

PRELIMINARY INVESTMENT ROADMAP

Preliminary study on the development of Clean Energy Complex



Performed by:
Power Engineering Consulting JSC 1



DECEMBER 2025



MAIN CONTENTS

1. Introduction
 2. Regulation compliance
 3. Brief description on the Project and Cost
 4. Economic – Financial Analysis
 5. Risk Analysis
 6. Preliminary Project Schedule
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1. INTRODUCTION



INTRODUCTION – OBJECTIVES

- The Khanh Hoa Clean Energy Complex Project (formerly Ninh Thuan) is a strategic initiative aimed at advancing Vietnam's net-zero emissions target by 2050. It focuses on de-risking investments in renewable energy infrastructure.
- The project will support the development of **a clean energy complex** with an installed capacity comprising:
 - ◆ **3,500 MWp** of Solar PV,
 - ◆ **1,440 MW** of pumped storage hydropower and,
 - ◆ **350 MW** battery energy storage system - BESS.



INTRODUCTION OF UNOPS, OWNER & CONSULTANT



PROJECT OWNER
**PETRO VIETNAM POWER
CORPORATION (PV POWER)**



SPONSOR
**UNITED NATIONS OFFICE FOR
PROJECT SERVICES**



EVNPECC1

CONSULTANT
**POWER ENGINEERING CONSULTING JSC
1 (PECC1)**

2. REGULATION COMPLIANCE



REGULATION COMPLIANCE & SUITABILITY

1. LAW COMPLIANCE & INSTITUTIONAL FRAMEWORK

The Electricity Law and other laws related to project development have been studied and listed, introducing a legal framework that the Project must comply with for each stage:

- + Project development and investment process
- + Power tariff calculation and PPA contract
- + Land use
- + Taxes

The institutional frameworks that the project must comply with have been studied, including:

- + National Power Development Plan in the 2021-2030 period
- + Provincial development plan where the project is located
- + Decision No. 70-NQ/TW on ensuring energy security



REGULATION COMPLIANCE & SUITABILITY

2. THE SUITABILITY AND ROLE OF THE LAM SON PROJECT IN THE CONTEXT OF THE 2021-2030 NATIONAL POWER DEVELOPMENT PLAN (REVISED)

- The development target in the revised National Power Development Plan (Revised PDP VIII) is a challenge:
 - The capacity increase from 2025 to 2030 is 280%.
 - Challenges in developing LNG sources, offshore wind power, and pumped storage hydropower to meet the (revised) PDP are analyzed.
- The role of the Lam Son Energy Complex in the context of the revised PDP VIII:
 - The Lam Son project is not included in the revised PDP VIII.
 - The development of other power sources satisfying the plan faces many challenges.
 - The Lam Son Complex is designed as a stable power supply by combining three different sources, with reasonable costs and potentially a suitable alternative to the delayed sources in PDP VIII.



MASTER PLAN OF FORMERLY NINH THUAN (1319/QĐ-TTg)

No.	Work	Capacity scale (MW)		
		Status	Capacity scale which was additionally approved in the master plan in the 2021-2030 period	Potential capacity scale for development
I	Power source list under PDP VIII (Under Decision No.500QĐ-TTg, dated May 15, 2023)		4,270.0	224.0
1	Solar power			224.0
2	Ca Na LNG		1,500.0	
3	Pumped storage hydropower		2,400.0	
4	Self-consumption solar power		320.0	0.0
5	On-shore wind power		50.0	

MASTER PLAN OF FORMER NINH THUAN (1319/QĐ-TTg)

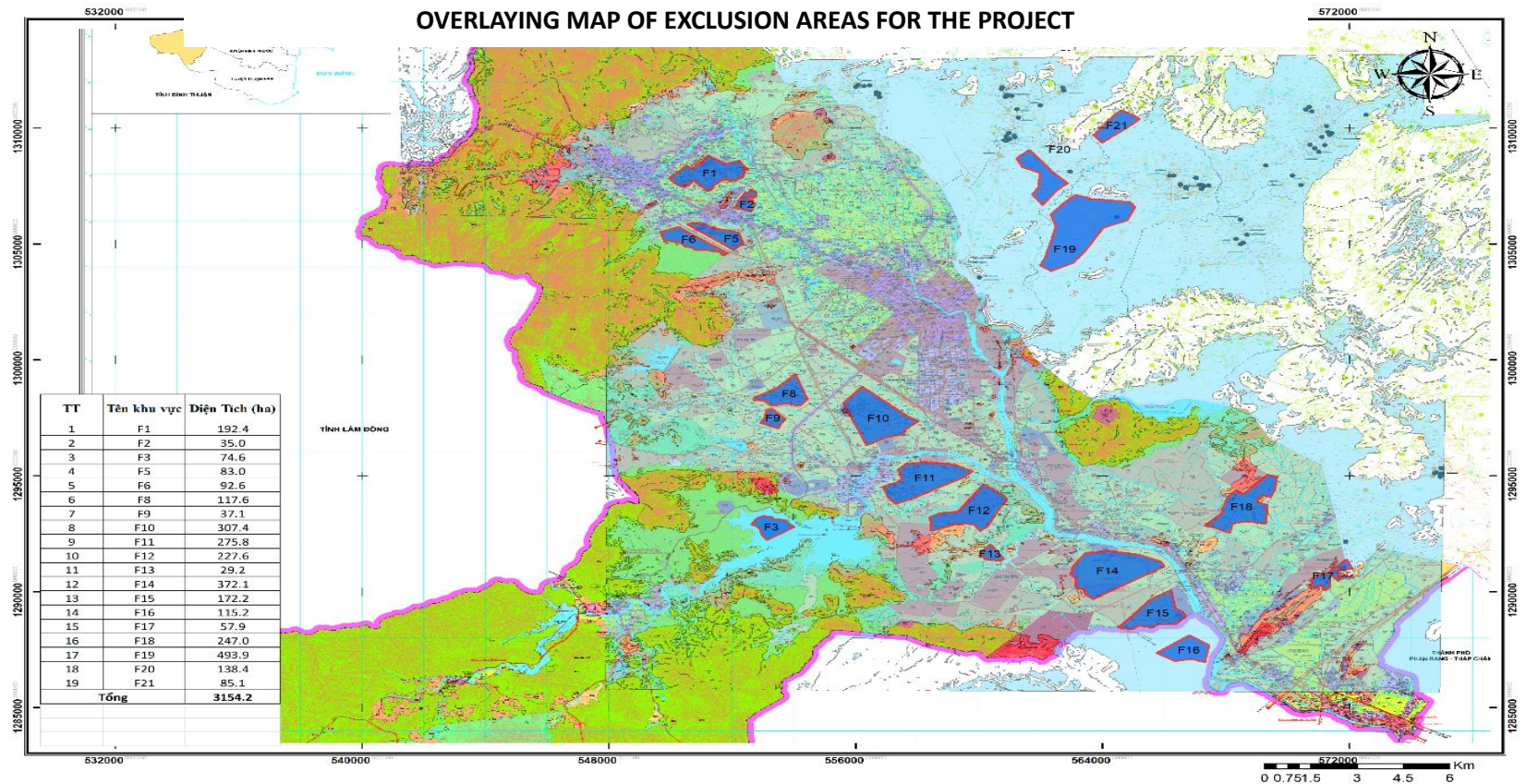
No.	Work	Capacity scale (MW)		
		Status	Capacity scale which was additionally approved in the master plan in the 2021-2030 period	Potential capacity scale for development
II	Power source list additionally approved to the master plan		19,010.7	50,370.2
1	Ca Na LNG (Capacity increase)			4,500.0
2	Hydropower	329.5	144.5	
3	Solar power	3,161.0	3,400.0	11,211.8
3.1	Grid solar power	3,161.0	120.0	5,487.8
3.2	Self-consumption solar power		3,280.0	5,724.0
4	Wind power		15,454.2	30,000.0
4.1	On-shore wind power	549.2	3,454.2	
4.2	Off-shore wind power		6,000.0	15,000.0
4.3	On-shore wind power beyond 6 nautical miles		6,000.0	15,000.0
5	Biomass, waste to energy, geothermal, biogas power		12.0	58.4

3. BRIEF DESCRIPTION ON THE PROJECT AND COST



SOLAR POWER LOCATION

LAM SON CLEAN ENERGY COMPLEX PROJECT
OVERLAYING MAP OF EXCLUSION AREAS FOR THE PROJECT



SOLAR POWER – OUTPUT OF FARMS

No.	Farm	Calculated capacity (MWp)	Calculated capacity (MW)	Quantity of PV panels (pcs)	Quantity of Inverter (pcs)	DC/AC ratio	P50 (GWh)	P75 (GWh)	P90 (GWh)
1	F1	234.27	196	327645	560	1.195	367.5	354.3	342.4
2	F2	79.92	66.5	111780	190	1.202	124.86	120.39	116.35
3	F3	141.51	117.25	197910	335	1.207	220.00	214.10	206.90
4	F4	265.10	225.25	370764	635	1.193	416	401.1	387.6
5	F5	368.15	308.7	514890	882	1.193	578.2	557.5	538.8
6	F6	450.00	378	629370	1080	1.19	709	683.60	660.7
7	F7	165.25	138.25	231120	395	1.195	262.4	253	244.5
8	F8	128.48	106.75	179685	305	1.204	200.6	193.4	186.9
9	F9	123.17	102.9	172260	294	1.197	195.3	188.31	181.99
10	F10	560.23	470.4	783540	1344	1.191	892.8	860.8	832
11	F11	220.27	185.85	308070	531	1.185	350.5	337.9	326.6
12	F12	38.61	31.5	54000	90	1.226	61.38	59.18	57.19
13	F13	125.10	105	174960	300	1.191	199.57	192.42	185.97
14	F14	38.61	31.5	54000	90	1.226	61.38	59.18	57.19
15	F15	350.00	294	489510	840	1.19	552.4	532.6	514.8
16	F16	213.80	172.2	299025	492	1.242	324.7	313	302.6
Total		3502.45	2927.05	4898529	8363		5516.59	5320.78	5142.49

SOLAR POWER – SUMMARY OF PLANT LOCATIONS

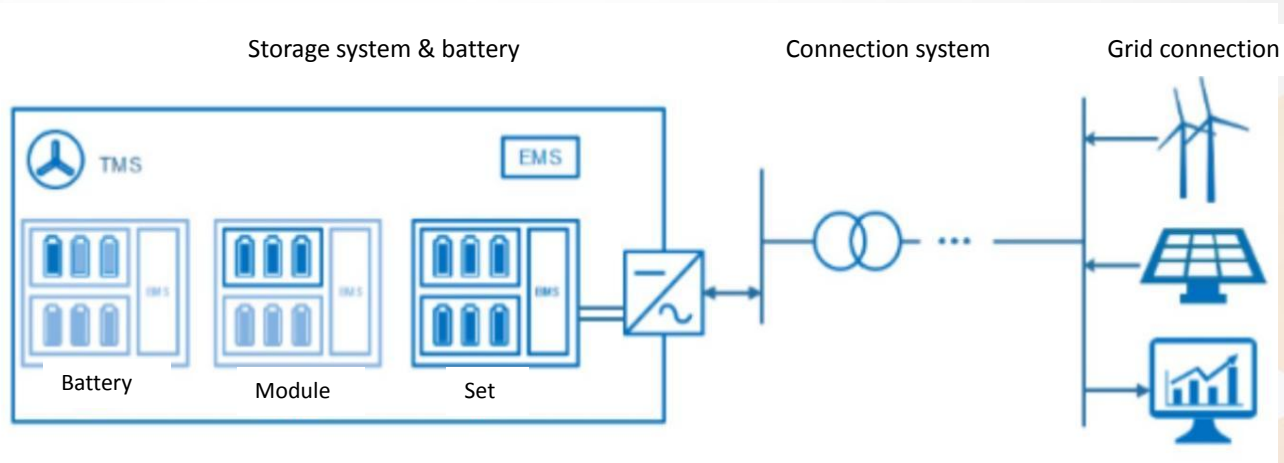
No.	Farm symbol	Specifications of locations		
		Geographical location	Installed capacity of panel (MWp)	Anticipated output (GWh)
1	F1	Lam Son commune	234.26	367.5
2	F2		79.92	124.86
3	F3		141.51	220.00
4	F4		265.10	416
5	F5	Ninh Son commune	368.15	578.2
6	F6		450.00	709
7	F7		165.25	262.4
8	F8	Anh Dung commune	128.48	200.6
9	F9	My Son commune & part of Anh Dung commune	123.17	195.3
10	F10	My Son commune	560.23	892.8
11	F11		220.27	350.5
12	F12	Phuoc Hau commune	38.61	61.38
13	F13	My Son commune	125.10	199.57
14	F14	Bac Ai commune	38.61	61.38
15	F15		350.00	552.4
16	F16		213.80	324.7
Total			3502.45	5516.59



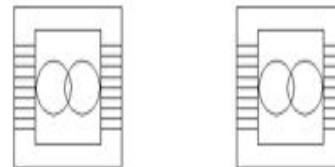
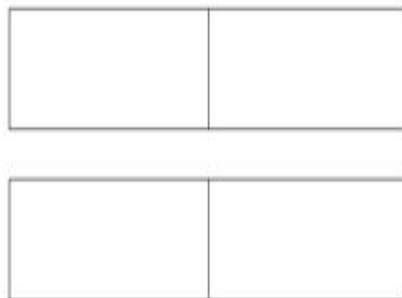
BATTERY ENERGY STORAGE SYSTEM

Illustration for BESS and connection

for grid



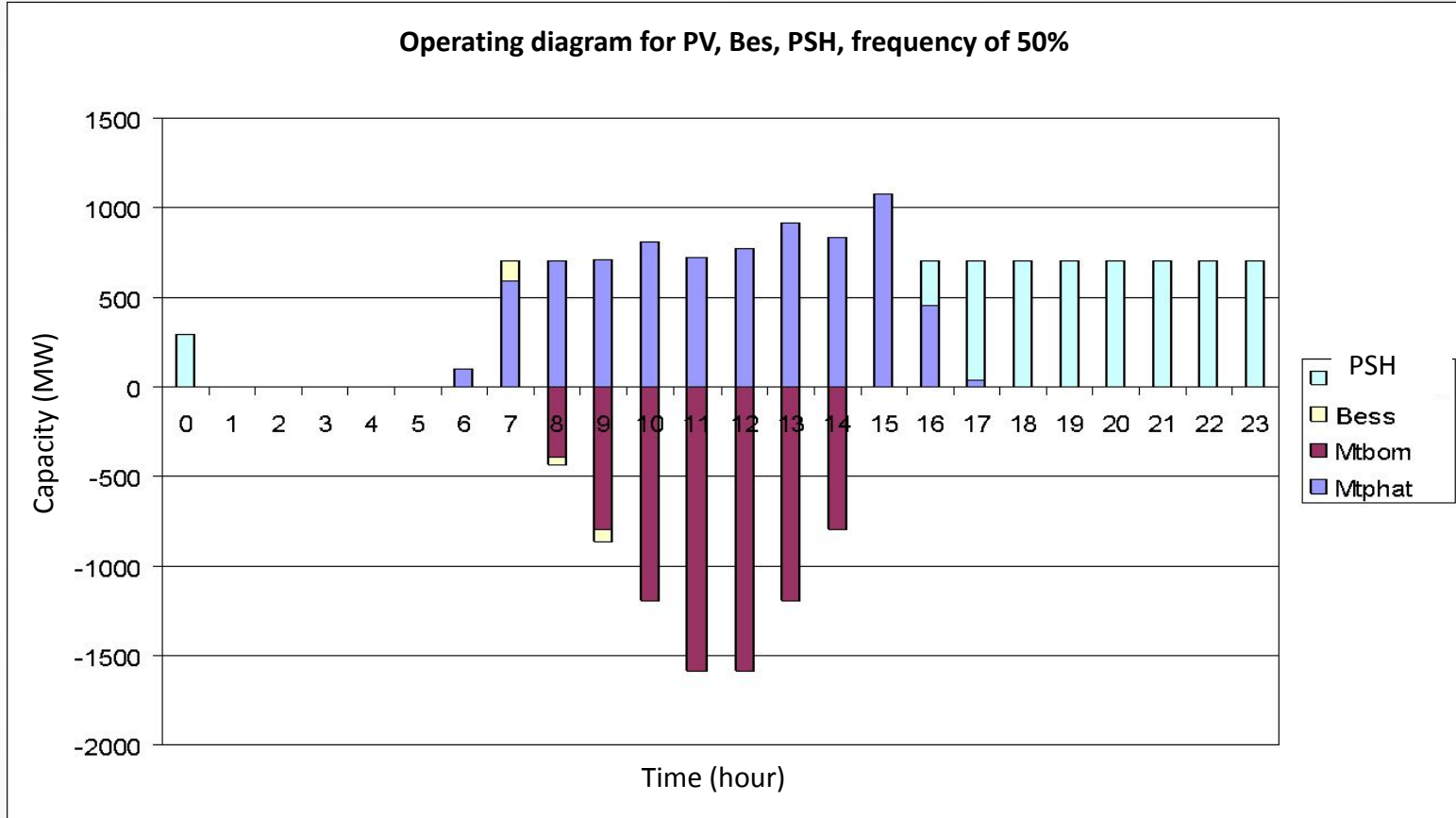
01 block for BESS



PUMPED STORAGE HYDROPOWER



Operating diagram for PV, BESS, PSH at frequency of 50%; 17h





PUMPED STORAGE HYDROPOWER PLANT

Calculation table for the operation of the complex in the first year

No.	Frequency	Daily Etb PV		Daily Etb PV to PSH	PVphat	PVbom	Bess	PSH	E combination		Energy conversion factor
1	0.10%	877.37		856.31	442.77	-413.54	0.00	294.31	737.08		0.71
2	5%	785.22	40.73	766.38	385.92	-380.46	0.00	271.96	657.88	34.18	0.71
3	10.0%	755.79	38.53	737.65	357.19	-380.46	0.00	271.70	628.89	32.17	0.71
4	15.0%	733.01	37.22	715.42	417.67	-297.75	0.00	208.97	626.63	31.39	0.70
5	20.0%	712.89	36.15	695.78	364.95	-330.83	0.00	233.35	598.30	30.62	0.71
6	25.0%	850.97	39.10	830.55	433.55	-397.00	0.00	281.07	714.62	32.82	0.71
7	30.0%	680.07	38.28	663.75	366.00	-297.75	0.00	207.57	573.57	32.20	0.70
8	35.0%	666.08	33.65	650.09	368.88	-281.21	0.00	196.38	565.26	28.47	0.70
9	40.0%	651.75	32.95	636.11	354.90	-281.21	0.00	198.00	552.90	27.95	0.70
10	45.0%	634.88	32.17	619.64	338.43	-281.21	0.00	198.38	536.82	27.24	0.71
11	50.0%	619.63	31.36	604.76	356.63	-248.13	0.00	176.09	532.72	26.74	0.71
12	55.0%	603.64	30.58	589.15	357.56	-231.58	0.00	164.90	522.47	26.38	0.71
13	60.0%	583.20	29.67	569.20	337.62	-231.58	0.00	162.11	499.73	25.55	0.70
14	65.0%	562.87	28.65	549.36	284.69	-264.67	0.00	184.00	468.69	24.21	0.70
15	70.0%	541.00	27.60	528.02	329.52	-198.50	0.00	140.64	470.16	23.47	0.71
16	75.0%	516.42	26.44	504.03	338.61	-165.42	0.00	115.20	453.81	23.10	0.70
17	80.0%	487.44	25.10	475.75	310.33	-165.42	0.00	118.17	428.50	22.06	0.71
18	85.0%	453.39	23.52	442.51	293.64	-148.88	0.00	105.77	399.41	20.70	0.71
19	90.0%	409.28	21.57	399.45	283.66	-115.79	0.00	79.62	363.28	19.07	0.69
20	95.0%	340.68	18.75	332.51	233.26	-99.25	0.00	69.16	302.42	16.64	0.70
21	100.0%	70.61	10.26	68.92	68.92	0.00	0.00	0.00	68.92	9.26	
22	Total		602.26						Total	514.24	
23	Eo PV		5275.78						Eo of the energy	4504.71	

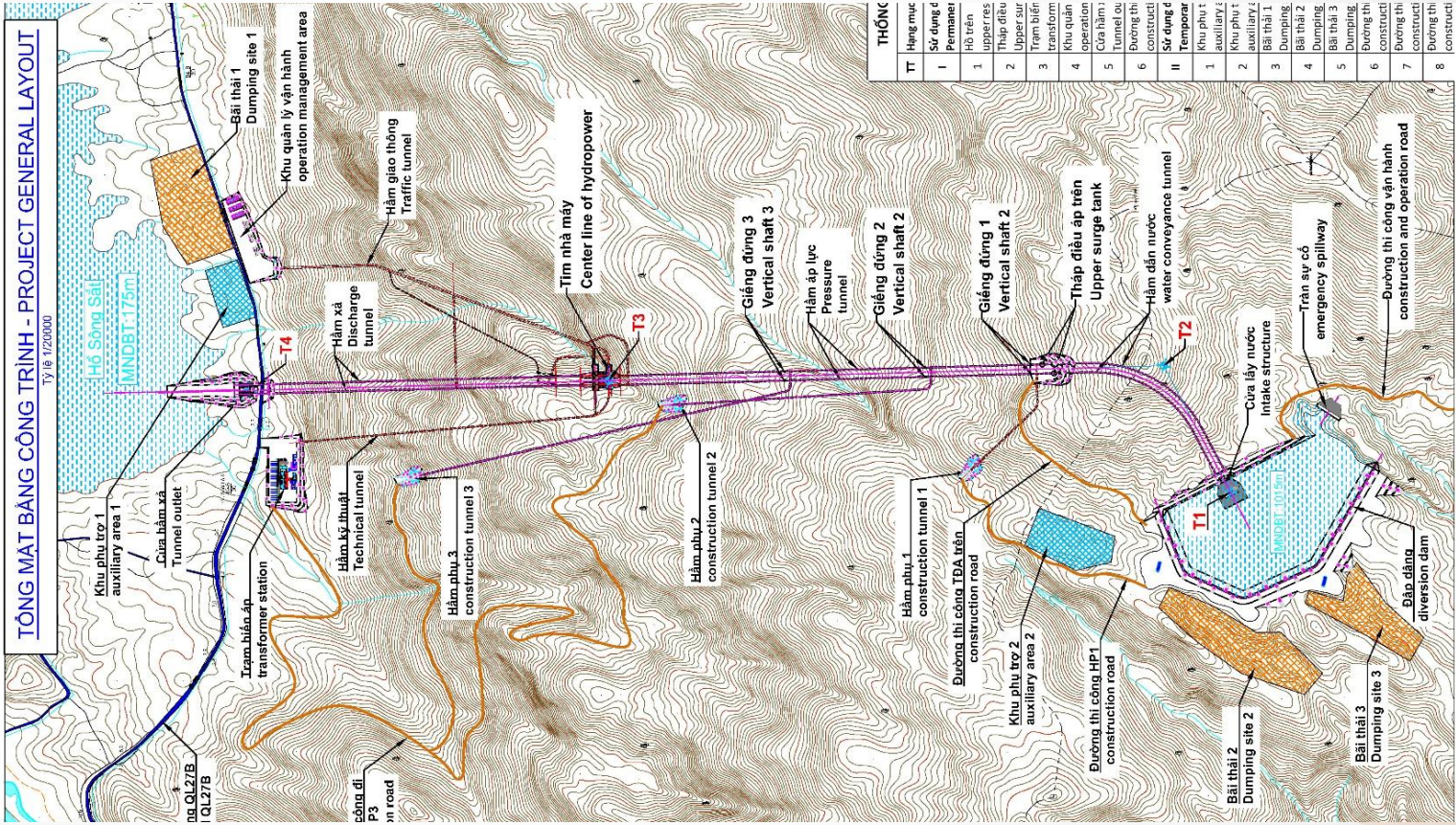


PUMPED STORAGE HYDROPOWER PLANT

Calculation table for the operation of the complex in the 20th year

No.	Frequency	Daily Etb PV		Daily E tb PV to PSH	PVphat	PVbom	Bess	PSH	E combination		Energy conversion factor
1	0.10%	845.1		824.8	407.6	-413.5	3.2	289.7	700.6		0.70
2	5%	756.3	39.2	738.2	360.6	-363.9	13.7	255.4	629.7	32.6	0.70
3	10.00%	728.0	37.1	710.5	356.1	-347.4	6.6	242.4	605.1	30.9	0.70
4	15.00%	706.0	35.9	689.1	377.0	-297.8	13.0	206.2	596.2	30.0	0.69
5	20.00%	686.6	34.8	670.2	364.1	-297.8	7.3	206.3	577.6	29.3	0.69
6	25.00%	670.8	33.9	654.7	363.9	-281.2	9.1	193.3	566.3	28.6	0.69
7	30.00%	655.0	33.1	639.3	335.9	-297.8	5.1	205.0	546.0	27.8	0.69
8	35.00%	641.6	32.4	626.2	336.3	-281.2	8.7	196.2	541.2	27.2	0.70
9	40.00%	627.8	31.7	612.7	333.1	-264.7	14.4	183.1	530.7	26.8	0.69
10	45.00%	611.5	31.0	596.8	381.7	-215.0	0.1	150.8	532.6	26.6	0.70
11	50.00%	596.8	30.2	582.5	341.4	-231.6	9.6	161.7	512.6	26.1	0.70
12	55.00%	581.4	29.5	567.5	330.4	-231.6	5.5	162.6	498.5	25.3	0.70
13	60.00%	561.7	28.6	548.2	306.6	-231.6	9.6	160.1	476.2	24.4	0.69
14	65.00%	542.2	27.6	529.1	320.9	-198.5	8.8	137.4	467.1	23.6	0.69
15	70.00%	520.8	26.6	508.3	325.0	-182.0	1.3	127.5	453.8	23.0	0.70
16	75.00%	497.6	25.5	485.6	287.9	-182.0	15.2	125.7	428.9	22.1	0.69
17	80.00%	470.0	24.2	458.7	282.7	-165.4	10.6	116.4	409.7	21.0	0.70
18	85.00%	437.1	22.7	426.6	284.5	-115.8	25.9	78.7	389.0	20.0	0.68
19	90.00%	394.2	20.8	384.8	268.6	-99.3	16.6	67.6	352.8	18.5	0.68
20	95.00%	327.7	18.0	319.9	199.2	-99.3	21.3	67.1	300.7	16.3	0.68
21	100.00%	68.0	9.9	66.4	66.4	0.0	0.0	0.0	66.4	9.2	
22	Total		572.67						Total	489.21	
23	Eo PV		5016.57						Eo of the energy cluster	4285.51	

HO SONG SAT PSH – GENERAL LAYOUT





POWER TRANSMISSION SYSTEM

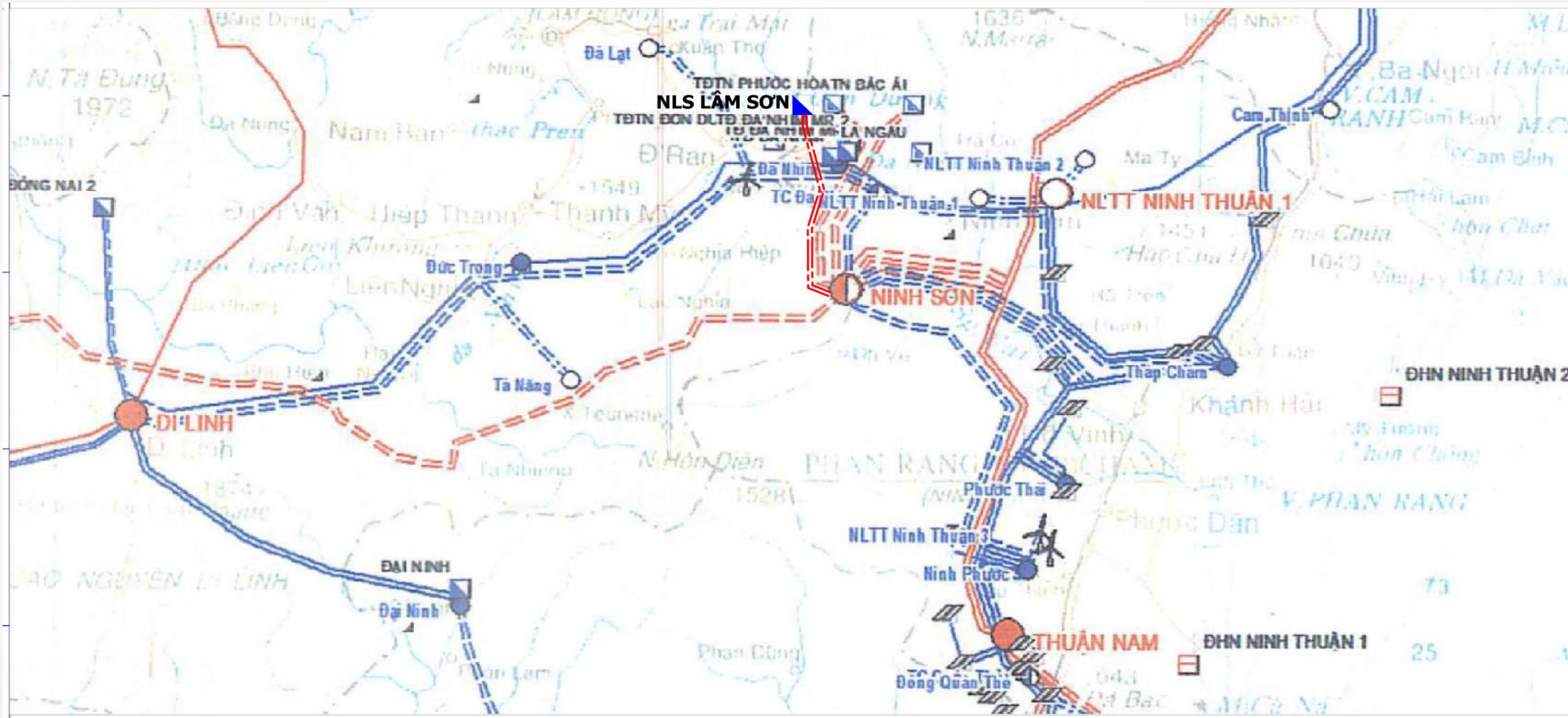
Current status of the regional power system

List of substations and 500kV transmission lines of the regional power system:

No.	Project	Capacity (MVA)	Note
1	Thuan Nam	2x900	Grid connection of the Thuan Nam Solar Power Plant

No.	Name of transmission line	No. of circuit	x	km	Ghi chú
1	Thuan Nam – Vinh Tan	2	x	15.7	Phased conductor 4xACSR400
2	Thuan Nam – Van Phong	2	x	149.3	Phased conductor 4xACSR400

INTEGRATED CONNECTION DIAGRAM TO THE POWER SYSTEM



PRELIMINARY ASSESSMENT OF ENVIRONMENTAL & SOCIAL IMPACTS

No.	Land category	Unit	Area
1	Annual cropland	m ²	
a	Paddy land	m ²	674.532
b	Other annual cropland	m ²	20.435.466
2	Perennial cropland	m ²	4.966.622
3	Production forest land	m ²	2.394.646
4	Protection forest land (for pumped-storage hydropower)	m ²	476.624
5	Unused land	m ²	4.749.137
6	Religious land	m ²	69.398
7	Mineral land	m ²	86.919
8	Total area	m ²	33.853.344



PRELIMINARY COST ESTIMATES

No.	Cost items	Value before tax, USD				VAT, USD	Value after tax, USD
		PSH (1440 MW)	SPP(3500 MWp)	BESS (350 MW)	Total		
(1)	(2)	(3)	(4)	(5)	(6) = (3)+(4)+(5)	(7) = (6)*10%	(8) = (6)+(7)
1	Compensation, Support and Resettlement costs	822,307	322,408,781	113,170	323,344,259		323,344,259
2	Construction costs	259,664,319	531,676,403	14,667,640	806,008,362	80,600,836	886,609,198
2.1	Civil works	228,117,455	455,000,000	7,000,000	690,117,455	69,011,746	759,129,201
2.2	500KV connection transmission line	31,546,863	76,676,403	7,667,640	115,890,907	11,589,091	127,479,997
3	Equipment costs	311,318,028	1,295,000,000	140,000,000	1,746,318,028	174,631,803	1,920,949,831
4	General Costs: investment consultancy costs and other costs	193,659,082	554,606,999	43,202,463	791,468,543	79,146,854	870,615,398
4.1	General Costs: investment consultancy costs and other costs (excluding loan interest)	57,098,235	182,667,640	15,466,764	255,232,639	25,523,264	280,755,903
4.2	Interest during construction	136,560,847	371,939,359	27,735,699	536,235,904		536,235,904
5	Contingency Costs	125,780,578	466,350,565	34,049,515	626,180,658	62,618,066	688,798,723
5.1	Contingency for additional quantities: 10% of Item (1-4.1)	62,890,289	233,175,282	17,024,757	313,090,329	31,309,033	344,399,362
5.2	Price escalation contingency: 10% of Item (1-4.1)	62,890,289	233,175,282	17,024,757	313,090,329	31,309,033	344,399,362
	TOTAL	891,244,314	3,170,042,748	232,032,788	4,293,319,850	396,997,559	4,690,317,409

4. ECONOMIC AND FINANCIAL ANALYSIS

ECONOMIC – FINANCIAL ANALYSIS

- **Operation and Maintenance (O&M) Costs:**
 - The O&M cost applicable to solar power, i.e. photovoltaic (PV) systems, is 1.8%, in accordance with Circular No. 12/2025/TT-BCT.
 - The O&M cost applicable to pumped-storage hydropower (PSH) is 0.9%, as stipulated in the draft regulation on electricity selling price determination for PSH (i.e. energy storage systems) issued by the Ministry of Industry and Trade (MOIT) in July 2025.
- Interest costs are applied to foreign loans for equipment procurement, with an interest rate of 7% per annum, a loan term of 20 years, and a grace period for principal repayment during the construction phase.



ECONOMIC – FINANCIAL ANALYSIS

- **Equipment replacement costs:** The project is designed with an operation lifetime of 40 years, during which the replacement of major equipment (PV modules, Battery Energy Storage System (BESS) and inverters, hydraulic equipment, etc.) is required in order to maintain performance and extend the operation lifespan. Specifically:
 - The BESS and inverters of the PV system are replaced every 10 years.
 - Other components of the PV system are replaced in the 20th operation year
 - Equipment of the PSH system is replaced in the 21st operation year
 - PV Module Decommissioning cost: For a 3.5 GW solar power system, this cost is estimated at 5% of the initial PV CAPEX, equivalent to approximately USD145 million, after deducting the recoverable value from recycling and resale of components.
- **The discount rate** applied for the economic analysis is **10%**.

ECONOMIC – FINANCIAL ANALYSIS

Power generation of the complex over the technical lifetime of the solar power component

Year	Total solar power generation (GWh)	Solar power generation directly fed into the grid (GWh)	Output from BESS fed into the grid (GWh)	Output from PSH fed into the grid (GWh)	The project's total net power output delivered to the grid (GWh)
1	5512.94	2919.31	70.58	1687.24	4677.14
2	5495.74	2915.20	71.23	1677.15	4663.57
3	5475.78	2910.41	71.98	1665.43	4647.82
4	5453.59	2905.10	72.82	1652.40	4630.32
5	5427.53	2898.85	73.80	1637.10	4609.75
6	5397.58	2891.67	74.93	1619.52	4586.12
7	5362.08	2883.17	76.27	1598.68	4558.12
8	5325.48	2874.40	77.66	1577.19	4529.24
9	5289.43	2865.76	79.02	1556.02	4500.79
10	5252.27	2856.85	80.42	1534.20	4471.48
11	5219.55	2849.01	81.65	1514.99	4445.66
12	5191.27	2842.24	82.72	1498.39	4423.34
13	5165.20	2835.99	83.70	1483.08	4402.78
14	5140.80	2830.14	84.63	1468.76	4383.52
15	5116.95	2824.43	85.53	1454.75	4364.71
16	5096.98	2819.64	86.28	1443.03	4348.95
17	5079.79	2815.52	86.93	1432.94	4335.39
18	5060.94	2811.00	87.64	1421.87	4320.51
19	5039.86	2805.95	88.44	1409.49	4303.88
20	5018.57	2800.27	89.24	1395.88	4285.54

ECONOMIC – FINANCIAL ANALYSIS

- **Benefits of Carbon Credits**
 - Vietnam's grid carbon emission factor is 0.6592 tCO₂/MWh (according to Circular No.1762/BĐKH-PTCB)
 - The project can be considered to be carbon-zero. Therefore, the reduction in CO₂ emissions during the project operation can be considered equivalent to the grid emission factor multiplied by the project's power output.
 - The carbon credit term is 20 years..



ECONOMIC – FINANCIAL ANALYSIS

- **Self-Consumption Service Transactions**
 - Generally, power prices for self-consumption services are about 10% or more higher than those for conventional power generation, due to higher opportunity costs, more stringent technical requirements, and the limited number of power plants capable of providing such service.
 - Circular No. 11/2025/TT-BCT (issued on February 1, 2025, by the Ministry of Industry and Trade) stipulates the method for determining and the procedures for approving self-consumption service prices in the power system, as well as the main contents of self-consumption service contracts.
 - However, to date, no specific figures or regulations have been officially issued regarding power prices for self-consumption services. Therefore, in this report, we only present the potential benefits of the project without quantifying them.

ECONOMIC – FINANCIAL ANALYSIS

LCOE of the project

	Basic scenario	Capital increases by 10%	Power output decreases by 10%
LCOE (cent/KWh)	11.07	12.12	12.29



ECONOMIC – FINANCIAL ANALYSIS

Economic indicators

Scenario	Power price	Eo	Investment cost	NPV	EIRR	B/C
	USc/kWh	million, kWh	million, USD	million, USD	%	-
Excluding CDM						
Basic scenario	12.57	4474.43	3757.1	468.9	11.98	1.14
Capital increases by 10% (K+10%)	12.57	4474.43	4132.8	141.4	10.55	1.04
Power output decreases by 10% (E -10%)	12.57	4026.99	3757.1	76.7	10.33	1.02
K+10% and E-10%	12.57	4026.99	4132.8	-250.9	9.02	0.93



ECONOMIC – FINANCIAL ANALYSIS

Economic indicators

Scenario	Power price	Eo	Investment cost	NPV	EIRR	B/C
	USc/kWh	million, kWh	million, USD	million, USD	%	-
Basic scenario	12.57	4474.43	3757.1	623.2	12.63	1.18
Capital increases by 10% (K+10%)	12.57	4474.43	4132.8	295.7	11.14	1.08
Power output decreases by 10% (E-10%)	12.57	4026.99	3757.1	215.5	10.92	1.06
K+10% and E-10%	12.57	4026.99	4132.8	-112.0	9.57	0.97



ECONOMIC – FINANCIAL ANALYSIS

The project's LCOE in the basic scenario is **11.07 USc/kWh**. The basic scenario, with or without revenues from carbon credit shows acceptable economic indicators.

The project remains economically feasible in the event of a 10% increase in capital or a 10% reduction in power generation (or a 10% reduction in the power selling price), provided that carbon credit benefits are included.

The project is not economically feasible if both adverse impacts occur simultaneously.



ECONOMIC – FINANCIAL ANALYSIS

Costs for Financial Analysis

The costs applied in the financial analysis are similar to those used in the economic analysis.

Capital Mobilization Models

The estimated capital structure is assumed to :

- Reduce investor risk by limiting the proportion of equity capital.
- Optimize the cost of capital, as debt capital is cheaper than equity capital.
- Achieve a reasonable rate of return (**IRR 12–15%**)

With this objective, a typical capital structure is as follows:

- **Equity capital (not less than 20%)**
 - According to regulation, equity capital must account for at least 20% of the total investment capital.
 - Due to the characteristics of capital sources requiring high expected returns and high risk, equity capital usually accounts about 20%-25% (sharing risk with other sources). For Lam Son, in this study, equity capital is assumed to account for 20% 25% of the initial capital during the project development and debt repayment process. The 25% value will be used if the loan amount is insufficient to ensure debt repayment ability.
 - **The expected return is 12%**



ECONOMIC – FINANCIAL ANALYSIS

- **Commercial loans from domestic banks (estimated at approximately 20%-30%)**
 - Domestic banks currently apply credit limits to renewable energy projects due to risks associated with Power Purchase Agreements (PPAs) and long payback periods. However, domestic banks can still participate in co-financing with international banks, especially during the construction phase.
 - According to actual project data (Source: EVN RE 2023; IFC Vietnam RE Portfolio), BIDV, Vietcombank, Techcombank, and several other banks typically provide approximately **20%–30%** of the total loan capital for renewable energy projects.
 - The domestic loan component helps ensure the availability of domestic cash flow, supports disbursement, and leverages domestically secured collateral.
 - Commercial loans are assumed to be 32% (equivalent to the construction cost portion of the total investment); interest rate (VND) is approximately 10%



ECONOMIC – FINANCIAL ANALYSIS

- **Preferential Loans from DFIs (Development Finance Institutions)**
 - Institutions such as IFC, ADB, KfW, AFD, and JICA typically provide direct financing for **10%–40%** of the total project investment, depending on the project size and environmental sustainability (“green”).
 - They may provide direct loans, or participate through credit guarantees and hybrid financing structures combining preferential and commercial capital.
 - In Vietnam, some typical examples include :
 - Bac Lieu Wind Power Plant – ADB financing 35%
 - Trung Nam Wind Power Project – IFC and AFD financing 30%
 - Phu Lac Wind Power Plant – KfW financing 40%
 - In this report, the capital source is assumed to be approximately **48%**, with an interest rate of around **7%/annum**.



ECONOMIC – FINANCIAL ANALYSIS

- **Green Credit (Green Bond)**

- Vietnam currently has policies to encourage the issuance of green bonds (Decree No. 06/2022/ND-CP and Circular No. 17/2022/TT-NHNN).
- A number of pioneering projects in the renewable energy sector (such as projects developed by BCG Energy, Trung Nam, and Bamboo Capital) have issued green bonds equivalent to approximately **5%–15% of total investment capital**.
- Interest rates applied to green credit (**1%–3%**) are usually lower than the market average; however, this form of financing often requires a credit guarantee. This is a very effective source of capital for renewable energy projects. Typically, this source can account for about 5%–10% of CAPEX.

However, in Vietnam, only a few projects have successfully accessed this source of capital, and investors' experience in using it is still limited. Therefore, in this study, this form of financing is presented **for reference purposes only** and is not included in the financial calculations to ensure the reliability and feasibility of the results.



ECONOMIC – FINANCIAL ANALYSIS

The Consultant assumes three capital mobilization models as follows:

- Scenario 1: Domestic loan with a **10%** interest rate – this is the most expensive investment method,
- Scenario 2: Borrowing USD at a **7%** interest rate to purchase equipment. This model is based on the guidance of Circular No. 12/2025/TT-BCT.
- Scenario 3: Borrowing EUR at a **4.46%** interest rate to purchase equipment. This model represents potential development credits available from the European Union.



ECONOMIC – FINANCIAL ANALYSIS

Content	Sources of Capital				
	Owner's Equity	Domestic commercial loan (VND)	Foreign loan (USD)	Foreign loan (EUR)	Total
Capital structure					
Scenario 1	25%	75%			100%
Scenario 2	20%	34%	46%		100%
Scenario 3	20%	34%		46%	100%
Loan terms					
Grace period (year)	During Construction Period				
Repayment period (year)	10	10	10	10	
Interest rate (%/year)		10%	7%	4.46%	
Commitment fee (% of undisbursed amount)			0.30%	0.20%	
Appraisal fee (% of loan amount)			0.50%	0.40%	
Management fee (% p.a.)			0.10%	0.10%	
Expected Internal Rate of Return (IRR) (Investor expectations)	≥ 12%				



ECONOMIC – FINANCIAL ANALYSIS

Other related costs

- Depreciation: (Straight-line method)
 - Hydropower equipment depreciation: 15 years,
 - Solar power equipment depreciation: 15 years,
 - Other costs depreciation: 20 years,
- Corporate Income Tax (CIT)
 - The CIT rate applied to the power complex is 10% for the first 15 years from the start of plant operations, and 20% thereafter. Additionally, the project enjoys a tax holiday (CIT exemption) for the first 4 years and a 50% reduction in tax payable for the following 9 years.
- Project Discount Rate (I_{ck}): Equal to the Weighted Average Cost of Capital (WACC) of the capital sources mobilized for the project.

Financial benefits

- Energy benefit is defined as the electricity selling price that ensures the project's FIRR reaches 12% (which is the maximum value allowed by the Ministry of Industry and Trade), multiplied by the project's annual electricity output.
- Benefits from carbon emission reduction credits are similar to those calculated in the economic analysis.

ECONOMIC – FINANCIAL ANALYSIS

Kịch bản	I _{ck}	Tarrif	E ₀	Investment cost	Interest rate during construction time	NPV	FIRR	B/C	Pay-back Period	Break-even point
	%	USc/kWh	million kWh	million USD	million USD	million USD	%	-	year	USc/kWh
Scenario 1										
Base case scenario	8,26	10.61	4474.43	3757.1	865.3	419.68	12.00	1.12	15	9.44
E ₀ decreased by 10%			4026.99	3757.1	865.3	24.48	8.43	1.01	37	10.53
Investment capital increased by 10%			4474.43	4132.8	951.9	85.65	8.85	1.03	32	10.37
E ₀ decreased by 10% and Investment capital increased by 10%			4026.99	4132.8	951.9	-314.01	6.25	0.93	40	11.57
Scenario 2										
Base case scenario	7,18	10.06	4474.43	3757.1	536.2	662.65	12.00	1.17	14	8.47
E ₀ decreased by 10%			4026.99	3757.1	536.2	230.14	8.63	1.06	27	9.45
Investment capital increased by 10%			4474.43	4132.8	589.9	318.98	9.05	1.08	25	9.30
E ₀ decreased by 10% and Investment capital increased by 10%			4026.99	4132.8	589.9	-118.56	6.48	0.98	40	10.38
Scenario 3										
Base case scenario	6,25	9.54	4474.43	3757.1	465.2	877.21	12.00	1.21	13	7.70
E ₀ decreased by 10%			4026.99	3757.1	465.2	407.02	8.55	1.10	25	8.60
Investment capital increased by 10%			4474.43	4132.8	511.7	520.91	8.98	1.12	16	8.46
E ₀ decreased by 10% and Investment capital increased by 10%			4026.99	4132.8	511.7	45.65	6.41	1.01	37	9.44

5. RISK ANALYSIS



RISK ANALYSIS

No.	Risk Description	Risk Clarification
1	Engineering geological conditions	Medium/Low
2	Meteo-hydrometeorology	Low
3	Solar power risk	Medium/Low
4	Energy storage battery system risks (BESS risks)	Medium/Low
5	Pumped storage hydropower risks	Medium/Low
6	Grid connection risks	Medium/Low
7	Construction time schedule risks	Low
8	Investment cost and economic-financial risks	Medium/Low
9	Environmental and social risks	High /Medium/Low



6. PRELIMINARY PROJECT SCHEDULE

Thank you!





PARTICIPATING PERSONNEL: UNOPS, OWNER & CONSULTANT

UNOPS

Representative in Vietnam :

Mr. Do Manh Toan

PROJECT OWNER

Petro Vietnam Power Corporation (PV Power)

CONSULTANT

Power Engineering Consulting JSC 1 (PECC1)

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- ○ **Tran Thai Hai** **Project Director**
- ○ Dang Huu Minh Tuan **Project Planner**
-
- ○ **Le Quang Huy** **Project Manager**
- ○ Vu Van Dien **Dam Expert**
- ○ Hoang Tho Duong **Hydropower Expert**
- ○ Nguyen Hoang Hai **Solar Power Expert**
- ○ Ho Minh Long **Geological Expert**
- ○ Trinh Quang Tien **Hydrometeorological expert**
- ○ Tran Thai Hai **Electrical System Expert**
- ○ Le Xuan Dung **Battery Technology Expert**
- ○ Nguyen Thi Thuong Huyen **Cost Estimates Expert**
- ○ Nguyen Thuy Hien **Financial Analysis and Energy Expert**
- ○ Cao Thi Thu Yen **EIA Expert**
- ○ Vu Thi Doan Trang **SIA Expert**



TASKS AND COMPLETION TIMELINES

No.	Work Items	Completion Time
1	Inception Report and Document Collection	30/7/2025
2	Preliminary investment roadmap: Regulatory and financial review	30/11/2025
3	Preliminary technical design and risk analysis	31/12/2025
4	Stakeholder consultation and preliminary design assessment	31/01/2026
5	Finalize study and report	28/02/2026
6	Approval from relevant Authorities/Departments	31/03/2026

IMPLEMENTATION PLAN – Teams of Experts (PECC1)

