Industry Snapshot- ENERGY

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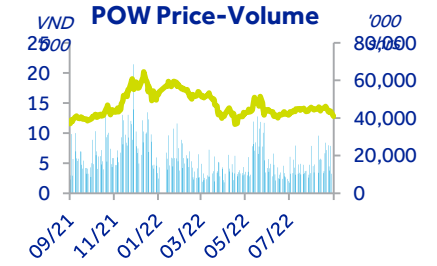
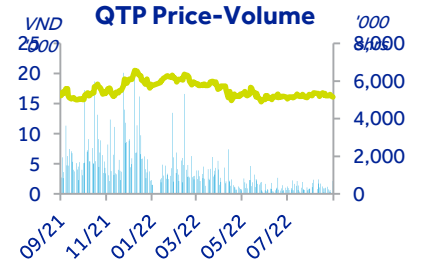
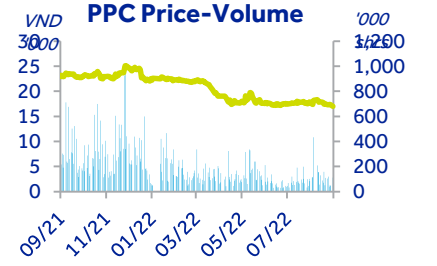
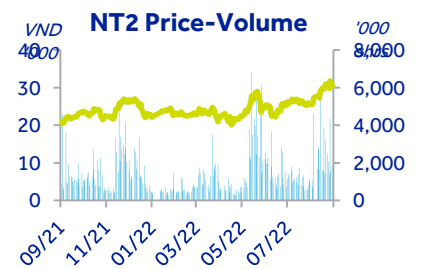
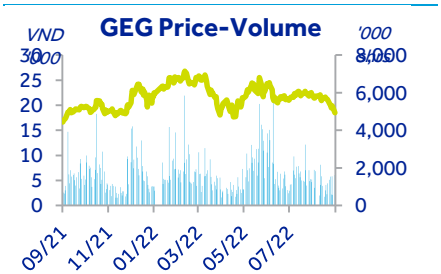










VIETNAM ENERGY INDUSTRY SNAPSHOT

The growth of a country's economy typically parallels the sustainable development and security of its energy sector. Recognizing the indispensable nature of the energy industry, the Vietnamese government has paid substantial attention to shape the progress of energy industry to serve as a foundation to power the economy forward. Thus, energy sector could be considered as an attractive proxy to the promising prospects for the long term development of the Vietnamese economy.

Industry overview: The development of the Vietnamese energy industry is under the support and guidance of the Government to serve national energy security, power the economy and facilitate the means of production. The Government has set aggressive targets for the sector in recent t

imes, as a stable source of energy is essential for the development of the economy and for Vietnam to be an attractive investment destination. Recently, the Vietnamese energy sector has succeeded in several points, particularly that it is now ranked 1st in ASEAN in terms of capacity from 2021, equivalent to a 40% increase in nationwide capacity since 2019, with great strides being made from renewable energy.

Opportunities & Challenges: As a developing country with many competitive advantages, Vietnamese GDP is expected to grow around 6% annually in the long term; energy production is forecasted to grow about 3% higher than the GDP generally, around 8% - 10% annually according to the Power Plan VIII (PP8). Some segments are expected to have higher growth such as renewable energy (excluding hydropower), which could bring substantial opportunities for investors. On the other hand, Vietnam's energy industry is also faced with challenges, including current poor flexibility of the transmission system, high initial required investment for wind and solar power; and optimization of different energy sources which are compatible with the national transmission grid.

Major events: Experiencing a difficult 2021 with heavy impacts from COVID-19, where the Government had to implement strict social distancing policies for 3 months (Jul – Oct), resulting in 2021's GDP only increasing by 2.58% (the lowest in a decade, yet still positive compare to many economies seeing contraction during the worst of COVID), as suppressed demand resulted in excess supply, leading to a decrease in production output and poor performance of many enterprises, including the energy industry.

The 4th draft of PP8 in April 2022 added two additional scenarios to bring the total to eight, which include a plan for energy conversion to reach the carbon reduction requirements and contingency plans in the event of a shortage of input materials. To illustrate, EVN signed 18 Purchasing Power Agreements (PPA) with Laos in Sep 2022 to support for the Northern energy demand. In addition, the desired power generation portfolio has adjusted to a much "Greener" mix compared to previous editions under its commitment to zero carbon emission by 2050; focusing on renewable energy development, stable and balanced grid corresponding to each region, limiting inner-regional transmission, optimizing transmission line cost, and reducing power loss rate and electricity prices in general.

Outlook: Generally we expect the whole energy segment will become brighter thanks to the recovery of the economy in 2022, particularly the normalization of many businesses and production activities post-pandemic. Nevertheless, there will be priority placed between various energy sources.

In the short run, we expect coal-fired energy to perform relatively well despite the fact that It might be impacted by the high input cost due to:

- El Nino is forecasted to start having a strong impact at the end of 2022. Thus, it will reduce the precipitation and lead to less productive hydropower plants.
- A weak transmission grid and incomplete storage technology, which is unable to adapt for the inflexibility of renewable energy (RE), including solar and wind energy, hampers RE's prospects to rapidly increase their share of the national energy portfolio in the short term; and
- To stabilize economic development, the government has to accept short term environmental costs of mobilizing thermal plants due to a shortage output from alternative sources.

However, we believe switching to renewables is inevitable in the long run and Vietnam owns many favourable conditions to carry out the transition, from a long coastline, typically tropical weather with high annual precipitation and long sunny hours. In addition, we expect the government will create new policies that encourage RE development, particularly wind power. For instance; the FIT in 2018 set preferential rates for solar and wind projects for a 20 year period. As a result, we appreciate companies that are processing promising RE projects that likely to be the key to focus for long term development such as REE, GEG and PC1.

	Market Cap (VND bn)	2021 Sales (VND bn)	2021 EAT (VND bn)	Trailing PER (x)	Trailing PBR (x)	2021 ROE (%)	2021 ROA (%)	YTD Return (%)	1 Year Return (%)	Div Yield (%)	3 months Value (bn VND)
Coal-fired											
PPC	5,563	3,868	216	35.9	1.0	4.5	3.9	-0.2	-18.1	9.6	93
HND	8,200	9,027	455	10.1	1.2	7.3	5.2	-10.0	2.9	8.8	34
QTP	7,335	8,571	578	14.8	1.2	9.4	6.5	-11.9	13.1	10	689
Hydropower											
REE	29,996	5,815	1,855	16.1	1.7	11.3	5.8	36.9	70.5	1.3	5,004
VSH	10,749	1,611	387	17.3	2.1	5.8	2.6	42.7	64.5	2.5	222
TBC	2,000	495	169	11.3	1.5	13.9	10.7	6.9	12.3	8.1	12
Gas Turbine											
POW	31,967	24,561	1,799	22.8	1.0	5.8	3.4	-27.1	27.3	1.4	11,392
NT2	9,169	6,150	534	14.8	1.8	12.6	8.1	6.5	54.9	3.7	2,679
BTP	1,077	1,213	127	8.5	0.9	9.9	6.7	-2.7	4.1	6.7	43
Solar & Wind											
GEG	6,407	1,381	283	20.7	1.9	7.6	2.3	2.2	49	2.6	1
BCG	7,335	2,618	609	8.9	0.5	7.3	1.6	-40.2	2.6	3.6	4,652
VN-Index	4,643,673			12.5	1.9						

Source: Bloomberg, FiinPro. Data as of Sep 22nd, 2022 except where stated

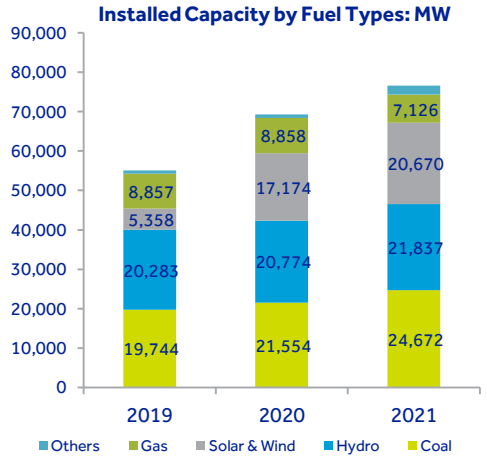
Industry overview

Capacity

In recent years, overall capacity in the Vietnamese energy generation sector has made great strides. From the end of 2019 to 2021, countrywide capacity saw an impressive increase by 40% from 54,880 MW to 76,620 MW and is now the leader in ASEAN in terms of capacity. Notably, renewable energies (RE), excluding hydro, saw a nearly four-fold increase during the period from 5,385 MW in 2019 to 20,670 MW and now accounts for 27% of overall installed capacity (renewables account for 55.5% when including Hydro).

Structure	2019	2020	2021
Coal thermal	35.8%	31.1%	32.2%
Hydro	36.8%	30.0%	28.5%
Solar & Wind	9.7%	24.8%	27.0%
Gas	16.1%	12.8%	9.3%
Others	1.6%	1.4%	3.0%
Total	100%	100%	100%

Sources: ACBS, EVN



Sources: ACBS, EVN

Coal-fired thermal capacity increased by 25% in two years from 19,744 MW (2019) to 24,672 MW (2021), to become the largest group, accounting for 32.2% of installed capacity. According to the PP8, coal-fired thermal is expected to reach the maximum capacity of 37,467 MW in 2030 and expansion will be paused to meet Vietnam's carbon emission commitment in COP26.

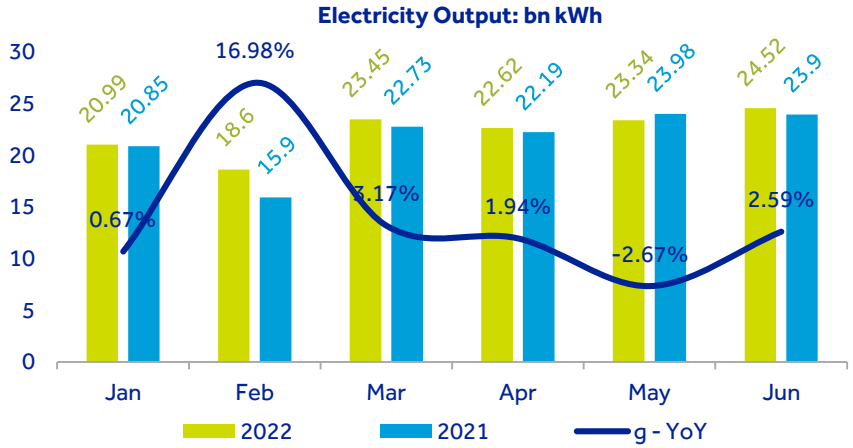
Hydro only increased by 1,600 MW from 20,283 MW (2019) to 21,837 MW (2021), accounting for 28.5% of the total as areas for new exploitation are becoming harder to establish and we do not expect impressive growth in terms of newly installed capacity from the hydro sector going forward.

Comment: Energy capacity has increased significantly over recent years. However, it has not been without its challenges. As the greatest increases in capacity have been in solar and wind energy, there has been some instability and incompatibility with the transmission system, given the inconsistent nature of generation from these sources. In addition, Wind and Solar energy concentrate in Central and Southern regions, which creates imbalance between sources and electricity consumption. Several provinces in the Central region have had to cut back on capacity and electricity production due to surpluses; whereas, other places, particularly in the Northern provinces have to ask for energy conservation due to possible supply shortages and overloaded transmission lines in the summer. The Government has noted these imbalances and is making adjustments in the PP8 which will be aimed at alleviating some of these issues

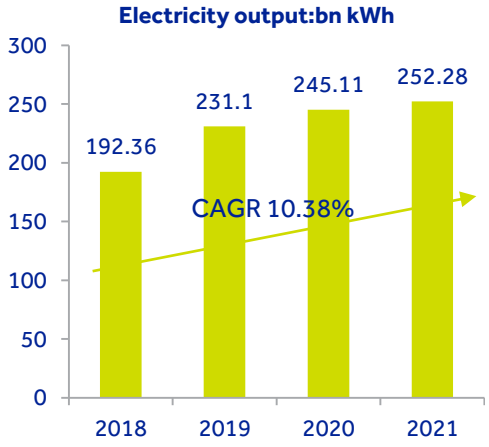
Output

Electricity production in 2021 reached 252.28 bn kWh, only increasing 2.93% YoY, the sharp decline in growth (CAGR of 10.4% over the 2018-2021 period) was due primarily to COVID-19 related lockdowns and social distancing policies to stem the spread of the virus.

In 1H2022, total electricity production reached 133.52 bn kWh, +3.02% YoY, completing 48.5% 2022 plan.



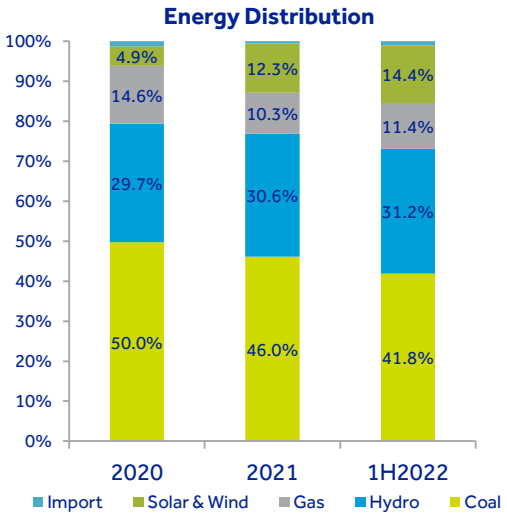
Sources: EVN, ACBS



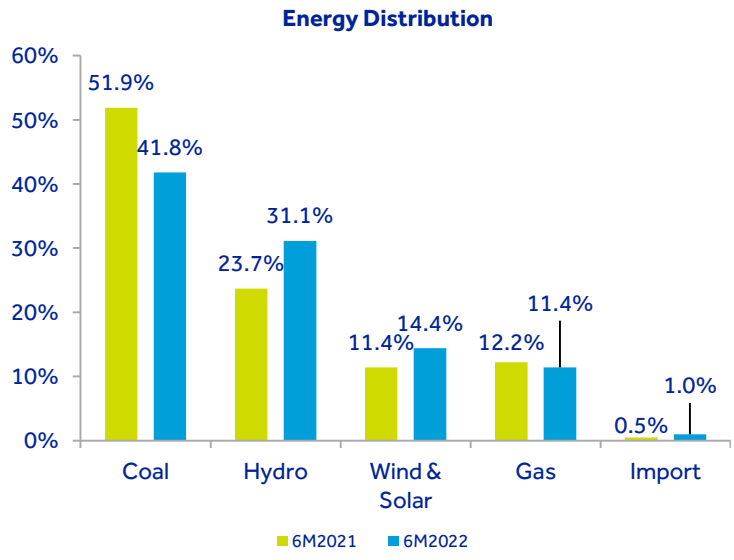
Sources: EVN, ACBS

Output Structure

In 1H2022, there was a noticeable transition in energy production with renewables accounting for a larger portion at the expense of traditional coal and gas produced output. Coal-fired thermal faced a descent from 51.9% (1H2021) to 47.8% (1H2022); whereas; hydro increased from 23.7% (1H2021) to 31.1% (1H2022) and RE sources (excluding hydro) increased from 11.4% (1H2021) to 14.4% (1H2022).



Sources: ACBS, EVN



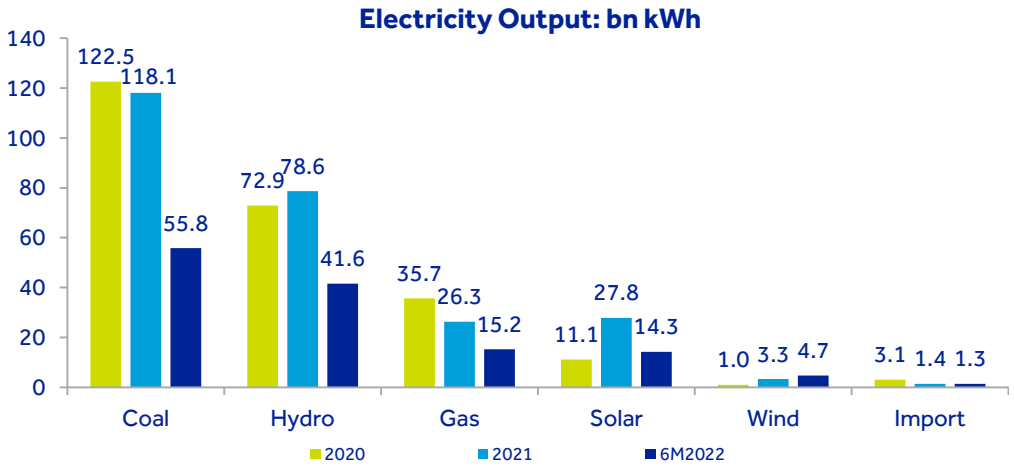
Sources: ACBS, EVN

Coal thermal energy output declined by 4% in 2021 compared to 2020 (2021: 46% - 2020: 50%), whereas, Hydro output reached 78.61 bil kWh (2021), +7.9% YoY.

Thanks to encouragement of FIT policies for RE (excluding hydropower) from 2018 to 2021, the output structure has been undergoing a transformation. Hence, solar power output more than doubled from 11.1 bil kWh (2020) to 27.84 bil kWh (2021).

However, the surge in solar and rooftop solar generation between 2018 and 2020 has negatively influenced the operational stability of the grid as storage capabilities have not kept pace with generation, therefore, solar energy has been stagnant since 2021.

Wind energy output in 1H2022 reached 4.7 bil kWh, increased by nearly five times compared to the whole year 2020 and by +42.4% compared to 2021.



Sources: ACBS, EVN

Comment: The overall increase in 1H2022 is an encouraging sign that the economy is recovering and that manufacturing and household activities are normalizing post-COVID. According to PP8, the CAGR of energy production would reach between 8% and 10% in the period of 2021 – 2030. We expect electricity consumption will achieve strong grow in 2022, after two year of subdued performance due to COVID-19.

The Government is reinforcing its commitment to transition the country's energy portfolio to comply COP26's commitment to reduce carbon emissions. Therefore, renewable sources such as Wind and Solar are taking center stage in the country's future energy development strategy. However, there are two big issues that need to be addressed for the long term development and the shorter term outlook covered in PP8:

- Which energy sources would serve as a foundation to satisfy national security energy. There must be redundancies in case there are disruptions to any single source. Renewable sources are dependent on weather, while storage technology has not yet been fully developed. Therefore, Coal-fired plants seem to be the number one contender to back stop the system while waiting for the development of more gas turbine power plants.
- Improvement of transmission grid to tackle the issue of peak time production surges that accompany RE. An overhaul of the transmission grid will not take place overnight. As a result, coal thermal, despite the disadvantages to the environment, still has its place Vietnam's energy mix.

We expect the 2022 output of coal-fired energy will reach around 111 bn kWh, -5.5% YoY. Hydro, in comparison, is expected to produce around 82 bil kWh by the end of 2022 due to:

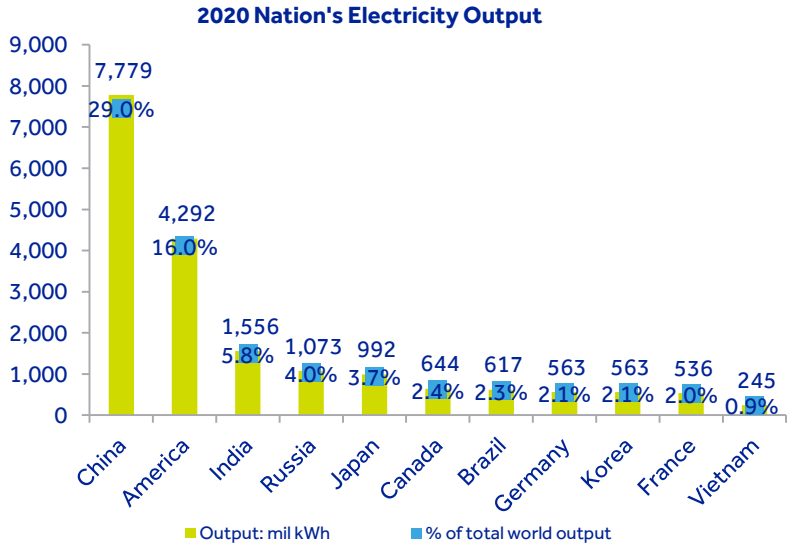
- The country is still experiencing La Nina effect, which brings higher than average rainfall to the regions, supporting the production from hydro plants, and;
- With the rainy season occurring in 2H2022, hydro production typically has its high season in the latter half of the year, particularly in Southern Vietnam.

We expect solar power output will continue to grow, yet at slower pace that was seen over the past couple years, to reach 28.2 bil kWh in 2022. Wind power is forecasted to be the next hot sector in renewables while waiting for the Government's incentive policies to be finalized and PP8 to be officially approved by the end of the year because Hydro is running out of potential exploitation and Solar is expected to be stagnant until after 2030 due to already successfully reaching the targeted capacity.

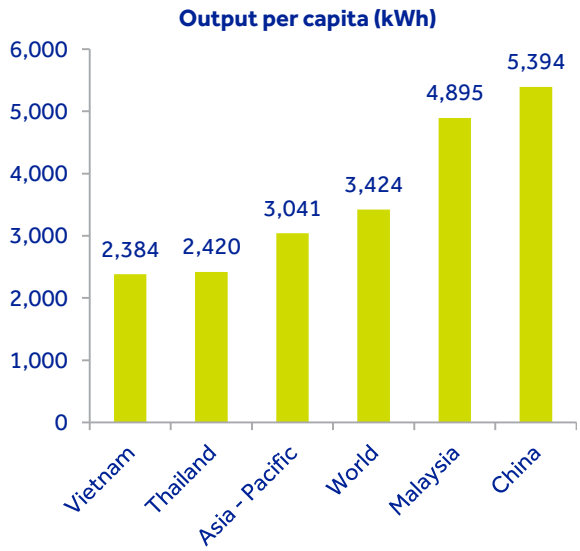
Output in a Global Context

Vietnam's electricity output is humble compared to other nations, accounting for less than 1% of the World's output (26,823 bil kWh). China accounted for 29% (7,779 bil kWh); America: 16% (4,292 bil kWh); and India: 5.8% (1,556 kWh).

Vietnam's electricity consumption per capita only reached 2,384 kWh – 2020, +1.41 times from 1,566 kWh – 2015; equivalent to 69.6% of the World (3,424 kWh); 78.4% of Asia – Pacific region, 48.7% of Malaysia; 44.2 of China and almost equals to Thailand.



Sources: EVN, ACBS



Sources: EVN, ACBS

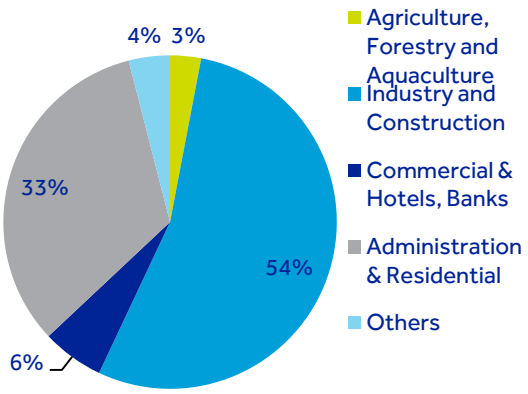
Comment: Vietnam's electricity output per capita is quite low compared to others. Thus, it is an attractive investment opportunity due to high potential of increasing energy output together with the growth of GDP as of the increasing of productivity.

Electricity Consumption Structure

There was not a tremendous differentiation in electricity consumption structure between 2019 and 2020, more than 80% of energy consumed was by two significant

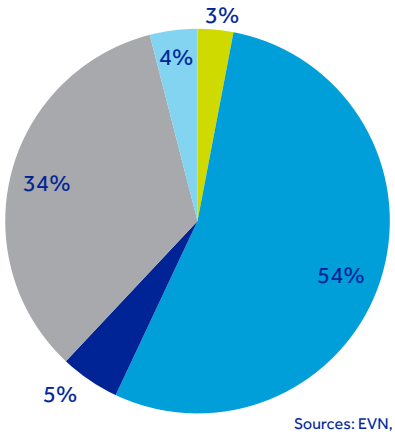
groups: Industry and construction (54% in both year) and Administration and Residential (33% in 2019 and 34% in 2020).

2019 Electricity Consumption Structure



Sources: EVN, ACBS

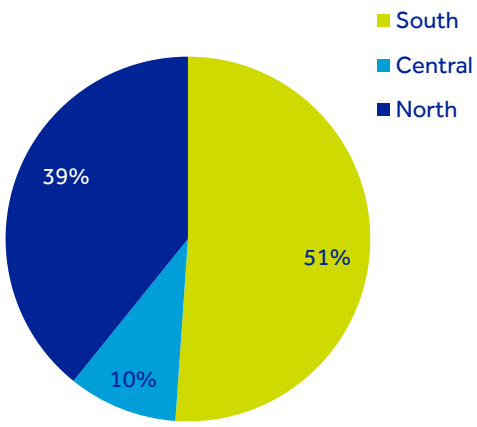
2020 Electricity Consumption Structure



Sources: EVN, ACBS

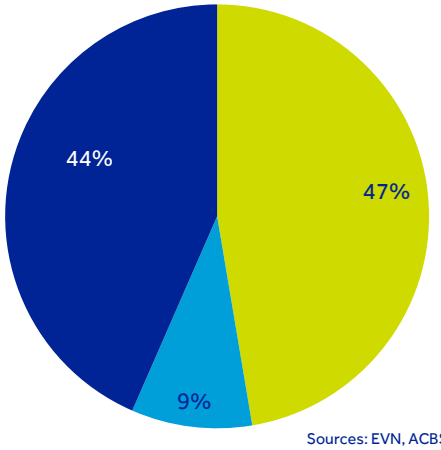
Energy consumption is concentrated in the Northern and Southern regions given the locations of major cities and industrial hubs. Over the past decade, energy consumption in the Northern region has been outpacing growth in the South thanks in part to the large amounts of manufacturing facilities sprouting up in the North, led by Samsung, which has invested c. USD20bn, and other manufacturing facilities relocating from China to diversify their production facilities. The absolute value of energy consumption has increased significantly for both regions, with the Northern increasing from 36.6 bn kWh – 2011 to 94.9 bn kWh – 2020 and the Southern region increasing from 47.6 bn kWh – 2011 to 101.2 bn kWh – 2020.

2011 Consumption



Sources: EVN, ACBS

2020 Consumption



Sources: EVN, ACBS

Intensity of power consumption

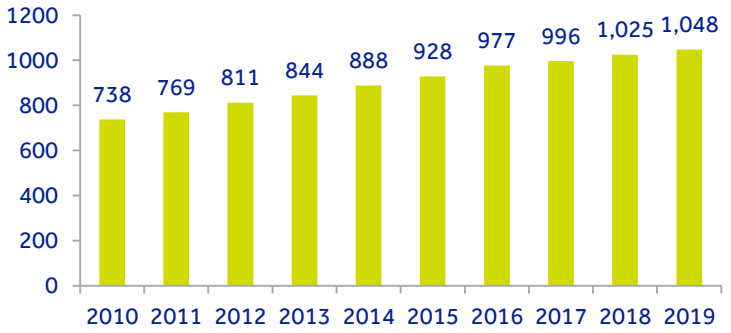
The intensity of power consumption per 1,000USD of GDP has increased over the years from 738 kWh/1,000 USD - 2010 to 1,048 kWh/1,000 USD – 2019. There are two main reasons for a hike of electricity's demand over previous decade:

- One, is the structural shift between economic sectors as the Vietnamese economy shifts to a more industrial economy over a historically agrarian society. The shift from less energy intensive sectors, such as agriculture, to

energy intensive industry such as basic chemicals, iron and steel and refining have been contributing to the greater power consumption to GDP ratio.

- Secondly, the "convenience" of using electricity has promoted the shift from using other fuels to using electricity. The most obvious everyday example is cooking with an increasingly popular induction cookers, gradually replacing gas and coal stoves as before. This shift is expected to continue in many other economic sectors, such as the upcoming of the Metro system in big cities will contribute to reducing fuel consumption data in urban traffic.

The intensity of power consumption over GDP (kWh/1,000 USD)



Sources: ACBS, EVN

Comment: We expect this momentum will continue in the long term because of the modern digital age. People are applying more technologies, using more electrical device and equipment in working such as computers and phones; and transportation including electricity cars, bus or subway.

Electricity price

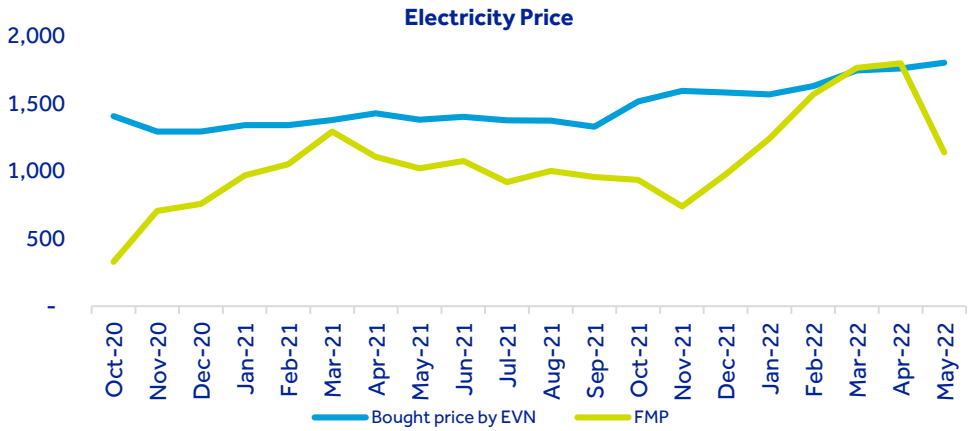
The Full Market Price (FMP) and Price of Electricity Bought (PEB) by EVN is on the uptrend from 10/2020. In particular, PEB increased from 1,404 VND (10/2020) to 1,798 (5/2022), equivalent to +28%. The FMP hiked from 328 VND in Oct 2020 to 1,136 VND in May 2022, equivalent to +246%.

According to Globalpetroprices.com, Vietnam's electricity price is about 8 cent/kWh, higher than Lao (5 cent/kWh) and Malaysia (3.9 cent/kWh).

The electricity price in Vietnam is partially regulated by the Ministry of Industry and Trade (MOIT) and the Government with the goal of balancing fair benefits for all stakeholders and target national security energy and long term economic growth. EVN determines the selling and buying prices of electricity every six months based on several criteria including the input and transmission costs. However, EVN has to report to MOIT and the energy price level must be in the applicable range approved by MOIT before.

Country	Electricity Prices: Cent/kWh
Laos	3.9
Malaysia	5
Vietnam	8
China	8.1
Taiwan	9.4
Indonesia	9.8
Thailand	10.6
Cambodia	14.8
Hong Kong	15.7
Philippines	16.6
Japan	23.3

Sources: ACBS, EVN

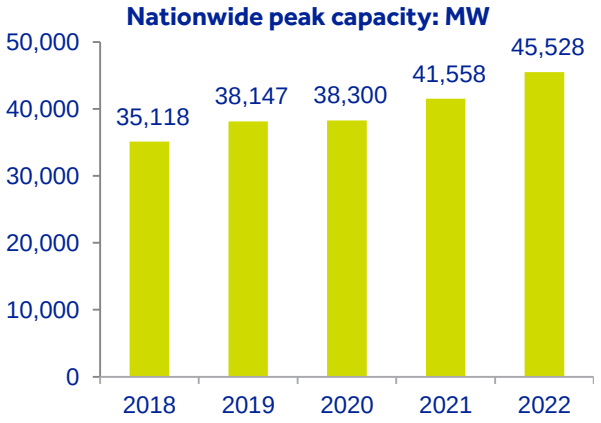


Sources: ACBS, EVN

Comment: Vietnam's electricity price is relatively inexpensive compared to other neighboring countries, contributing to Vietnam being an attractive destination for Foreign Direct Investment (FDI). Moreover, according to PP8, the electricity price is projected to increase 2.1% to 3% per year in conjunction with GDP growth about 7% to 8%. The energy market is still in its early stages in applying market mechanisms and is still under the management of the Vietnamese Government.

Peak-Baseload

In June 2022, a heatwave caused a hike in electricity demand leading to a new nationwide peak mobilization figure of 45,528 MW at June 21st, 2022 (+3,100 MW YoY), accounting for 60% of total installed capacity. According to the Government's analysis, the current installed capacity is sufficient to meet peak-load needs as the record high usage was still well within the in installed capacity limits.



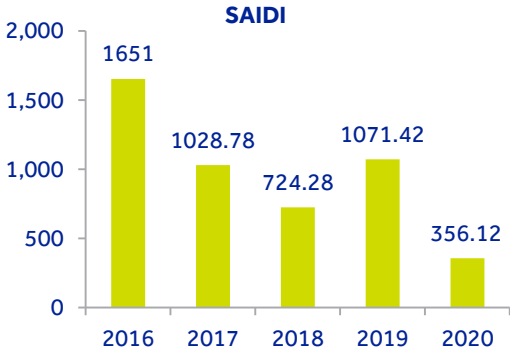
Sources: ACBS, EVN

Comment: In the short term, we expect the Government will not have to focus to install more capacity – expanding many more power plants, but manage to use current installed capacity more productively.

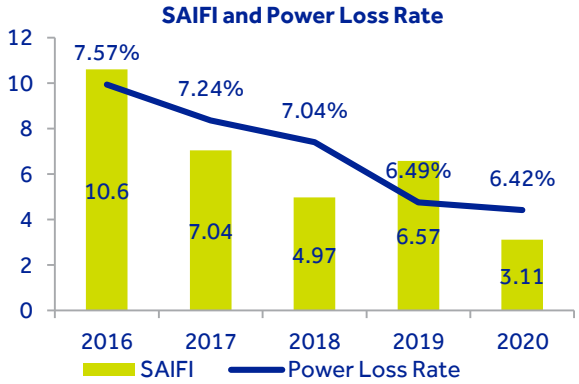
Sources: EVN, ACBS

Service reliability

The service reliability index including: SAIFI (System Average Interruption Frequency Index), SAIDI (System Average Interruption Duration Index) have advanced substantially. SAIFI has been improved by 71% from 10.6 times (2016) to 3.11 times (2020) per customer. Also, SAIDI has been reduced by 78% between 1,651 minutes (2016) and 356.12 minutes (2020) per customer. Furthermore, power loss rate reduced from 7.57% in 2016 to 6.42% in 2020 as the power efficiency been improved.



Sources: EVN, ACBS



Sources: EVN, ACBS

Transmission

According to the 4th draft PP8, 10,994 km of new 500 KV lines will be deployed (compared to less than 2,300 km in the 3rd draft) and 1,325 km old 500 kV lines need to be repaired until 2030.

15,659 km of new 220 KV lines will also be built during the same period (compared to less than 1,400 km in the 3rd draft) and 6,500 km old lines need to be repaired.

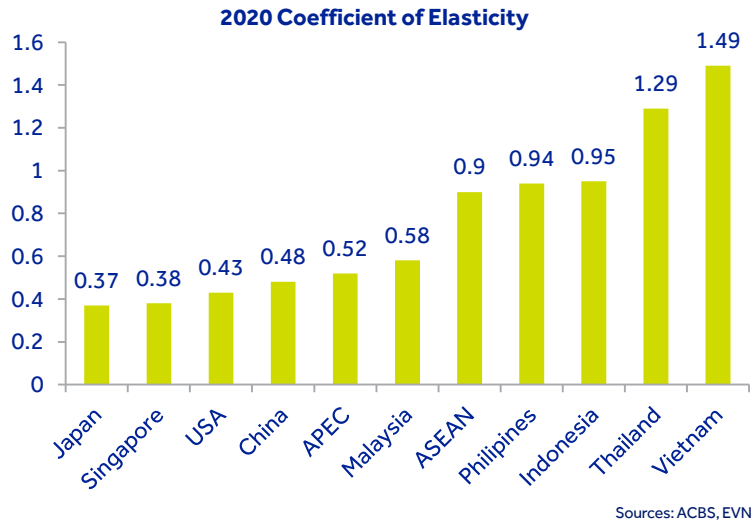
Unit: km	2020	(+)	2030	PP7 in Comparison
500 KV lines	8,527	10,944	19,471	Less 2,300
220 KV lines	18,477	15,659	34,136	Less 1,400

Sources: ACBS, EVN

Comment: We expect that in the 2020 – 2030 period, the government will pay more attention to improving the transmission system rather than building more power plants and increasing capacity given the current supply/demand dynamics. Developing transmission lines and substations will be an urgent need to deal with drawbacks of RE that have been put into operation and other incoming projects.

Coefficient of Elasticity

Coefficient of Elasticity describes the growth of electricity production compared to the growth of GDP (i.e. a figure of 1.5 indicates that electricity production must increase by 1.5% to produce a 1% increase in GDP). Vietnam's Coefficient of Elasticity reduced from 1.84 (2011 – 2015) to 1.44 (2016 – 2020), yet was still high compared to peer nations: Thailand (1.29), Indonesia (0.95); and Philippines (0.94). This indicates Vietnam has been consuming electricity not economically over previous years, that the increased electricity consumption has resulted in lower marginal GDP growth compared to peers.



Sources: ACBS, EVN

Comment: The results suggest that Vietnam has not used electricity efficiently, however, we believe there are two main reasons behind the high Coefficient of Elasticity.

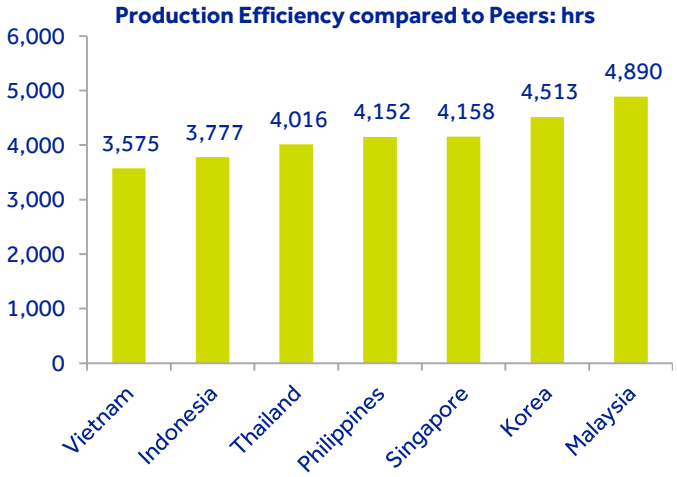
- First, Vietnam focused to undergo industrialization in the past to serve the GDP's growing target, particularly intensive energy industry such as cement and steel. To illustrate, according to The Ministry of Industry and Trade (MOIT), the amount of crude steel produced reached 23 mil ton – 2021, increased by more than four fold compared to 2011 and seventy times than to 2001. The amount of cement produced reached 108.4 mil ton – 2021, almost doubled compared to 56 mil ton – 2011.
- Second, due to old and obsolete machines and equipment, the wasted electricity index is comparatively high.

We expect the Coefficient of Elasticity will improve thanks to:

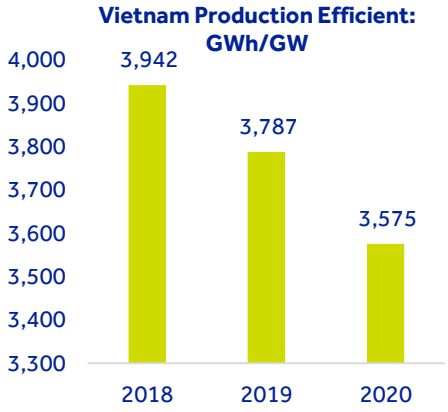
- The improvement of productivity as a result of applying digital technologies in business and daily life activities, new management methods, accumulated skills and experiences leads to GDP growth outpaces energy needs.
- Investing new and modern machines and equipment to use energy more efficiently, reducing the cost of energy usage per unit produced.

Production Efficiency

The Production Efficiency data shows how effective electricity sources are used. The analysis show that Vietnam's average 2020 power production efficiency is relatively low at around 3,575 hours (also known as Tmax - hours of maximum capacity use, Tmax = Production electricity/ installed capacity), lower than neighbor countries: Indonesia's 3,777 hours, Singapore's 4,158 hours, Thailand's nearly 4,016 hours, Malaysia's 4,513 hours and the Philippines' 4,152 hours. Consequently, the Government's priority in setting PP8 is to implement an energy saving campaign and utilize energy more efficiently.



Sources: EVN, ACBS



Sources: EVN, ACBS

Comments: The Vietnamese Production Efficiency has dipped recently with the rapid increase in the proportion of solar power capacity in the period 2018-2021. The mobilization index rate of solar power is relatively low, which is around 21% compared to 80% of coal-fired thermal. Thus, in the PP8 for the period 2020-2030, the Government does not prioritize additional solar power capacity (except for projects which have already been approved before).

National Development Plan VIII – fourth draft

PP8 OVERVIEW

The National Power Development Plan VIII (PP8), which covers the period from 2021-2030 (with some outlook to 2045), is the guiding policy for the development of Vietnam's energy sector. The PP8 is currently in its fourth draft and is expected to passed before the end of the year. Key points of the PP8 include:

- Ensuring sufficient electricity output as energy security is an essential requirement for economic and social development.
- Reducing pollution by devoting resources to develop green, clean, and environmentally friendly energy sources; meeting Vietnam's commitments on minimizing emissions.
- Developing synchronous and diversified forms of energy, especially renewable and environmentally friendly sources, with reasonable costs, protecting the benefits of the state, investors and consumers.
- Optimizing all different forms of energy, with a priority to develop gas thermal turbines and replacing of coal-fired energy.

The capital investment plan is 7,530 trillion VND in total including;

- Allocating c. 306,150bn VND each year from 2021 – 2030, (total 3,000 trillion VND); in which:
    - Investing in adding capacity: 2,250 trillion VND ,
    - Investing in upgrading the power grid: 750 trillion VND;
- Allocating c. 282,600bn VND each year between 2031 – 2045, (total 4,530 trillion VND); in which:

- Investing in adding capacity: 3,300 trillion VND,
- Investing in upgrading the power grid: 1,230 trillion VND.

The transmission system will be limited between regions to reduce power loss rate through long distance transfer. Each region is supposed to provide adequate electricity output on its own. According to 4th draft PP8, in the primary scenario, it will not be necessary to build more grid lines compared to PP7 (edited version).

Electricity prices are forecasted to rise from 7.9 US cents/kWh in 2020 to about 11.7 – 12.9 US cents/kWh in 2030. The growth rate will be around 2.1% per year until 2045 (primary scenario).

CAPACITY

Coal-fired capacity will be stagnant after reaching maximum capacity 37,467 MW in 2030 (accounting for 31% in 2030 and 13.2% in 2045). Furthermore, coal fired plants could be reconfigured to use biomass or methane as inputs.

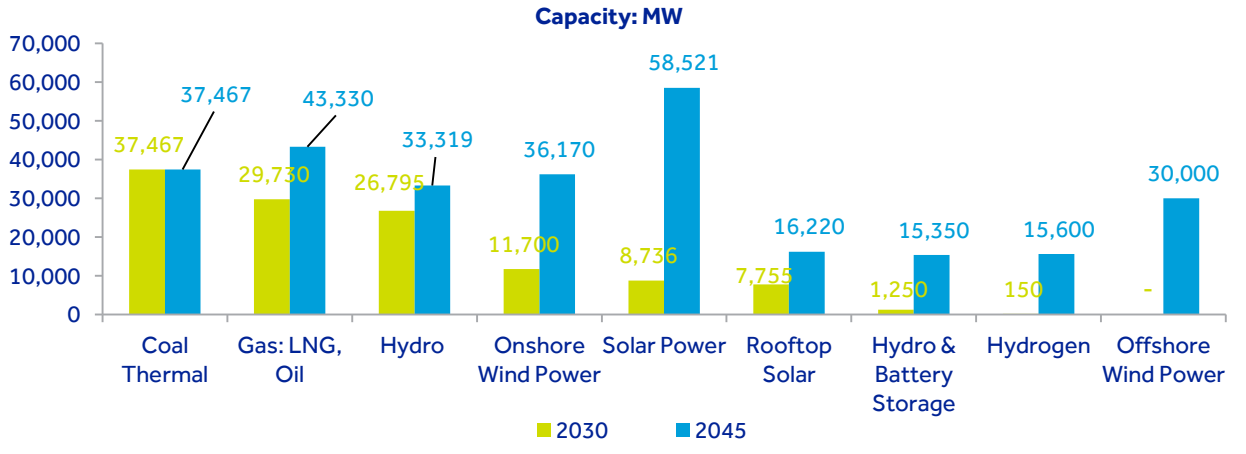
Gas thermal power generation using LNG will be prioritized to generate electricity alongside coal thermal, reaching 29,730 MW in 2030 (24.5%), achieving maximum capacity 43,330 MW in 2035, and will account for 15.5% in 2045.

Hydro capacity will reach 26,795 MW in 2030 and 33,319 MW in 2045, accounting for 22.1% and 11.7% respectively.

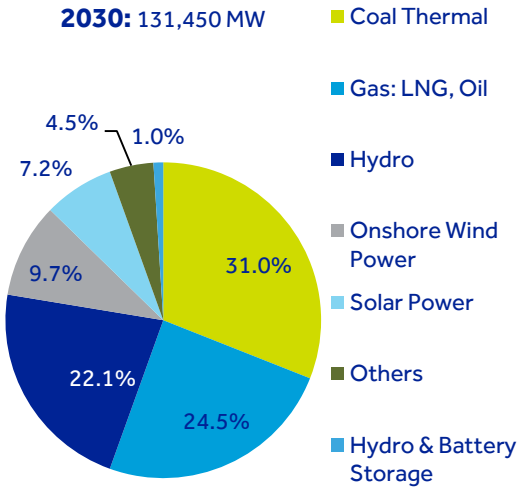
Wind power (Onshore) capacity will achieve 11,700 MW in 2030 (9.7%), and 66,170 MW (Onshore and Offshore) in 2045 (23.2%).

Solar power (excluding rooftop) capacity will reach 8,736 MW in 2030 (7.2%) and 58,521 MW in 2045 (20.3%).

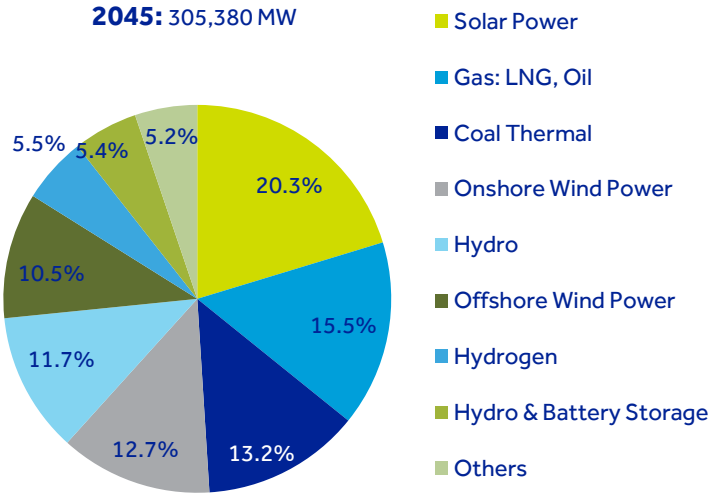
Hydro and battery storage will be only developed after 2030 and reach 15,350 MW in 2045 (5.4%).



Sources: ACBS, EVN



Sources: EVN, ACBS



Sources: EVN, ACBS

OUTPUT

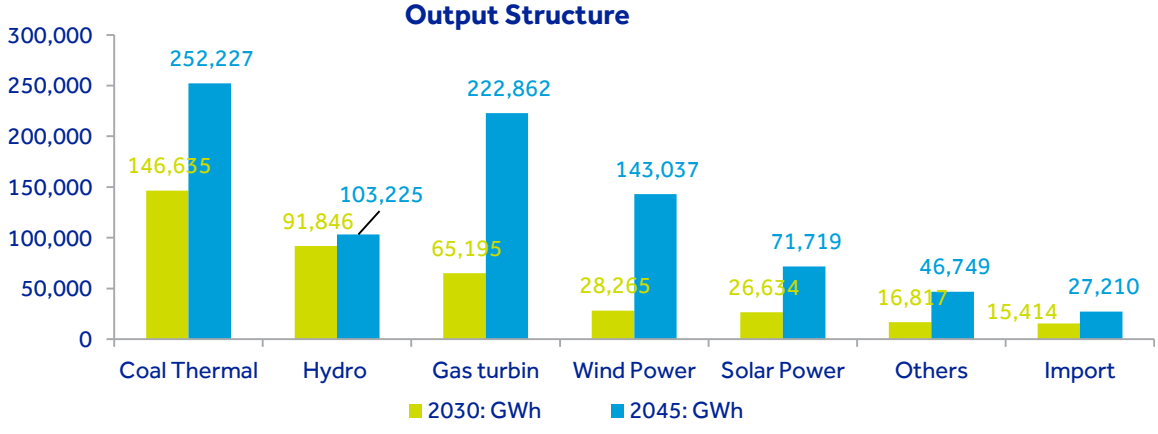
Coal-fired power is still expected to account for a large proportion of the output structure in 2030 with 146.6 bn kWh, accounting for 43% of total output. However, with plans to cap output from coal fired plants after 2030, its proportion drops to 25% in 2045, even though output production increases to 252.2 bn kWh.

Hydro power stands as the 2nd biggest output source in the expected 2030 structure with 91.8 bn kWh, 24%. Nevertheless, as further exploitation of hydro power is expected to be limited by geographical constraints, hydro is only expected to account for 11% in 2045, although output rises to 103.2 bn kWh.

Gas turbines are anticipated to replaced coal thermal as a fundamental source of energy for the whole system and become the largest output source in 2045. It will account for 17% (65.2 bn kWh) and 26% (222.9 bn kWh) in 2030 and 2045 respectively.

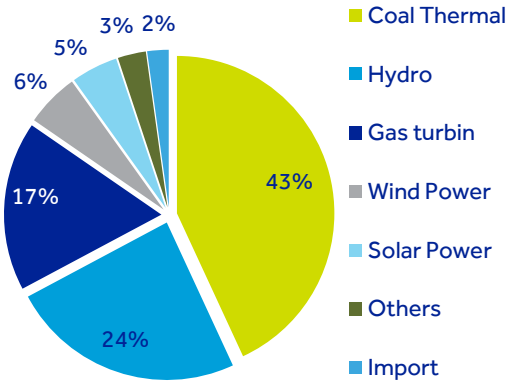
Wind power will be developed significantly and provide 143 bn kWh in 2045, which would make it the 3rd largest output source.

Solar power is projected to be stagnant until after 2030 as the sector has already reached its target capacity. Therefore, its supply is estimated not to increase substantially until after 2030 and would reach 71.7 bn kWh in 2045.



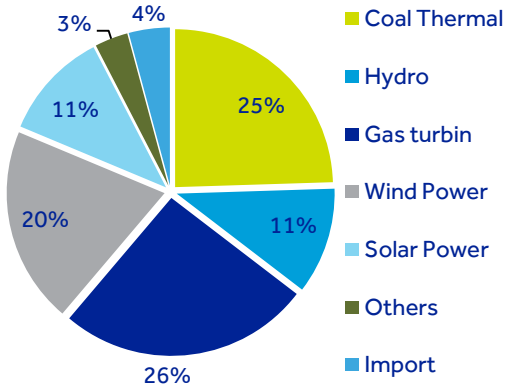
Sources: EVN, ACBS

2030 Output Structure



Sources: EVN, ACBS

2045 Output Structure



Sources: EVN, ACBS

Comment:

Even though **coal-fired** plants have a negative outlook in the long term (10-25 years), its importance to the current energy portfolio cannot be denied.

- Coal power, together with gas turbines, are serving as backbone sources for the whole system to ensure national energy security.
- Several coal power plants have demonstrated efficiency with low business investment rate.

Hydropower, thanks to favorable geography, Vietnam has been able to develop many plants to exploit hydroelectricity, however, the potential to build more plants is drying out. As a result, hydroelectricity is not expected to be a major source of new capacity going forward.

Gas thermal is the 1st contender for supplanting coal thermal as a primary contingency power source, covering RE drawbacks such as inflexibility and depending on weather conditions, and also reducing carbon emission. However, there have been several issues in implementing gas thermal projects, including:

- Unstable input gas prices. Gas volumes are supplied by PV GAS and prices are indexed to oil prices, but under Government's regulation.
- Exhausting domestic oil/gas fields and high initial cost of exploiting new ones.

We expect solar power will be less promising for investors in the 2020 – 2030 period as new projects are not expected to be approved until after 2030 as a result of extraordinary development between 2018 – 2021 which resulted in:

- Mismatches between high usage and high production times. Without the ability and capacity for mass storage, the solar power sector has not been very efficient for overall power generation. Solar power peaks for around a 5 hour period during the day between 10 AM and 3 PM, but the electricity demand at that time is relatively low compared to others.
- In addition, the North's location is not naturally suitable for developing RE including solar power. EVN has to transmit surplus electricity output from the Central and Southern regions to North resulting in power loss and waste during the transmission and potentially causing some instability for the whole system.

Wind power would be priority over solar and is expected to develop into the largest RE source in 2045. We expect this sector would be the most attractive in energy industry in the long term thanks to the enormous potential for growth according to PP8. When PP8 is approved (expected at the end of 2022), many wind power projects would benefit as well as companies contains these projects such as GEG.

Energy storage, including **hydro storage** and **battery** capabilities are expected to be developed after 2030 and will be supportive and beneficial to the transmission system and alleviating some of the current drawbacks of RE.

Energy Subsector Outlooks

Coal-Fired

Short Term Outlook: POSITIVE	Long Term Outlook: NEGATIVE
Coal-fired power is still an essential part of the overall power generation portfolio, accounting for nearly 50% of the total output volume. While there will be a shift towards cleaner alternatives given technologies, costs and environmental effects associated with coal power, this process will not take place overnight and coal will remain a key energy producer for some time.	Due to Vietnam's commitments to reduce carbon emissions at COP26, new coal-fired plants are expected not to develop after 2030 and face curtailment risks in the long term as cleaner sources become more readily available, cheaper and transmission/storage issues are addressed.

Gas Turbine

Short Term Outlook: NEUTRAL	Long Term Outlook: POSITIVE
Gas powered thermals are expected to be an alternative to coal-fired to maintain the balance between macro economic growth and environmental sustainability. However, unstable gas prices, anchored to oil prices, are expected to linger to the end of 2022, due to the continued destabilization of the global market with the Russian invasion of Ukraine, which would hinder gas thermal plants net profits.	Gas-fired is anticipated to keep growing both in capacity and output amount to comply with PP8. Hence, its outlook would be relatively brighter compared to coal-fired.

Hydropower

Short Term Outlook: POSITIVE	Long Term Outlook: NEGATIVE
Thanks to the La Nina period lasting longer than expected, 2022 is anticipated be an another vibrant year for Hydropower. However, El Nino is forecasted possibly return in 2023-2024 period, thus; hampering the output and profit growth in that period.	Hydropower sector is not projected to have huge growth potential in both capacity and output due to diminishing resources for exploitation. Hence, the performance is expected to vary with the La Nina – El Nino cycles rather than capacity expansion and output growth.

Solar

Short Term Outlook: NEUTRAL	Long Term Outlook: POSITIVE
Solar power has developed rapidly from 2019-2021 and has already reached its targeted production capacity of 2030. As a result, according to PP8, solar capacity is expected to be stagnant until after 2030 as the current transmission and storage capabilities have not kept pace with the solar capacity development.	After 2030, solar power scale is expected to expand continually given expected upgrades to the transmission and storage capabilities, thereby returning to the race for capacity and output growth together with Wind power.

Wind

Short Term Outlook: POSITIVE	Long Term Outlook: POSITIVE
According to PP8, Wind power is expected to be at the forefront of new renewable energy project developments; whereas solar power is projected to halted until after 2030. Preferential FIT rates are expected to be established after the passing of PP8 which should further bolster the wind energy segment.	With demand for energy usage in the country expected to continue to outpace GDP growth by a few percentage points and the orientation shifting towards renewable energy generation, the wind power segment is expected to an attractive investment channel in Vietnam. Further bolstering the outlook for the wind segment are the constraints on both solar and hydro, paving the way for wind to take center stage in renewable energy development.

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BUY:where we believe prospective 12 month VND total return (including dividends) will be 15% or more.
HOLD:where we believe it will be -15% to 15%.
SELL:where we believe it will be lower than -15%.

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