

MINISTRY OF INDUSTRY AND TRADE
ELECTRICITY AND RENEWABLE ENERGY AUTHORITY

EVALUATION REPORT

NATIONAL POWER DEVELOPMENT PLAN – PDP
(REVISED POWER DEVELOPMENT PLAN 7
AND POWER DEVELOPMENT PLAN 8
IMPLEMENTATION UPDATE)

Hanoi, March 2024

TABLE OF CONTENT

1.	3	
2.	6	
2.1	6	
2.2	7	
2.3	10	
3.	11	
3.1	Implementation progress of power grid development for the period of 2016-2022	11
3.1.1	500 kV power grid	12
3.1.2	220 kV power grid	13
3.1.3	500 kV inter-regional power connection grid	14
4.	ASSESSMENT OF THE PREVIOUS PDP IMPLEMENTATION	16
4.1	Overall assessment	16
4.2.	Shortcomings, limitations and causes	17
5.	PROGRESS OF PDP8	24

1. ASSESSMENT OF ACTUAL AND FORECASTED ELECTRICITY DEMAND

The National Power Plan VII (PDP7) was prepared in 2010 and approved in 2011 for the period 2011-2020, with a vision to 2030. After four years of implementing the plan, PDP VII was revised and then approved through Decision No. 428/QD-TTg dated March 18, 2016 by the Prime Minister. The revised PDP7 report updated the socio-economic situation, providing verification and evaluation of the economic growth rate that reflected the actual conditions and the national orientation, thereby providing important input into the power source and power grid development program for the remaining planning period. However, the unforeseen emergence of the COVID-19 pandemic has significantly impacted economic growth and electricity usage in 2022. Section I – Assessment of actual and forecasted electricity demand will focus on comparison and assessment of actual demand for the period 2015-2020 compared to the forecast under the Revised PDP7 in terms of two main indicators: electricity and capacity. Table 1 indicates the actual electricity demand versus the demand forecasts under the two scenarios as per the approved revised PDP7.

Table 1: Actual electricity consumption versus electricity demand forecast under Revised PDP7

Year	Actual consumption		Revised PDP7 – High-load scenario		Revised PDP7 – Base-load scenario	
	Atp (GWh)	Pmax (MW)	Atp (GWh)	Pmax (MW)	Atp (GWh)	Pmax (MW)
2014	126,500	22,210	126,500	22,210	126,500	22,210
2015	143,397	25,809	140,000	24,840	140,000	24,840
2016	160,257	28,109	158,021	28,138	156,290	27,830
2017	174,513	30,931	177,278	31,654	173,549	30,988
2018	192,361	35,126	197,879	35,429	191,854	34,350
2019	209,769	38,249	219,961	39,491	211,308	37,937
2020	216,826	38,617	242,578	43,705	230,924	41,605

Gross Domestic Product (GDP) is the most influential parameter in forecasting the electricity demand. The Revised PDP7 report used two GDP growth scenarios for the period 2016-2020, i.e., 6.9%/year for the baseline scenario and 7.6% for the high-load scenario. In principle, if the forecast model is suitable and other sets of parameters such as population, urbanisation rate, electricity price, etc. do not have significant differences between reality and assumptions, the actual electricity demand will be closer to the baseline scenario, also known as the Base-load Scenario. Unfortunately, the Vietnam GDP growth rate in 2020 was reduced to only 2.91% due to the unprecedented impact of the COVID-19 pandemic.

Table 2: Comparison of forecasted and actual electricity sales by regions

Comparison	Region	2015	2016	2017	2018	2019	2020
Baseline scenario (GWh)	Northern	55,239	63,235	70,141	77,644	85,633	93,695
	Central	13,526	15,998	17,862	19,399	21,022	22,632

Comparison	Region	2015	2016	2017	2018	2019	2020
	Southern	71,236	77,057	85,545	94,811	104,653	114,598
Actual consumption (GWh)	Northern	58,917	66,960	73,562	82,184	90,038	94,915
	Central	13,529	14,976	16,081	17,560	19,332	19,119
	Southern	69,535	76,912	83,220	91,108	99,076	102,788
Difference (%)	Northern	6.2%	5.6%	4.7%	5.5%	4.9%	1.3%
	Central	0.0%	6.8%	11.1%	10.5%	8.7%	15.5%
	Southern	2.4%	0.2%	2.8%	4.1%	5.6%	10.3%

The above results show significant differences between the forecast and actual consumption in all three regions.

Detailed assessment of electricity consumption by regions and of key provinces/cities by the end of 2020 is as follows:

- Among the three regions, the Northern region has the best transportation infrastructure and is also least affected by the lack of local power sources. Therefore, the North attracted industrial production investment during the implementation of the PDP. According to the statistics, it saw very high electricity demand growth rates during 2016-2020 in some Northern provinces, namely Ha Nam, with the specialisation in cement production, achieving 26.2% p.a, Thanh Hoa province, with the existence of Nghi Son Refinery & Petrochemical Company, reaching 22.5% p.a, etc. Some provinces with low consumption level also experienced significant increase in electricity demand, such as Cao Bang province, which reached 20.3% p.a, Tuyen Quang at 17.1% p.a, etc. Meanwhile, the electricity consumption growth rates maintained high in provinces with major industrial production, such as Thai Nguyen at 17.1% p.a, Vinh Phuc at 16.4% p.a, Quang Ninh at 17.0% p.a, Hai Phong at 13.1% p.a, etc. Hanoi, the capital, reached the electricity demand growth rate of 8.3% p.a despite being not as high as in the previous period.

- The Central region was expected to have relative development progress through the establishment of economic zones (EZ), industrial parks and commercial centres, hotels and guesthouses, and resorts across the central provinces, such as Chan May EZ (Thua Thien Hue), Chu Lai EZ (Quang Nam), Dzung Quat EZ (Quang Ngai), Nhon Hoi EZ (Binh Dinh), Van Phong EZ (Khanh Hoa) and many planned industrial parks. In fact, only Chu Lai and Dzung Quat Ezs had actual high electricity demand. Despite its lower growth rates than expected, the central region showed an electricity consumption transition from industrial production to trade and services. The electricity consumption share of the industrial sector decreased from 42.1% in 2015 to 40.9% in 2020. That number of the trade and service sector increased from 8.2% in 2015 to 10.2% in 2019 and decreased to 7.2% in 2020 (due to the COVID-19 pandemic). The Central region's leading provinces have their commercial electricity growth maintained at high rates, such as Quang Nam at 17.3% p.a, Quang Ngai at 17.1% p.a, Quang Binh at 17% p.a, and Da Nang only reached 7.6% p.a.

Despite its revision, the revised PDP7 was prepared at a time when key Southern provinces were experiencing high electricity growth rates, and the Southern region's RGDP rate was expected at 7.4% from 2016 to 2020. Consequently, the growth rate of electricity sales was projected to be 10.8% p.a. In fact, the electricity demand growth rate of the region only reached 9.3% p.a from 2016 to 2020. Many provinces and cities in the region have not achieved the expected electricity growth rates. For instance, Ho Chi Minh City achieved 6.6% p.a, lower than expected at 7.6% p.a; Dong Nai at 8.8% p.a, lower than expected at 9.5% p.a; except Binh Duong province maintained a high growth rate of 14.2%, higher than expected at 10.1% p.a.

For the period 2021-2022, analysis of actual operation data and the power source mix by types were the basis for Vietnam to continue to evaluate and prepare the PDP8 with the aim to achieve net-zero targets by 2050.

Table 3: Power sources mix – By Investors - in 2021-2022

No.	POWER INVESTORS	2021	2022
	TOTAL CAPACITY(MW)	76,364	77,749
1	EVN + GENCOs	29,901	29,901
1.1	Directly managed by EVN	11,974	11,974
1.2	GENCO1	7,014	7,014
1.3	GENCO2	4,421	4,421
1.4	GENCO3	6,450	6,450
1.5	EVNCPC	42.5	42.5
2	PVN	5,525	6,163
3	VINACOMIN	1,815	1,815
4	BOT	7,556	7,556
5	Other investors	30,995	31,743
6	Imported electricity	572	572
	Share (%)	100%	100%
1	EVN + GENCOs	39.2%	38.5%
2	PVN	7.2%	7.9%
3	VINACOMIN	2.4%	2.3%
4	BOT	9.9%	9.7%
5	Other investors	40.6%	40.8%
6	Imported electricity	0.7%	0.7%

Table 4: Power source mix – By Types - in 2021-2022

No.	TYPE OF POWER SOURCE (MW)	2021	2022
	TOTAL SYSTEM CAPACITY	76,364	77,749
1	Hydropower	21,816	22,504
-	<i>Hydropower</i>	<i>17,839</i>	<i>18,097</i>
-	<i>Small-scale hydropower</i>	<i>3,978</i>	<i>4,407</i>

2	Coal-fired power	24,674	25,312
3	Gas-fired thermal power	7,152	7,152
4	Oil-fired thermal power	1,501	1,501
5	Renewable energy (RE)	20,484	20,544
-	<i>Wind</i>	<i>3,987</i>	<i>3,987</i>
-	<i>Solar farm</i>	<i>8,515</i>	<i>8,515</i>
-	<i>Rooftop solar</i>	<i>7,664</i>	<i>7,664</i>
-	<i>Biomass + Waste</i>	<i>318</i>	<i>378</i>
6	Diesel and others	165	165
7	Imported electricity	572	572
No.	TYPE OF POWER SOURCE (%)	2021	2022
	Share (%)	100%	100%
1	Hydropower	28.6%	28.9%
-	<i>Hydropower</i>	<i>23.4%</i>	<i>23.3%</i>
-	<i>Small-scale hydropower</i>	<i>5.2%</i>	<i>5.7%</i>
2	Coal-fired power	32.3%	32.6%
3	Gas-fired thermal power	9.4%	9.2%
4	Oil-fired thermal power	2.0%	1.9%
5	Renewable energy	26.8%	26.4%
-	<i>Wind</i>	<i>5.2%</i>	<i>5.1%</i>
-	<i>Solar</i>	<i>11.1%</i>	<i>11.0%</i>
-	<i>Biomass + Waste</i>	<i>0.4%</i>	<i>0.5%</i>
6	Diesel and other	0.2%	0.2%
7	Imported electricity	0.7%	0.7%

The above data indicates that Vietnam must ensure the balanced development of various power sources to achieve both its declaration at COP26 and ensure its energy security and sustainable development.

2. ASSESSMENT OF POWER SOURCES DEVELOPMENT PROGRAMMES IMPLEMENTATION

2.1 Power source development for the period 2016-2020

During the first 5-year period of 2011-2015, approximately 17GW of power sources (including small hydro power and renewable energy - RE) were put into operation, equivalent to more than 81% of the target volume assigned for this period under PDP7. Among the three regions, the North reached the highest fulfillment at 96% of its assigned target while the South met the lowest at 62.7%. The North attracted many investors during this period because of its potential for domestic coal resources and hydropower, especially small-scale power. In the South, it was expected to develop coal-fired or imported LNG fired thermal power sources but faced many more difficulties

thus delaying the progress of power source development. This led to a high volume of electricity being transmitted from the North to the South in recent years.

During the period of 2016-2020, power source development investment was implemented under the Revised PDP7. The total installed capacity of the whole power system reached 132% against the total capacity required for the period because of the rapid development of solar energy in 2019 and 2020. Meanwhile, the traditional power sources development (i.e., hydropower, gas, coal – mainly coal-fired power) remained behind schedule as in the previous periods, *only reaching nearly 60% of the planned volume*. The delay mostly occurred between 2019 and 2020, both in the North and the South, with the total capacity of traditional power sources delayed, amounting to more than 7000 MW against the total power capacity target in the revised PDP7.

In the same period (2016 – 2020), ten (10) large power projects were expected to be in operation according to the Revised PDP7 but delayed after 2020, including: Song Hau 1 #2 (PVN-1200 MW), Thai Binh 2 (PVN -1200 MW), Long Phu 1 (PVN-1200 MW), Na Duong 2 (TKV-110 MW), Cam Pha 3 (TKV - 440 MW, not yet invested), Cong Thanh (600 MW), O Mon III, etc. Meanwhile, renewable energy (mainly solar power) had exceeded the plan (due to the impact of the Government's incentives for renewable energy development). This caused difficulties in balancing electricity supply because the equivalent operating hours (EOH) of RE were only about 1/3 that of traditional thermal power sources.

2.2 Review of the list of power sources under the Revised PDP7

According to the Revised PDP7 approved at Decision No. 428/QĐ/TTg dated 18 March 2016 of the Prime Minister and its other relevant supporting decisions, by the end of 2020, the total capacity to be operational in the period 2016-2030 was **109,090 MW/482 projects**, i.e., 35,470 MW for the period 2016-2020; 45,030 MW for the period 2021-2045; and 28,590 MW for the period 2026-2030.¹

2.2.1 Coal-fired power

In the Revised PDP7, 37 coal-fired power projects with a total capacity of 35,112 MW were approved and expected to operate for the period 2016-2030. Of which, 12 projects with a total capacity of 8,750 MW were operated during 2016-2020 (including the second unit of Hai Duong thermal power plant (TTP) operating in 2021 under the Revised PDP7) and 25 projects with a total capacity of 26,542 MW expected to be operated in the period 2021-2030. The capacity distribution of these additional 25 projects were: 16 projects with a total capacity of 13,930 MW would be in the North, 01

¹ Assuming that the additional wind and solar power projects not yet under operation would be equally distributed for 2021-2025 and 2026-2030. Periods.

project with a capacity of 1,200 MW would be in the Central and 8 projects with a total capacity of 11,142 MW would be in the South.

There were 11 projects with a total capacity of 11,740 MW being suspended or not being feasible in the period 2016-2030, namely Cam Pha III and Quang Ninh III TTP due to lack of planned plant sites, in addition to that Quang Ninh Provincial People's Committee (PPC) proposed to remove them from the PDP through Letter No. 2270/UBND-XD3 dated 16 April 2021; Rang Dong TTP had not called for investment; Hai Phong III had not prepared its pre-feasibility report and was proposed to be removed from the PDP by the Hai Phong PPC through Letter No.1424/UBND-CT dated 08 March 2021; Vung Ang III TTP was proposed to transition from coal to LNG by the Ha Tinh PPC through report No. 400/TTr-UBND dated 06 November 2020 to the Prime Minister; Long An I and Long An II TTP shifted to use LNG with a capacity of 2 x 1500 MW as per Decision No. 1080/TTg-CN dated 13 August 2020; Tan Phuoc I&II TTP did not have an approved plant site, and the Ministry of Industry and Trade (MOIT) was appraising the proposal for their transition to use LNG with a capacity of 2x1500 MW to be operated in the period 225-2027; Bac Lieu TTP was suspended according to the Government Office's meeting conclusion No. 326/TB-VPCP dated 13 October 2016.

2.2.2 Gas turbine power

The total capacity of gas turbine power approved for operation in the period 2016-2030 was 26,640 MW, corresponding to 20 projects. Regarding domestic gas use, there were 10 projects with a total capacity of 8,740 MW (6 projects with a total capacity of 4,090 MW in the Central region, 4 projects with a total capacity of 4,650 MW in the South), of which the Kien Giang I&II projects (1500 MW) in the Revised PDP7 were expected to use Block B gas. In fact, Block B gas was only sufficient to supply O Mon Thermal Power Complex (TPC), but not enough to supply gas to Kien Giang I&II projects. Besides, the terminal's natural conditions were also not favorable for supplying LNG to power plants in this area. Therefore, it is necessary to carefully consider and evaluate the possibility of continuing the Kien Giang I&II plant complex in this area.

Regarding LNG thermal power, there are 10 projects with a total capacity of 17,900 MW added to the PDP: 01 project of 1500 MW in the North (Quang Ninh LNG), 01 project of 1500 MW in the Central (Hai Lang LNG), and 08 projects of 14,900 MW in the South (Nhon Trach III & IV LNG plants of 1500 MW, Hiep Phuoc LNG plant of 1200 MW, Son My I LNG plant of 2250 MW, Son My II LNG plant of 2250 MW, Bac Lieu LNG plant of 3200 MW, Ca Na LNG plant of 1500 MW, Long Son LNG plant of 1200-1500 MW, Long An I LNG plant of 1500 MW (Long An II LNG plant of 1500 MW to be operated before 2035). The Long An LNG Complex (Long An I & II), Tan Phuoc 1&2 (with a total capacity of 2x1500 MW – being proposed to shift from coal to LNG) are located far in the Soai Rap River, which makes LNG transportation difficult and costly, thus the concentrated development of LNG power in this area needs to be carefully considered.

2.2.3 Hydropower

According to the Electricity and Renewable Energy Authority's hydropower statistics, the economic and technical potential of medium- and large-scale hydropower in Vietnam is about 23,000 MW - 25,000 MW of installed capacity. As of 2020, Vietnam's total hydropower capacity is approximately 21,000 MW, 17,000 MW of which from medium and large hydropower, so the *potential of medium- and large-scale hydropower has been almost fully exploited*.

The total hydropower capacity (including small-scale hydropower) under the Revised PDP7 for the period 2016 – 2030 is 7471 MW, of which 2,540 MW has been operated in the period 2016 – 2020, and the remaining 4,930 MW is expected to be operated in the period 2021 – 2030.

2.2.4 Wind power

The Revised PDP7 approved a list of power sources and power grid connections for 190 wind power projects with a total capacity of 11,860 MW. According to Document No. 4219/EVN-TTD dated 22 July 2021 of EVN, a total of 144 projects had signed power purchase agreements (PPA) with a total capacity of 8,145 MW. Before 31 October 2021 (the expiry date of Decision No. 39/2018/QĐ-TTg dated 10 September 2018 by the Prime Minister), it was expected that 95 wind power projects with a total capacity of 4,835 MW would be put into operation. Of which, about 62% of the approved wind power projects of 7,339 MW were in the South, 37% were in the Central with 4,401 MW, and only 1% (of 120 MW) was in the North.

2.2.5 Solar power

The Revised PDP7 approved a list of power sources and power grid connections for 175 solar power projects with a total capacity of 19,098 MW_p/15,400 MW_{ac} of concentrated solar power, 96% of which are located in the Central and South regions. Among these 175 projects, 8,673 MW_{ac} have been operated during 2016 – 2020, and the remaining 6,727 MW_{ac} is expected to be operated in the period 2021 – 2030, of which 497 MW in the North, 3,556 MW in the Central and 2,674 MW in the South. In addition, during the period 2016 – 2020, there were 9,694 MW_p/7,755 MW_{ac} of rooftop solar being operated, which did not require additional approval under the Revised PDP7, and 93% of these power projects concentrated in the Central and South regions.

2.3. Assessment of achievement in 2023

- As of 2023, the total installed capacity (with COD) of the whole system reached approximately 80,555 MW, an increase of about 2,800 MW compared to that of 2022, of which 21,664 MW of RE (wind and solar power) accounting for 27%; 26,757 MW of coal-fired power accounting for 33.2%; 22,872 MW of hydropower (including small-scale hydropower) accounting for 28.4%. The total installed capacity of Vietnam ranked first in the ASEAN region.

- The total system electricity production and imported electricity of 2023 reached 280.6 billion kWh, an increase of 4.56% compared to that of 2022.

- The maximum load capacity (Pmax) of the entire system in 2023 was 46,348MW, an increase of 2.01% compared to that of 2022.

- Electricity production and purchased electricity by EVN in 2023 was estimated to reach 271.1 billion kWh, an increase of 3.54% compared to that of 2022 (of which electricity production of EVN's power companies accounted for about 14.7%, GENCO's coal-fired electricity accounted for about 27.8% and the purchased electricity accounted for 57.4%).

2.3 Assessment of additional power source distribution under the Revised PDP7 and the power load demand of each region

In the North: In the period of 2021–2030, the North's load is forecasted to increase by 23,810 MW (equivalent to an average growth of 9.4% per year). However, its increased power supply capacity only reached 21,540 MW, which was 10% lower than the additional load. The region's power capacity growth rate also reached 7.1%, much lower than the load growth (9.4%), leading to differences in installed capacity/Pmax with a decline from 31% in 2020 to only 8% in 2030. Considering the weather conditions (dry and rainy seasons), the peak time without solar power generation, and the maintenance and repairing time of coal-fired TTPs, the total power supply capacity of the North will not guarantee electricity supply for the region. The North's electricity system will basically not be able to balance itself and will have to rely on a large volume of inter-regional transmitted electricity.

In the Central and South regions: In the period of 2021-2030, the central and southern power systems both have a higher installed capacity of additional power sources than their load growth. In the Central, the load growth is projected to increase to 4,370 MW while the installed capacity reached 7,220 MW, equivalent to 294% higher than the load capacity. In the South, the installed capacity increased by 41,097 MW, nearly two times higher than that of the load. The average annual growth of installed capacity in the Central and Southern regions reached 12.1% and 9.1%, respectively, which is higher than their load capacity growth (10.9% and 9.0% respectively). This will lead to an even higher correlation between installed capacity and Pmax of the regions in 2023 compared to that of 2020 (272% and 89%, respectively). This redundant volume in the Central and Southern regions will increase the volume transmitted to the North, putting significant pressure on the North-South inter-transmission system.

Evaluation: *The distribution of newly added power sources under the Revised PDP7 for the period up to 2030 does not meet the load growth of each region.* The additional power capacity of the North is 10% lower than its installed capacity, causing the difference in Pinstalled/Pmax of the region to decrease to only 8% in 2030. The North's power system will not be able to balance supply and load, especially during

peak times at night and in dry season. Therefore, the North will have to receive a large amount of power from the inter-regional grid to meet the load. In contrast, the power supply-demand imbalance in the Central and Southern regions already generates redundant power volume, which tends to grow because the additional installed capacity in the two regions for the period of 2021 – 2030 is higher by 294% and 91% than their load demands. This will cause a significant increase in the power volume transmitted from the South to the North compared to that of 2020, leading to overload on the North-South 500kV transmission power system, especially at the sections of Da Nang – Vung Ang and Vung Ang – Ha Tinh – Nho Quan.

3. POWER GRID DEVELOPMENT PROGRAM FOR THE PERIOD OF 2016 – 2020

3.1 Implementation progress of power grid development for the period of 2016-2022

During the period 2016 – 2022, a number of key power grid projects to supply electricity for the South have been operated with the aim to strengthen the power transmission system and contribute to ensuring power loads and improving power quality. Typically, the projects such as Vinh Tan 500 kV line – to Song May – Tan Uyen, Song May – Tan Uyen 500 kV line, Tan Uyen 500 kV substation and synchronously connected to Vinh Tan Power Center have enhanced the reliability of the 500 kV power system in the South; The project Vung Ang – Quang Trach – Doc Soi 500 kV transmission lines synchronised with the circuit line 3 to enhance North – South transmission, the project 500 kV Pleiku 2 substation to support importing hydropower from Southern Laos and release the regional hydropower capacity, etc.

In addition, this period experienced changes in the power mix, notably the development of renewable energy. Many power grid projects of 500 – 220 kV have been promptly built to meet the need for capacity release from large thermal power sources and new RE in the region. To address this need, many new power transmission lines had been additionally studied and constructed just in time, for instance, the 500 kV Quang Trach – Doc Doi – Pleiku 2 transmission line, RE connection works, etc.

The investment and construction of the approved 500 – 220 kV transmission lines under the Revised PDP7 made good progress, but some projects remained behind schedule. The main reasons were the financial difficulties, technical construction solutions, delays in other relevant works (such as power plants and substations). Besides, the compensation for site clearance also faced many challenges. High-voltage line work passes through many localities while each province has different compensation policies. In recent years, many households have built temporary houses with a large area within the power projects' foundations and corridors to claim compensation, thus delaying the progress of the relevant projects.

In the 2016 – 2020 period, EVN invested in constructing about 19,100 MVA 500 kW substation, about 29,300 MVA 200 kV substation, 2,300 km of 500 kV transmission line, and 5,400 km of 220 kV transmission line. The implementation rates of 500 kV and 220 kV substations were respectively 88.8% and 90.6%. These rates of 500 kV and 220 kV transmission lines were respectively 77.6% and 73.9%.

The amount of power grid transmission implemented in the 2016 – 2020 period against the Revised PDP7 is as follows:

3.1.1 500 kV power grid

In the period of 2016-2022, most of the 500 kV projects were on track, while some projects were behind schedule due to the need to synchronise with some delayed power source projects. Hence, the actual schedule has to be adjusted against the Revised PDP7 and due to other reasons – mostly delays in bidding, compensation, site clearance, materials, and equipment preparation, etc., during the implementation.

In the same period, the North invested and constructed most of the 500 kV substations as planned, except the Vung Ang 500 kV substation with only 01 machine newly built of 900 MVA because there was no room for a second one. The 500 kV transmission lines and connection lines were delayed after 2020 due to difficulties in site clearance and route agreements with the provinces. The 500 kV transmission line connecting large thermal power plants such as Cong Thanh – Nghi Son TPP, Nam Dinh – Pho Noi TPP were behind schedule because they had to synchronise with the delayed power source projects.

The Central region was leading in investment and construction of 500 kV power grid development, i.e, 100% of the 500 kV substation investment plan was completed, and typically in the South, the Pleiku 2 500 kV substation to import hydropower from Southern Laos and release the regional hydropower capacity, and other works to release the capacity of thermal power and RE in the region such as the project to raise the capacity of 500 kV Vinh Tan and Di Linh substations. The project Vung Ang – Quang Trach – Doc Soi 500 kV transmission line was synchronised with circuit line 3 to enhance North – South transmission. The 500 kV transmission line of Van Phong – Vinh Tan TPPs was behind schedule due to the delay in synchronisation with Van Phong TPP.

The South completed about 80% - 82% of the power grid development under the Revised PDP7. Typically, the Vinh Tan 500 kV transmission line - branch to Song May - Tan Uyen, Song May - Tan Uyen 500 kV transmission line, Tan Uyen 500 kV station and synchronously connected to the Vinh Tan Electricity Center have many important meanings in terms of economic - political – social development, increasing the reliability of the 500 kV power system (adding a third circuit of the 500 kV Vinh Tan - Song May transmission line), meeting the criteria N-1, N -2.

If it were not for the low load growth and delays of some power sources, the achievement of 500 kV grid development by the National Power Transmission Corporation (NPT) was relatively high as follows:

3.1.2 220 kV power grid

In the period 2016 – 2022, considering the entire power sector, the total amount of new construction and renovation of 220 kV power grids nationwide reached a quite high rate against the Revised PDP7. It's estimated that, for the entire period 2016-2020, the substation implementation reached 90.6%, and that of the transmission line reached 73.9%. Some projects are behind schedule due to main reasons such as compensation, site clearance, and route agreements with localities and other subjective reasons from the NPT.

The detailed construction and renovation of 220 kV power grid implemented in each region against the Revised PDP7 are as below:

The volume of 220 kV substations by the NPT reached 90.6%, and the remaining 20 projects are being implemented but cannot be completed in 2020, mainly in the North and the South. The reason for the operational delay is mainly difficulties in site clearance and slow implementation.

The volume of 220 kV transmission line nationwide only reached 73.9% against the Revised PDP7, mainly in the Central and the South, reflecting the fact that it becomes more challenging in transmission lines investment. The main reasons for the operational delay are difficulties in compensation, site clearance, power cut arrangement for construction, bidding issues, etc.

3.1.3. 500 kV inter-regional power connection grid

In the period up to 2030, the Revised PDP7 approved many inter-regional power connection grid projects that play an important role in capacity release and ensuring power supply, such as Vung Ang – Quang Trach – Doc Soi – Pleiku 2 500 kV transmission line, Vung Ang 3 – Quynh Lap – Thanh Hoa – Nam Dinh 1 – Pho Noi, Central region Trung – Krong Buk – Tay Ninh, Binh Dinh – Van Phong – Vinh Tan, etc. The implementation progress and expectations of these projects are as follows:

Evaluation: In general, many key power grid projects scheduled to be completed in the 2021-2025 period, according to the Revised PDP7, are still in the Pre-Feasibility (FS) and FS stages such as the Nam Dinh – Thanh Hoa – Quynh Lap – Quang Trach transmission line, Dung Quat TBK – Krong Buk – Tay Ninh, Thuan Nam – Chon Thanh. Therefore, the above projects are likely to be delayed, affecting the operation of the power system.

Table 5: Volume of the transmission lines (Km) during 2021-2022

Unit: km

TRANSMISSION LINE	TOTAL	NPC	SPC	CPC	HANOI	HCMC	NPT
2021	27,523	0	0	0	8.8	126.6	27,388
500 kV	8,973						8,973
220 kV	18,550				8.8	126.6	18,415
2022	29,728	0	168.0	0	8.8	126.6	29,425
500 kV	10,467						10,467
220 kV	19,262		168.0		8.8	126.6	18,958

Table 6: Volume of the power transmission substations during 2021-2022

Unit: MVA

SUBSTATION	TOTAL	NPC	SPC	CPC	HANOI	HCMC	NPT
2021	112,075	0	0	0	500	2,500	109,075
500 kV substation	43,200						43,200
220 kV substation	68,875				500	2,500	65,875
2022	119,525	0	0	0	500	3,000	116,025
500 kV substation	46,650						46,650
220 kV substation	72,875				500	3,000	69,375

4. ASSESSMENT OF THE PREVIOUS PDP IMPLEMENTATION

4.1 Overall assessment

Over the years, the power sector industry has completed the tasks assigned by the Party, Government, and people, being one of the pillars of the country's economy. It has basically met the increasing electricity demand and has performed well as an instrument for macroeconomic regulation and implementation of social security of the Government. The industry has gained profits from power production and business, fulfilling its obligations to the state budget while preserving and developing capital.

The main results from 2011 to present are below:

(i). Planning and management of planning are implemented with effective methods, and being effective instruments for managing power sector investment and development, ensuring sufficient electricity for socio-economic development and national security. During the period 2011 – 2020, there were two national power development plans, i.e., the PDP7, and the Revised PDP7 and, at present, the PDP8 is under development. The PDP focuses on the following issues: Forecasting of electricity demand; Calculating and identifying power sources and power grid development programmes; Calculation of investment capital needs and economic-financial analysis of power development options; Environmental protection in power development. The centrally-governed cities and provinces have all planned their power development for the period of 2011-2020 and the period 2016-2025, with a vision to 2035. The national and provincial PDP have truly become effective instruments to manage investment in the power sector, ensuring sufficient electricity for socio-economic development and ensuring national security.

In addition to the PDPs at all levels, the implementation of these PDPs also received adequate attention and instruction. The National Steering Committee on developing National PDP was established in 2011, the National Steering Committee on Power sector development was established in 2016 to implement the PDPs. At the provincial level, through the Department of Industry and Trade as a focal point, the provincial PDPs have played an important role in building infrastructure, attracting investment, and meeting the needs of socio-economic development in each province.

(ii). The investment in power supply infrastructure has experienced strong development, which is an essential condition for ensuring the power supply.

(iii). The Government has issued many incentives and policies to adjust electricity prices based on market mechanisms, facilitating conditions for the power sector to achieve financial autonomy step by step, and to have enough capacity for investment and development.

(iv). Commercial electricity business and customer service have been improved in terms of power quality and services.

(v). Power loss and power savings have achieved key milestones, contributing to the power supply.

(vi). The competitive electricity market has been formed, developed, and improved, contributing to improving the efficiency of the power sector.

(vii). The implementation of the National Program on Demand Side Management (DSM) has contributed to reducing the growth of electricity demand, thereby contributing to ensuring supply and demand balance and gradually improving the quality of and reliability of power supply.

(viii). The protection of natural resources and environment in power development has been prioritised.

During the period of 2011 – 2020, overall, the power system ensured the power supply for socio-economic development and national defence:

- The load growth was close to the forecast in the revised PDP7. In 2020, the total commercial power output reached 93.9% of the load forecast (the COVID-19 pandemic made the rate relatively low).
- The development of power source reached 132% of the total installed capacity against the plan for 2016 – 2020 period, but the power mix was different from the plan, i.e., thermal power only reached 60% while RE exceeded by up to 480%. This would lead to a short-term risk of power shortage due to the delay of thermal power projects.
- The development of the power grid according to the expected data in 2020 was quite high (over 80% for the 220 kV power grid; 72.7% for the 500 kV transmission line, and 88% for the 500 kV substation). However, the volume of transmission lines to be completed by the end of the year would be relatively high.

4.2. Shortcomings limitations and causes

Shortcomings and limitations

4.2.1. Shortcomings in preparation and implementation of the PDPs

The preparation of PDPs saw some shortcomings and limitations as follows:

- Synchronisation of the plans: The PDPs are highly systematic because they are inter-connected to the national plans of many other sectors such as coal, oil – gas, RE, socio-economic development, transportation, urban planning, industrial development, etc. In fact, the synchronisation of these plans is relatively challenging because their preparation time often does not coincide.

- The data for the PDPs are inconsistent and not comprehensive, causing inaccuracies in forecast and calculations.

- The process of appraisal and approval of the planning is lengthy, leading to a shortened implementation time after approval.

- The additional approval of many power source and grid projects to the PDPs at the end of the 2011-2020 period has strongly affected the overall planning, the synchronisation, and integration in PDPs.

- The planning and additional approval of RE projects are not synchronised with the power grid development planning, have not kept up with the pace of technological development and the reduction rate of RE project investment costs, leading to the unsystematic development of RE, and difficulties in operating the national power system, releasing generation capacity, etc.

- The management of planning in the recent period has faced challenging times in making timely adjustments. Vietnam's average load growth rate is at over 10% p.a, hence, it requires the development of power sources and grids to meet the load demand. In the recent period, there have been many major changes such as the suspension of the Ninh Thuan nuclear power plant difficulties in the construction of coal-fired power plants related to embargo issues, capital arrangement issues, site clearance issues, and environmental issues and the strong development of RE following the Government's incentives for renewable energy development. Facing these challenges, MOIT has directed to conduct reviews, calculations and propose solutions to ensure power supply for the country, i.e., adding Nhon Trach 3 and 4 TPPs using LNG; adding An Khanh Bac Giang TPP, wind and solar power plants; Adding 500 kV Vung Ang - Doc Soi - Pleiku 2 transmission line; Strengthening inspection and urging contractors to ensure progress of the power plants, etc. The above solutions have contributed to basically supplying the electricity demand for the socio-economic development of the country. However, there are times when the planning management has not responded promptly to the desired progress of the power project investors, especially in the solar and wind power projects. This shortcoming also has objective causes as RE are unstable sources and first-time developed with a large volume in Vietnam, so it is vital to conduct detailed calculation of the absorption capacity of the power system. In addition, the development of the above-mentioned RE sources also requires a suitable roadmap to ensure the overall efficiency of the power system (due to the high cost of RE sources); at the same

time, it is necessary to evaluate the environmental issues of the projects, i.e., evaluating the project's land use, waste collection and treatment like solar panels, batteries, etc. MOIT is robustly coordinating with EVN, international development organisations and experts, and Vietnamese consulting firms and research institutes to resolve the above issues step by step.

- In order to meet the load demand with a growth rate of over 10% per year, the PDPs have to be regularly updated and adjusted. The power planning in the recent period has been quite “rigid” in nature. The PDPs have determined the scale, time of operation, and investors of each power project. Its advantage is that it accurately determines the project volume and investors. However, the downside is the lack of flexibility in implementation. If any problems arise and require changes in scale and time of operation, the investors will have to spend time adjusting the planning. In the document approving the tasks of PDP8, the Government directed that the implementation of PDP8 should be an “open” planning that only identifies the list of key national power projects, and their needs and spatial distribution, thereby increasing flexibility in the plan implementation.

4.2.2. Shortcomings in power source development

Power source projects, especially non-EVN projects, are often behind schedule, seriously affecting the assurance of electricity supply in the coming time.

According to the Revised PDP7, in the period 2016-2030, there are a total of 116 power projects that need to be invested and put into operation (RE projects are not included). After nearly 3 years of implementation, many projects have not been deployed due to proposals and recommendations of the local government, such as coal TPPs in Bac Lieu, Quang Ninh, Ha Tinh, and many other provinces proposed to supplement new LNG power centers such as Bac Lieu, Ba Ria Vung Tau, and Ninh Thuan. Most of the BOT projects implemented by foreign investors are behind schedule against the PDP, and many power source projects under construction are also delayed such as Long Phu 1, Song Hau 1, Thai Binh 2. According to a recent survey, the total capacity of power projects that can be put into operation in the period 2016-2020 only reached 15,500 MW/21,650 MW (nearly 72%). The power projects not being implemented with slow progress against the PDP are causing major difficulties and challenges in ensuring power supply in the coming time.

The failure to strictly comply with the PDPs has caused the imbalance development of the power system, significantly affecting the reliability, stability, and efficiency of the power sector, in detail:

The PDP has clearly determined the list of power projects to be invested by year, ensuring the balance of electricity supply and demand in each region, prioritising projects located near the load centres to enhance power security, reduce grid investment

costs and minimize transmission losses. In fact, only the majority of EVN's projects comply with the above criteria, while there are many projects belonging to other investors or many facing difficulties with registration (which need to be on schedule) or requesting a mechanism to put ahead power projects which are planned for the following (*later*) years and not yet being prioritised. Such facts have led to problems related to increased volume, transmission length, circuit congestion, and loss of power supply safety. The widespread investment and insufficient prioritisation of key projects have caused unfavourable factors in the management and implementation of the power projects, including on the investor's side, project management board, consulting units, and construction contractor, leading to a delay in progress. According to the assessment, in the upcoming period, almost only projects implemented by EVN can meet the deadlines, while other power source investors, especially BOT power sources, are mostly behind schedule.

According to the PDP for the period 2011-2020, power source projects are approved with attached investors. It is said that the project implementation capacity and the ability to mobilise capital of some investors would be the main reasons for the delayed progress or being unable to deploy projects, especially coal-fired thermal projects.

4.2.3. Shortcomings in power grid development

Procedures for revising PDPs are difficult, complicated, and time-consuming. Especially, the provisions of the Planning Law, once effective, will affect the implementation of the power transmission grid projects.

Difficulties in compensation and site clearance: These are the biggest obstacles that have the greatest impact on the implementation of power projects in recent years. There are several reasons for these issues, i.e., (i) The policies still have many shortcomings, the compensation unit price is not proper and inconsistent among many localities, leading to local people not accepting it and the processing time being prolonged; (ii) The people's awareness is low, they do not cooperate and comply with the law; (iii) The local authorities have not been really active in land clearance work for power transmission grid projects in the area. (iv) The constraint in land management in some localities, especially in remote areas, affects the identification of land origin, causing disputes and prolonged lawsuits; the compensation unit prices are still inadequate, especially in bordering areas between provinces. There is no regulation on the area of land borrowed for temporary construction, leading to unreasonable demands for compensation by local people.

Difficulties in agreeing on the location of the transformer substations and power transmission line with local authorities: Currently, EVN has encountered many difficulties in agreeing on locations, arranging transformer substations, and laying out

power transmission lines with local governments, especially in areas with limited land funds, leading to a prolonged agreement process. There is also asynchrony and overlap between plans (power development, infrastructure development, industrial parks, tourism, etc.) causing many power projects already agreed upon by the government to have their plans and route designs changed, leading to prolonged timelines and slow progress in project implementation.

Difficulties in the authority level to decide investment policies for group-A power projects: According to the provisions of the 2014 Law on Investment, the investment policies for group A construction investment projects with total investment below the level of the Prime Minister's approval (under 5,000 billion) must be approved by the local government where the project implementation unit is headquartered or where the power transmission grid project is located. This regulation will make it difficult to decide on investment policies for power transmission line projects passing through many provinces/cities because one province/city cannot make a decision on investment policies for power transmission lines passing through other provinces/cities.

Difficulties in converting forest land to implement power transmission grid projects: By law, the power transmission grid projects passing through natural forests must have the Government's decision on forest land conversion to power transmission grid projects. The procedures and process to convert forest land are extremely complicated, time-consuming, and require involvement of many levels and ministries/sectors (Ministry of Agriculture and Rural Development, Ministry of Natural Resources and Environment, MOIT, Ministry of National Defence, The Government Office, etc.) so it has greatly affected the implementation of many key construction investment projects of EVNNPT in recent times (500 kV transmission line connecting Nghi Son 2 TPP, 220 kV Nha Trang - Thap Cham transmission line, 220 kV Huoi Quang - Nghia Lo - Viet Tri transmission line, etc).

4.2.4. Shortcomings in RE development

- Barriers to the price compensation mechanism:

The price of renewable energy power is currently higher than that of electricity from traditional power sources (thermal power, large hydropower, etc.). EVN is being assigned by the Government to purchase all electricity output from renewable energy projects at the prices set by the Government. As such, EVN is performing the function on behalf of the State, the cost compensation for RE is being blended with the costs of the power sector, not clearly separated in electricity bills. As the share of RE in the power mix increases, the compensation price part will increase and greatly affect the cost and price of the electricity.

- Technical barriers:

Because of its heavy dependence on weather conditions, terrain, climate, etc., renewable energy sources are often concentrated in a few provinces and localities (most of them have small on-site consumption loads), where the power grid system has not met the requirements for power transmission. In a power system that integrates a large number of unstable power sources, such as wind and solar, it is necessary to build a large backup power source, which wastes investment on the grid. The study, construction, and operation of energy storage devices; building smart grid systems, building real-time weather and meteorological forecasting systems; issues of power flow control and voltage control; frequency, harmonic suppression in systems with a large proportion of renewable energy, etc. still do not meet practical requirements. Recently, the progress of building a number of power grid projects to ensure capacity release of wind and solar power plants newly added in provinces with great potential for wind and solar power like Ninh Thuan, Binh Thuan, etc., is still slow. It is difficult to add new power projects in potentially full/overloaded areas.

- Financial barriers:

Investing in renewable energy projects requires large capital and carries high risks because their capacity and output depend on weather conditions. The capital recovery period could be longer due to their investment rates and electricity prices being higher than that of traditional energy sources. Therefore, without the Feed-In Tariff (FIT), financial institutions and commercial banks will not be willing to lend RE investment projects.

- Regarding synchronisation of PDPs: The additional planning of RE projects to the PDPs is not synchronised with the power grid development planning and has not kept up with the speed of technological development and the rate of cost reduction in power project investment. This has led to the unsystematic development of RE projects and the difficulties in operating the national power system, releasing the generating capacity, etc.

4.3 Major causes

- The orientation of PDPs has not been thoroughly implemented, and some adjustments have a significant impact on the issue of electricity supply and demand (some proposals on changing the PDPs, such as the Ninh Thuan nuclear power development, changes in RE development policy, etc.)

- Lack of investor selection mechanism to arrange investment capital for the power sector, leading to a lack of capital investment.

- Lack of sanctions for investors to take responsibility regarding to the delays of the key power projects (for both state-owned and non-state enterprises, and foreign enterprises, etc.)

- The coordination of localities in implementing power projects is not well-organised and lacks robust actions; in some cases, localities previously supported the project but later changed their minds, causing disruption to the PDPs.

- Several remaining gaps in the state management in investment and construction process; overlapping and unclear legal regulations; lack of specific mechanisms for power development; lack of procedures; prolonged project implementation time; reduced efficiency.

- The plans, implementation progress, and determination of resources for some power projects are unclear. The capacity of domestic investors and contractors is limited both financially and technically. According to the PDP for the period 2011-2020, the power source projects are approved together with investors implementing these projects. In particular, the poor capacity of project implementation and capital mobilisation of some investors are said to be among the main reasons for the delayed progress or not being able to deploy projects, especially coal-fired thermal power projects.

- Many obstacles in negotiating BOT projects have lengthened the project development time. The process of negotiating BOT contracts and granting investment licenses is still prolonged due to the involvement of many ministries/sectors. The main problems come from issues of incentives, guarantees, foreign currency conversion, early termination of contracts, etc. The time to consider and give opinions from state management agencies on issues is often long-lasting.

- Several projects have been delayed due to embargos (the Contractor of Long Phu I TPP is embargoed by the US Government).

- The electricity tariff lacks breakthroughs and is slow to change, and there is no two-part tariff, electricity purchase price by region to give signals for investment orientation and load development.

- The electricity price of power plants has yet to be attractive to investors because Vietnam is currently diversifying the power sources, accompanied by policies on electricity tariff and power purchase agreements for each type of power source. Especially in a changing market of RE development, it is necessary to adjust and supplement the selling prices of electricity to coal-fired and gas-fired power plants as they have to increase costs to integrate unstable RE sources.

- Localization of electrical equipment and materials has not met the requirements.

- The compensation work of site clearance for power projects still faces many difficulties. It tends to be complicated, affecting their construction progress, especially at present arising difficulties in forest land use conversion because of the complicated and time-consuming procedure. Some important power grid projects were unable to commence on construction or start operations in 2020 due to compensation and site

clearance, especially in big cities; Obstacles related to forest land use conversion; and the lengthy investment procedures. In which, some projects have problems with prolonged site clearance (such as 220 kV lines connecting 500 kV stations of Pho Noi, Viet Tri, Luu Xa), problems with converting forest land use purposes (such as projects Nghia Lo 220 kV substation and 220 kV Nghia Lo - 500 kV Viet Tri transmission line, 220 kV Huoi Quang - Nghia Lo transmission line, Nha Trang - Thap Cham, etc.). In particular, some key projects synchronised with the delayed BOT power sources (500 kV transmission line connecting Nghi Son 2, Van Phong 1, Hai Duong TTP).

- There are many gaps in land management in some localities, especially in remote areas, affecting the identification of land ownership and causing prolonged disputes and lawsuits. The compensation costs remain inadequate, especially for bordering areas between provinces. There are no regulations for land temporarily borrowed for construction purpose, resulting to local people making unreasonable compensation demands.

- Due to the nature of power projects, there is always a need for adjustments according to the load development situation. However, due to the enforcement of the revised Law on Planning, these adjustments cannot be made promptly when new factors that arise during the projects' implementation, thus leading to delays in many projects.

4.4 Lessons learnt

- The socio-economic development, technological development, and power development undergo numerous changes; hence, it is necessary to propose several scenarios to evaluate all impacts.

- It requires a thorough, long-term planning and implementation orientation. There is a detailed roadmap with clear and consistent signals for investors.

- It is necessary to resolutely implement the principle that electricity prices have to be accurately calculated to cover sufficient costs and ensure reasonable profits to encourage investors.

- The PDPs should be more "open", listing only important and accurate power projects, facilitating flexibility in implementation.

- There should be solutions to strictly handle the delay of power source projects (rewards and penalties, supporting policies, cancellation of investors' development rights of delayed power projects, alternative measures, etc.).

- The delay in power grid investment is quite significant, thus the investment policy of power grid projects should be considered 2-3 years in advance.

5. PROGRESS OF PDP8

The PDP8 was approved through the Prime Minister's Decision No. 500/QD-TTg dated 15 May 2024. The Prime Minister assigned the MOIT to prepare the PDP8 implementation plan with the progress as follows:

According to mandates in Decision No. 500/QD-TTg approving the PDP for the period 2021-2030, with a vision to 2050 (PDP8); Pursuant to Article 45 of the Law on Planning, MOIT has coordinated with relevant ministries/sectors to prepare the implementation plan for PDP8 and has submitted 06 requests to promulgate the PDP8 implementation plan (Report No. 4548/TTr-BCT dated 14 July 14 2023; Report No. 6046/TTr-BCT dated 31 August 2023; Report No. 7146/TTr-BCT dated 13 October 2020; Report No. 8356/TTr -BCT dated 24 November 2023 and Report No. 644/TTr-BCT dated 26 January 2024 and 1345/TTr-BCT dated 1 March 2024).

Based on the directions of the Standing Government in Notice No. 74/TB-VPCP dated 29 February 2024, and Notice No. 129/TB-VPCP dated 29 March 2024, MOIT submitted Report No. 2090/TTr-BCT dated 29 March 2024 to the Prime Minister to promulgate the implementation plan for PDP8. On 1 April 2024, the Prime Minister issued Decision No. 262/QD-TTg approving the PDP8's implementation plan. This includes a list of important power source/grid projects, investment priorities of the power sector and a list of RE power projects of 46 localities. MOIT is continuing to coordinate with other 17 provinces to update and complete the list of RE projects in these provinces and to complete the missing lists of other localities, then submit the next implementation plan for the PDP8 for the approval of the Prime Minister.