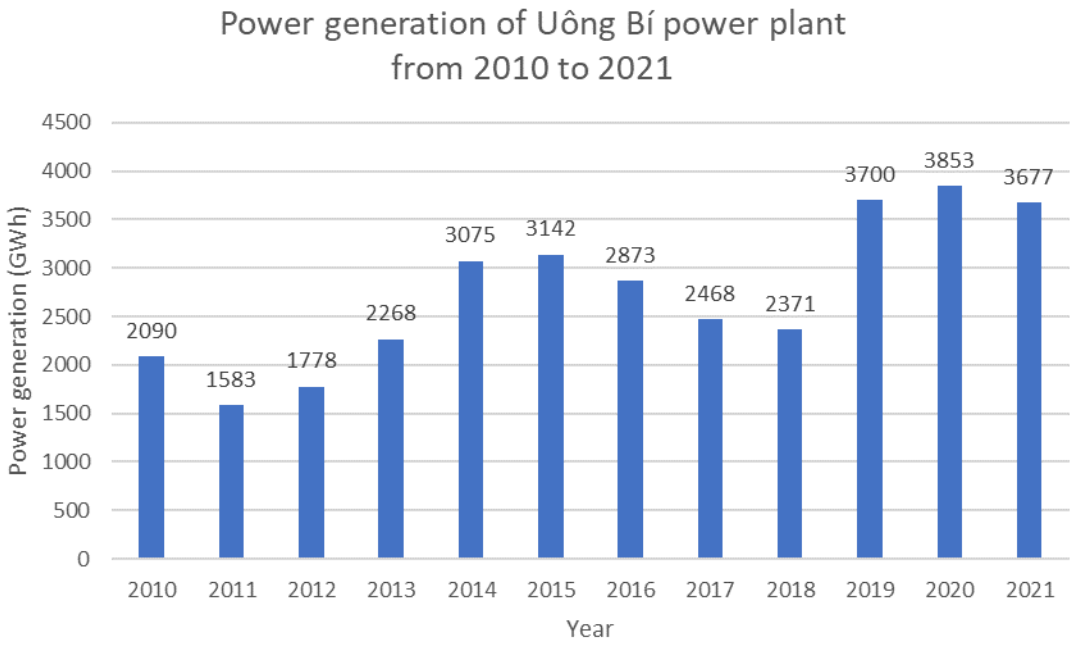
Uong Bi is a dependent accounting unit under EVN GENCO1, therefore, the transition strategy of the plants will be decided by EVN. EVN is developing a comprehensive transition strategy based on the decision of the government, the power development plants and other related policies.

Future policies such as carbon market, carbon tax will have an impact on EVN. EVN will conduct studies on such impacts to the SOE's financial situation.

Uong Bi CFPP's operators propose that there should be a mechanism to prioritise the power plants' operators to invest in renewable energy, especially in the North of Vietnam to address the risk of power shortage in this region.

Conclusion

- Plant will send required information and documents, statistics to EVNGENCO1 and EVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants, including Uong Bi Thermal Power Plants to the Consortium



5. Visit Hai Phong Coal Power Plant

Organisation	EVN – GENCO1 - Hai Phong Thermal Power Joint-stock Company (Hai Phong Thermal Power Plant 1 and Hai Phong Thermal Power Plant 2);
Venue	Tam Hung, Thuy Nguyen Dist., Hai Phong
Participants	Mr Tan – Technical Dept. Reprentatives from Labour Dept., Finance Dept. Ms. Nguyen Thi Minh Tam, Expert, Energy Dept., CMSC Mr. Chi Kien – Expert, Planning Dept., EVN
Consortium	Ms. Truong An Ha – Leader, Analyst, VIETSE Mr. Duong Viet Duc – Energy Expert, VIETSE Ms. Tran Hong Van – Comm. Specialist, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Le Duy Binh – Director, Business Advisor, Economica Mr. Pham Tien Dung – Senior Advisor, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Ms. Tran Thanh Huyen – Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	5 October 2022 (14:30 – 16:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps
Key findings	PRODUCTION CAPACITY • 7.2 billion TWh/year with 04 units • Has the expectation to upgrade capacity • Consume appx. 3 million tons of coal annually • Pulverized coal technology, subcritical. Use 40% domestic coal + coal mixture (import) ENERGY TRANSITION:

- Due to the penetration of recent renewable energy plants, the operation of Hai Phong Thermal Power has changed from the peak at noon to night time, however, they see advantages thanks to this shift
- Due to the increase of coal prices, the plants have to stop for some time
- Propose GENCO and EVN to buy coal domestically to maintain production
- If has to phase down or phase out to transition, there are 200 staff in operation and 100 staff in repair and maintenance will be remarkably affected. Need consultancy if has to carry out the transition.
- However, seriously consider potential renewable energy projects

INVESTMENT:

- By 2024 will meet the break-event point and starting to have profits thus, invesment is considered
- Investment to meet environmental standards: current emission status is not up to the standard and see some recent issues, thus estimated investment to meet the TC22 (22 Standard) is 1,500 billion VND; in addition to the fact that Thuy Nguyen will be upgraded to be a city, the amount of investment could be 2,700 billion VND.
- Want to have a clear standard on environmental protection so can plan ahead and avoid being passive with the policies
- Want the investment in technology upgrades to meet environmental standards will be allowed to reflect in the electricity pricing

LABOUR:

- 846 staffs, including more than 200 female staffs
- All are permanently contracted
- No unskilled labour, all are skilled labour
- So far no conflict between employers and employees, periodically has dialogues with employees
- Has Female Panel (ban nữ công)

CONTRACT:

- Coal buying long-term contracts with TKV and Dong Bac until 2040 (ends same year with the life cycle of the Plants)
- Land contract is signed until 2050, paid annually
- Has several trade and investment loan contracts but has the by Vietnamese Government, all will be paid by 2024

Remarks

1. **Environment**: due to urbanization the plant is now in the city area, therefore, they will face stricter environmental standards.
   They will need more investment to meet new standards (~2700 billion VND) but such investment is not allowed to pas to electricity price.

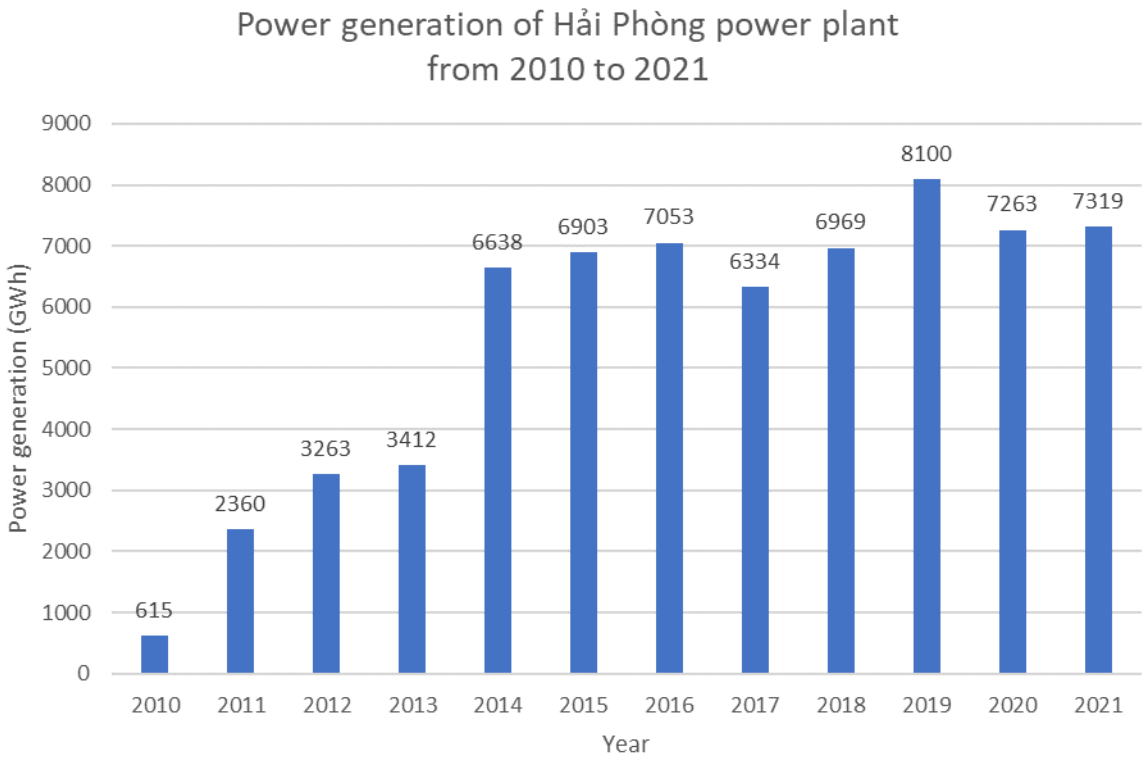
2. **Coal**: The plant is facing difficulty of coal shortage despite that plants can actively source for new supply. Coal supply contract is signed with Vinacomin in framework. Price and volume are renegotiated annually.

3. **Operation**: higher share of RE affects operation regime. Before coal plant generate max during day time. Now plant max generation switch to night time and generation capacity reduced during day time (peak of solar generation). Daily increase and decrease generation capacity impact the heat rate and equipment lifetime.

- **Finance:** Hai Phong Coal power plant has good financial situation. By 2024 they will pay all the loan and will have more profit afterward. They have plan to invest in Renewable energy but still waiting for PDP8 and for new RE mechanism.

Conclusion

- Plant will send required information and documents, statistics to EVN, EVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants, including these Hai Phong Thermal Power Plants to the Consortium



6. Visit Ninh Binh Coal Power Plant

Organisation	EVN – GENCO3 - Ninh Binh Thermal Power Joint-stock Company.
Venue	No1 Hoang Dieu str, Ninh Binh City, Ninh Binh
Participants	Mr. Trinh Van Doan, Director Mr. Do Viet Hoa, Deputy Director Mr. Vu Quoc Trung, Deputy Director Mr. Duong Xuan Hong, Deputy Director Reprentatives from Tech Dept, Labour Dept., Finance Dept, Safety Dept. Mr. Tan – EVNGENCO3 Mr. Chi Kien – Expert, Planning Dept., EVN
Consortium	Ms. Truong An Ha – Leader, Analyst, VIETSE Mr. Ta Quang Duy – Energy Expert, VIETSE Ms. Tran Hong Van – Comm. Specialist, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Pham Tien Dung – Senior Advisor, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Mr. Phung Quang Cuong – Partner, Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	6 October 2022 (9:30 – 11:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps
Key findings	PRODUCTION CAPACITY • Cumulative production capacity is 22.09 billion kWh • 600 million kWh/year, but in 2021 is 390 million kWh and contributed 38 billion VND to th State budget • Consumes 280 thousands tons of coal annually

- Use 30% import coal for blending, therefore the plant has been partly impacted by high price of coal in global market. The remaining coal consumption is from dosmetic sources with fixed prices but the matter is quality of coal (not meet the required standard). Currently, the key challenge is coal supplies, leading to some delays in delivery.
- The plant started to join auxiliary service market in 2015.

ENERGY TRANSITION:

- The plant has been intersted in energy transition, and highly awared of the milestones of emission reduction to align in 2028 and 2035. The decision to follow transition roadmap belongs to GENCO3 and EVN.
- In 2020, the plant pilotted co-firing with 15% and 20% biomass (wood pellet), the result was positive as boiler's efficiency was not affected and CO2 and SO2 emmissions were reduced. The plant considers co-firing a long-term solution but the barriers are mechanism. The biomass price increased much after Russia – Ukraine war, leading to difficulties in transition, and the plant was working with PECC2, WB... about the economical issues of co-firing. It's necessary to conduct a workshop on co-firing at national level.
- If has to phase down or phase out to transition, staff is the main challenge. Need consultancy if has to carry out the transition.
- If Ninh Binh city is upgraded to Tier 1 city, the plant will have to be in line with higher environmental protection standards.
- If the technology is changed, the plant has to as the local authorities for permission (re-conduct EIA).
- GENCO3 has been studying and implementing transition while managing several CFPPs and Gas-to-power plants. The key challenges for transition are material supplies and electricity price. Domestic gas sources are decreasing, and will have to import LNG in the future, as well as blend hydrogen.
- GENCO3 proposed the consortium to help Ninh Binh plant as transition requires several resources of finance, tech, and cost.

INVESTMENT:

- From 2016, the plant started to invested in turbines upgrade, and has invested about 150 billion VND to replace 3 of 4 old ones, 45 billion/turbine. The last turbine will be fully replaced by the end of 2023. Total investment for turbine upgrade is 200 billion VND.
- The plant has made some investments in developing circular coal slag discharge system, digital transformation, upgrading power generators, retrofiting transformer.
- Investment in electrostatic dust filter for environmental protection.
- Investment is a challenge due to low electricity price.

LABOUR:

- 400 staffs
- All are permanently contracted

- Mixture of ordinary labour and skilled labour
- So far no conflict between employers and employees, periodically has dialogues with employees
- Average income is 13 million VND (lowest among plants under GENCO3)

CONTRACT:

- Coal buying long-term contracts with TKV and Dong Bac until 2040 (ends same year with the life cycle of the Plants)
- Land contract expires in 2045, paid on annual basis.
- Beside contract for coal buying, the plant conducts several short-term contracts, and for facility replacement. The current biggest contract is to replace turbine number 4 (by Chinese contractor).
- Power purchase agreement and auxiliary service agreement are negotiated annually.

Remarks

Ninh Binh is the oldest coal power plant in Vietnam still in operation. Commissioned in the 1974, the plant has been gradually replacing main equipment (turbine and generator) in 2016. The last unit to be renewed by 2023.
As Ninh Binh city will be upgraded to Category I city, the plant will phase more stringent environmental regulations while new investment for mitigation measures cannot be justified due to the plant's small scale.

Ninh Binh is pioneering in fuel switching, being the first coal power plant to conduct experiments in co-firing biomass with coal. They want to explore the option further, expecting with support from the World Bank to conduct techno-economic feasibility assessment.
They propose to have a policy supporting the deployment of co-firing in coal power plants, especially the electricity price for co-firing.

Conclusion

- Plant will send required information and documents, statistics to EVNGENCO3 and EVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants, including Ninh Binh Thermal Power Plants to the Consortium

7. Visit Vung Ang 1 Coal Power Plant

Organisation	Vung Ang 1 Thermal Plant – PVPower Ha Tinh - PVN
Venue	Ky Loi, Ky Anh Dist., Ha Tinh
Participants	Mr. Tinh – Deputy Director Mr. Nguyen Dinh Khanh, Mr Thinh - Technical Dept. Mrs. Nga – Deputy Head of Finance Dept. Mrs. Yen – Head of Labour Safety Dept.
Consortium	Ms. Truong An Ha – Leader, Analyst, VIETSE Ms. Tran Hong Van – Comm. Specialist, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Pham Tien Dung – Senior Advisor, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Ms. Phung Quang Cuong – Partner, Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	7 October 2022 (9:30 – 11:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps
Key findings	PRODUCTION CAPACITY • Generation Capacity: 1,200 MW (2x 600 MW) with 2 units: Unit 1 since Dec 2014, Unit 2 since May 2015 • Annual output appx. 7.2 billion TWh/year • Plug in with the 220kV grid • Consume appx. 3.2 million tons of coal annually • Burnt/blended with oil/diesel • In 2021, hours of operation are 2633 hrs by Unit 1, 4510 hrs by Unit 2; output generated is 5.5billionTWh; heat loss rate is 10005 vs. 9736 • Apply measures to save energy up to 13% thanks to using medium voltage inverter

- Coal ash given free to local enterprises; however, the plant has to pay to process coal slag, yet these costs are not reflected to the electricity price

ENERGY TRANSITION:

- Due to the penetration of recent renewable energy plants, the operation of Vung Ang Thermal Plant 1 has shifted with generation peak at night time.
- Also see the impact of Covid-19 in the decrease of generation output.
- Pmin 370 per unit, however managed to not yet burn with oil.
- Due to the increase of coal prices (5a10 coal type rises from 2.2 million up to 3.2 million VND/ton), the plant has limited coal at times but has not yet stopped its operation.
- Has some preparation and received basic training in March 2022 for applying carbon market, has been trained recently on MRV, emission management planning
- Currently using EE measure to reduce emission
- If has to phase down or phase out to transition, the plant management don't see big risk since they believe the transition will take place gradually.

INVESTMENT & OWNERSHIP:

- Total investment: 33,130 billion VND, in which 23,192 billion VND is from loan
- Life cycle of Vung Ang Power Plant 1 is 30 years
- All contracts including electricity selling and coal buying contracts are monitored by PVPower
- However, propose that the input costs i.e. the increase of coal prices can be reflected in the output price
- Act as a branch, thus the plant doesn't have to submit tax report

LABOUR:

- 450 staffs, in which 62 are female. Average income is 20 to 21 million VND. Average age is 37. All are college and upper graduated, of which 287 are bachelors/engineers and 10 have post-graduated qualifications
- There are 250 work in operation, 3 shifts a day with 5 teams, 50 staffs per each shifts.
- No unskilled labour, all are skilled labour.
- So far no conflict between employers and employees, periodically has dialogues with employees
- Has Female Panel

- CONTRACT:
- Coal buying long-term contracts with TKV and Dong Bac, signed by PVPower

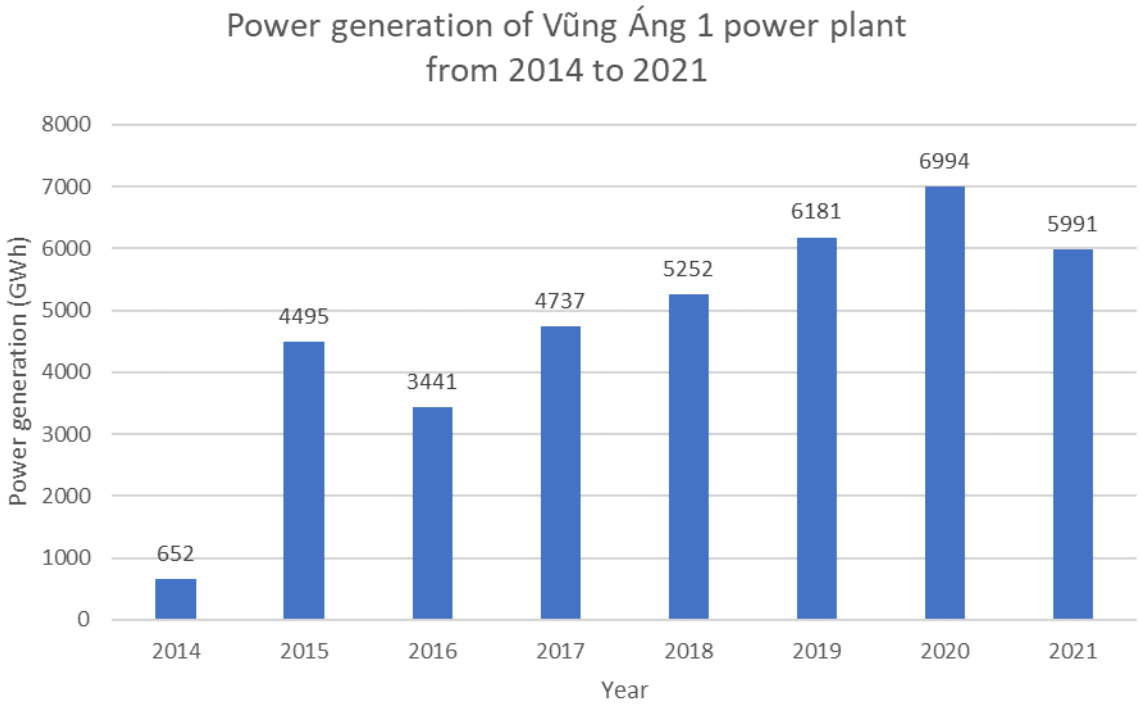
Remarks

Vung Ang coal power plant has already aware of the need for transition. The plant already deploy several measures to reduce emissions, for example, improving the technology to reduce oil consumption for startup, reduce the start up time, applying energy efficiency…

The plant's operator is also taken some steps to prepare for the carbon market participation by joining MOIT's training on GHG inventory, MRV.

Conclusion

- Plant will send required information and documents, statistics to PVN, PVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants to share to the Consortium.



8. Visit Pha Lai Coal Power Plant

Organisation	EVN – GENCO2 – Pha Lai Thermal Power Joint-stock Company.
Venue	Chi Linh, Hai Duong City
Participants	Mr. Dung, Deputy Director Mr. Duc, Supervisor of Pha Lai 1 Mr. Quyet, Supervisor of Pha Lai 2 Mr. Tuan - Tech Dept Mr. Quynh – Finance Dept. Mr. Chi Kien – Expert, Planning Dept., EVN
ETP	Mr. Do Manh Toan
Consortium	Ms. Truong An Ha – Leader, Analyst, VIETSE Mr. Duong Viet Duc – Energy Expert, VIETSE Ms. Tran Hong Van – Comm. Specialist, VIETSE Mr. Duong Van Tho - Comm. Specialist, VIETSE Mr. Pham Tien Dung – Senior Advisor, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Ms. Tran Thanh Huyen – Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	11 October 2022 (14:30 – 16:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps
Key findings	PRODUCTION CAPACITY • Planned output is 4.04 billion KWh/year but the actual output will depend on market demand • The self-supplied rate of the 2 plants is 9.5% average • Pha Lai 1 has the designed output of 80MW

- Pha Lai 2 has 2 units with the designed output of 300MW each
- Consumes max 3.5 million tons of coal annually
- Manage to sell coal ash and coal slag at 500 million VND per month
- Max 8000 hours with Pha Lai 2, in 2021, there was a breakdown unit that required 3 minor repairs in the year, so it did not run for 8000 hours, instead only 6000 hours with Pha Lai 2.
- Max 4000 hours for Pha Lai 1
- Hot and cold restart; if restart in less than 10 hours then will use FO oil; hot 150, cold 250
- Frequency of restart for Pha Lai 2 is 8 cold restart in a year, Pha Lai 1 needs even more restart sessions in a year

ENERGY TRANSITION:

- Can do energy transition, eager to have training for transition if new technology is required
- Can submit the city for more land area to build 2 new units, currently

INVESTMENT & OWNERSHIP:

- A State-owned company with 51% stakes owned by GENCO2
- Invest 1500 billion VND for the new environmental protection system; the plant has NO_x reduction burning pipe, Pha Lai 2 has desulfurization system.
- GHG emission is monitored realtime online and is reported to Environment Department of Hai Duong City, but total emission amount is not available when asked
- Total assets value is appx. 7,000-8,000 billion VND
- Has independent financial report

LABOUR:

- 827 staffs, 200 are female
- Average income appx. 15,5 million VND
- In the next 5 years, 300 staffs will retire
- All are permanently contracted
- All are skilled labour with 50% are bachelors/engineers, 10% post graduate
- So far no conflict between employers and employees, periodically has dialogues with employees
- Average income is 13 million VND (lowest among plants under GENCO3)

CONTRACT:

- Coal buying long-term contracts with TKV and Dong Bac until end of the life cycle of the Plants); in which TKV accounts for two thirds of total coal supply

- Beside contract for coal buying, the plant conducts several short-term contracts, and for facilitiy replacement. The current biggest contract is to replace turbine number 4 (by Chinese contractor).
- All loan contracts are paid off

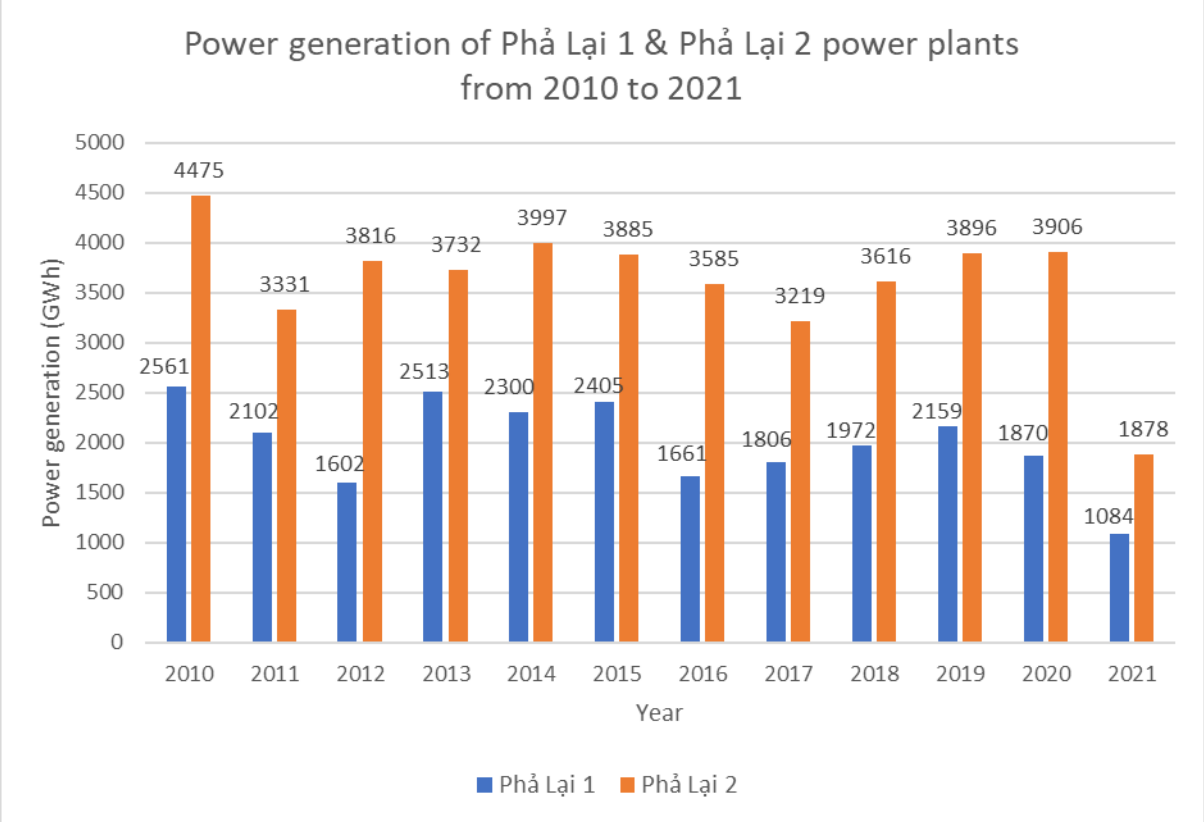
Remarks

Pha Lai 1 and 2 is the second oldest operating coal power plants in Vietnam after Ninh Binh. Pha Lai 1 is operating with only one out 8 boilers.

The plant is not yet having a strategy for transition.

Conclusion

- Plant will send required information and documents, statistics to EVNGENCO2 and EVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants, including Pha Lai Thermal Power Plants to the Consortium



9. Visit Cao Ngan Coal Power Plant

Organisation	Cao Ngan Thermal Power Plant – TKV
Venue	Quan Trieu, Thai Nguyen
Participants	Mr. Tuan – Director Ms. Thuy – Head of Finance Dept.
Consortium	Ms. Ngo To Nhien - Leader, Senior Energy Expert, VIETSE Ms. Truong An Ha – Analyst, VIETSE Mr. Duong Viet Duc - Energy Expert, VIETSE Ms. Tran Hong Van – Comm. Specialist, VIETSE Mr. Pham Tien Dung – Senior Advisor, Economica Mr. Nguyen Manh Hung – Senior Advisor, Economica Ms. Tran Thanh Huyen – Lawyer, NHQuang&Associates Mr. Luu Tue Dang – Lawyer, NHQuang&Associates
Date	11 October 2022 (9:30 – 11:30)
Content	• ETP & CMSC Roadmap to Net-zero package introduction • Consortium introduction on 1. Methodology and expected outcome introduction; 2. Explanation on how plants will benefit from the package and expectations of outcomes • Plant introduction on studied topics • Q&A • Next steps

Key findings

PRODUCTION CAPACITY

- The plant was built in 2002 and has been in operation since 2007
- Capacity production so far has met the target set for operation, financial effectiveness has met the financial plan as well
- Generation Capacity: 100 MW (2x 50 MW) with 2 units: Unit 1 since Dec 2014, Unit 2 since May 2015; annual output appx. 600 million kWh
- Actual hours in operation are 9394 for 02 units
- Burn limestone directly in the kiln, there is lime in the slag and ash, thus need to store and spray water to settle the lime before selling
- Manage to sell almost all coal ash and coal slag
- 930 VND/KWh is considered break-even price

ENERGY TRANSITION:

- Due to the penetration of recent renewable energy plants, the operation of Cao Ngan Thermal Plant has seen a decrease compared to same period of 2017 and 2018, currently the plant only operates at minimum rate from 8:00-16:00 daily. The plant also depends on the weather in Southern Central region where many wind and solar farms locate, thus this dependence can have negative impact on the plant's production line.
- Take actions in reducing emission thanks to transitioning of input fuels, planting more trees in the plant area
- Approach and take steps in co-firing solution
- No feasibility in expanding the land area

INVESTMENT & OWNERSHIP:

- Total investment: 1,700 billion VND, 20 year depreciation for key equipments
- Under the management of VINACOMIN Power, TKV owns 99.27% of VINACOMIN Power

LABOUR:

- 700 staffs work in Khanh Hoa mine, 700 staffs work in Nguyen Hong mine and 280 staffs work in the power plant
- Average income is 16 million VND per month
- If energy transition takes place, the management board says labour benefit packages need to be fully addressed

CONTRACT:

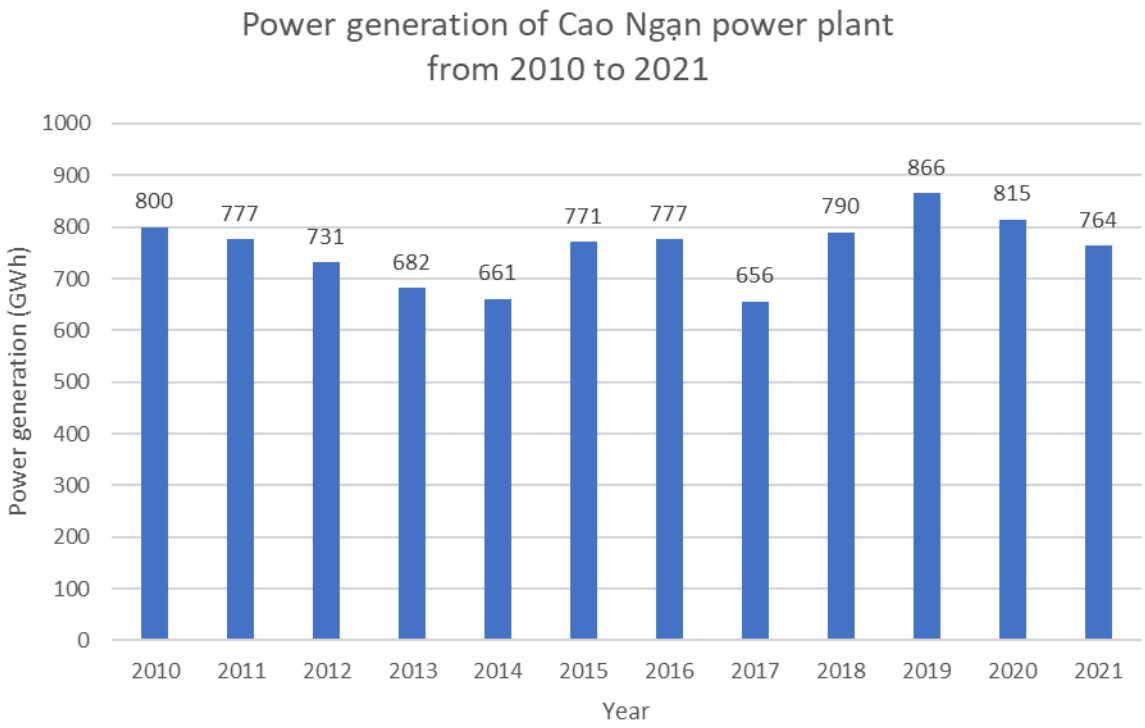
- Loans for plant construction have all been paid off, currently only minor loans which are set to be paid off by 2024

Remarks

As part of the general strategy of VINACOMIN Power, the plant has oriented to change fuel to reduce emissions, especially CO_2. They have approached co-firing technology using wood pellets and are aware that Ninh Binh has already tested the technology. They would also like to experiment on co-firing. There are several challenges mentioned by the plant regarding cofiring: (i) pricing mechanism for the technology, (ii) biomass supply and costs, impact on electricity price, (iii) technical aspects of deployment which require studies and expertise.

Conclusion

- Plant will send required information and documents, statistics to PVN, PVN will then pass to CMSC and eventually CMSC will share the consolidated from all plants to share to the Consortium.


Power generation of Cao Ngạn power plant
from 2010 to 2021
Power generation (GWh)
1000
900
800
700
600
500
400
300
200
100
0
800
777
731
682
661
771
777
656
790
866
815
764
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

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