

INDEPENDENT STUDY

Subject

Feasibility Study of Investment in Solar Power Plant for  
Industrial Estate as Alternative Power Supply

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An Independent Study in Partial Fulfilment of the Requirement of the Degree of  
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## **ABSTRACT**

This research has feasibility study of investment in solar power plant for industrial estate as alternative power supply. The aim of this research was to study the feasibility of investment in solar power plant project on industrial estate area of Thailand, analyse an estimated cost of project for different locations of Thailand and optimize the project investment in order to generating incomes and creating value added to EGAT. Estimate cost of project and analyse the feasibility of project using financial model such as cash flow report, income statement, debt profile, project financing and etc. Benefits were expected for further research which found the best solution of investment in solar power plant project based on different assumptions for industrial estate area of Thailand.

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## CHAPTER 1

### INTRODUCTION

#### BACKGROUND

Since Thailand has great solar potential, especially in the middle and north-eastern part of the country, which benefit from strong year round solar radiation levels. Compared to radiation levels in other countries, Thailand has more potential than other countries in the region and only closely lags behind the United States and Australia. Solar capacity has grown from 2 MW in 2010 to 2,768 MW in January 2016, which is higher than all other ASEAN countries combined. The target of the Alternative Energy Development Plan 2015-2036 (AEDP) is to increase the producing capacity from 1,570 MW in 2014 to 6,000 MW in 2036. Business Monitor International (BMI) expects solar power to contribute over 51% to the total renewable power mix in 2025.

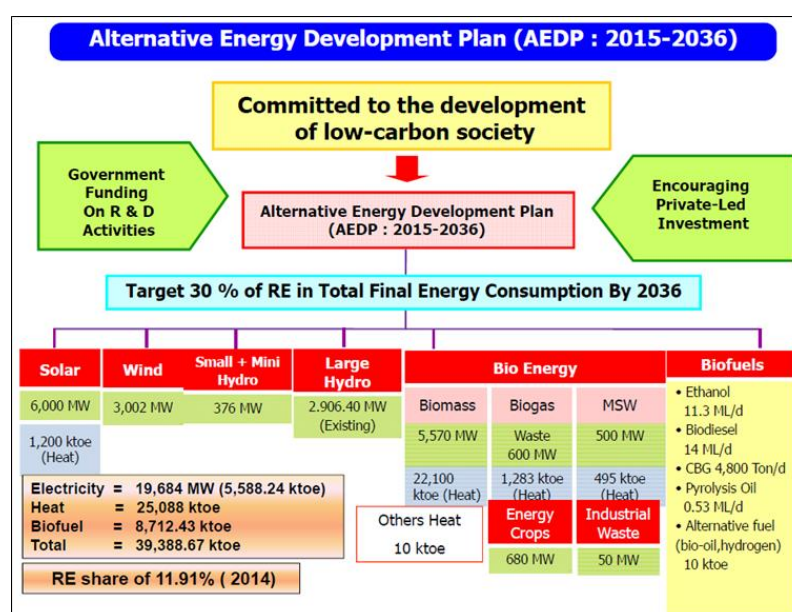




Figure 1-1 Alternative energy development plan 2015 (AEDP2015).

The Electricity Generation Authority of Thailand (EGAT) as Thailand's leading state-owned power utility under the Ministry of Energy, also actively pursue the above regional policy to build up the sustainable development and stability of an energy system, Solar Power Plant is one of their renewable energy development plan. This study provides the analysis and comparison on the investment in Solar Power Plant between EGAT's conventional Solar Power Plant and off-grid Solar Power Plant for the selected Industrial Estate.



Figure 1-2 EGAT Thap Sakae Solar Power Plant, Prachaup Khiri Khan Provincial Thailand.

### **OBJECTIVE**

1. Study the feasibility of investment in Solar Power Plant project.
2. Analyse an estimated cost of project for different locations.
3. Optimize the project investment, in order to generating incomes and creating value added to EGAT.

### **SCOPE**

1. Location and area of project.
2. Solar energy potential
3. Estimated cost of project
4. Economic and financial analysis

### **EXPECTED BENEFITS**

1. Possibility of investment in Solar Power Plant project.
2. Possibility of setting up the project in each area.
3. Found the best solution of investment in Solar Power Plant project based on different assumptions.
4. Generating more incomes for EGAT.

## **CHAPTER 2**

### **CONCEPTS AND THEORIES**

In this study, the researcher studied the concepts, documents and related research to be used for determining guidelines for conducting research. Especially the financial analysis theory. The content according to the order as follows.

#### **CASH FLOW**

The positive (inflow) or negative (outflow) movements of cash caused by an activity over a specific period of time.

#### **RETURN ON EQUITY**

Return On Equity (ROE). The relationship of annual aftertax earnings to the recorded shareholders' equity. Used as a measure of the effectiveness with which shareholder funds have been invested. A similar approach can be taken with the basic formula for return on owners' equity (ROE), which relates profit and the amounts of recorded equity.

$$ROE = \frac{\text{Net profit}}{\text{Equity}}$$

#### **PAYBACK PERIOD**

The period of time over which the cash flows from an investment are expected to recover the initial outlay.

#### **COST OF DEBT**

The cost to a company of employing debt, developed from the after-tax interest charges of various forms of debt.

### **COST OF EQUITY**

The cost to a company of employing common shareholders' funds, developed from the investors' expectations about the return from holding such shares, usually in the form of the combination of dividends and capital gains.

### **SENSITIVITY ANALYSIS**

The process of testing the impact on the results of an analysis from changes in one or more of the input variables.

### **RETURN ON INVESTED CAPITAL**

Company's profit for a particular period compared with the capital invested in the company. This shows how effectively the company is using the amount of capital invested in it to make a profit.

### **WEIGHTED AVERAGE COST OF CAPITAL**

Cost of capital (weighted average cost of capital, WACC). The weighted average of the after-tax cost to a company of all forms of long-term financing used; employed as a minimum standard for the return to be earned on new investments.

### **INCOME STATEMENT**

Income statement (operating statement, profit and loss statement). A financial statement reporting the periodic revenues and matching costs and expenses for a specified period, and deriving the income for the period.

### **NET PRESENT VALUE**

Net Present Value (NPV). Income statement (operating statement, profit and loss statement). A financial statement reporting the periodic revenues and matching costs and expenses for a specified period, and deriving the income for the period.

### **INTERNAL RATE OF RETURN**

Internal rate of return (IRR). The discount rate that equates the cash inflows and cash outflows of an investment project, resulting in a net present value of zero.

### **LEVELISED COST OF ENERGY**

Levelized cost of energy (LCOE) is a measure of a power source that allows comparison of different methods of electricity generation on a consistent basis. It is an economic assessment of the average total cost to build and operate a power-generating asset over its lifetime divided by the total energy output of the asset over that lifetime. The LCOE can also be regarded as the average minimum price at which electricity must be sold in order to break-even over the lifetime of the project.

## RELATED LITERATURE

(Zhen-YuZhao 2017) studied levelized cost of energy modeling for concentrated solar power (CSP) projects in China by constructs a mathematical model of the levelized cost of energy (LCOE) to calculate the power generation cost of CSP projects on the basis of lifetime cost structure analysis. This research offers a new method for power generation cost calculation of CSP projects and provides support for governments to formulate incentive policies for the industry.

(Alireza Haghighat 2016) studied techno economic feasibility of photovoltaic, wind, diesel and hybrid electrification systems for off-grid rural electrification in Colombia. This study aims at analysing the application of photovoltaic (PV) panels, wind turbines and diesel generators in a stand-alone hybrid power generation system for rural electrification in three off-grid villages in Colombia with different climatic characteristics by using HOMER software for modeled and optimized to determine the most energy efficient and cost-effective configuration for each location. Net present cost, initial capital cost, and cost of energy as economic indicators are the main performance indexes.

(B. Shiva Kumar 2015) studied performance evaluation of 10 MW grid connected solar photovoltaic power plant in India by using the simulation PV syst and PV-GIS software for improve designing, operating and maintenance new grid connected systems of A 10 MW photovoltaic grid connected power plant commissioned at Ramagundam, India.

(Abdul Ghafoor 2015) studied design and economics analysis of an off-grid PV system for household electrification in the city of Faisalabad, Pakistan by using modeled, life cycle cost (LCC) analysis and annualized life cycle cost (ALCC) analysis. The results show that unit cost of electricity produced using off-grid PV system is lower than the unit cost charged in case of conventional electric supply to the residential areas.

## CHAPTER 3

### METHODOLOGY

This research must have knowledge and understanding using technologies and tools, including how to operate the Solar Power Plant and working on the financial model to be used for the analysis feasibility of the project. This research also considered the other main factor as location and area of setting up the project which could be the main impact to cost and efficiency of the power plant. The procedure for the whole research are as follows:

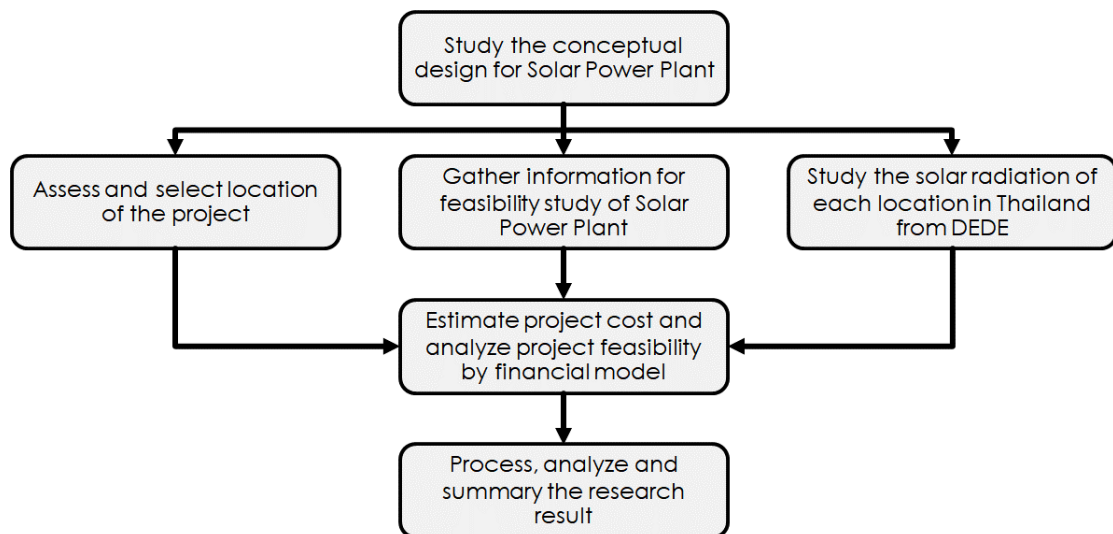


Figure 3-1 Study flow chart of this project

#### Study the conceptual design for Solar Power Plant as following items

1. Technology and characteristic of Solar Cell or Photovoltaic Cell.
2. The operation of solar electrical power generating system.
3. Main equipment and tools for electrical system.
4. Civil work for site preparation and structural support for solar panels.

5. Mechanical system for water requirement of the project.
6. Electrical system for transmission and electrical connections.

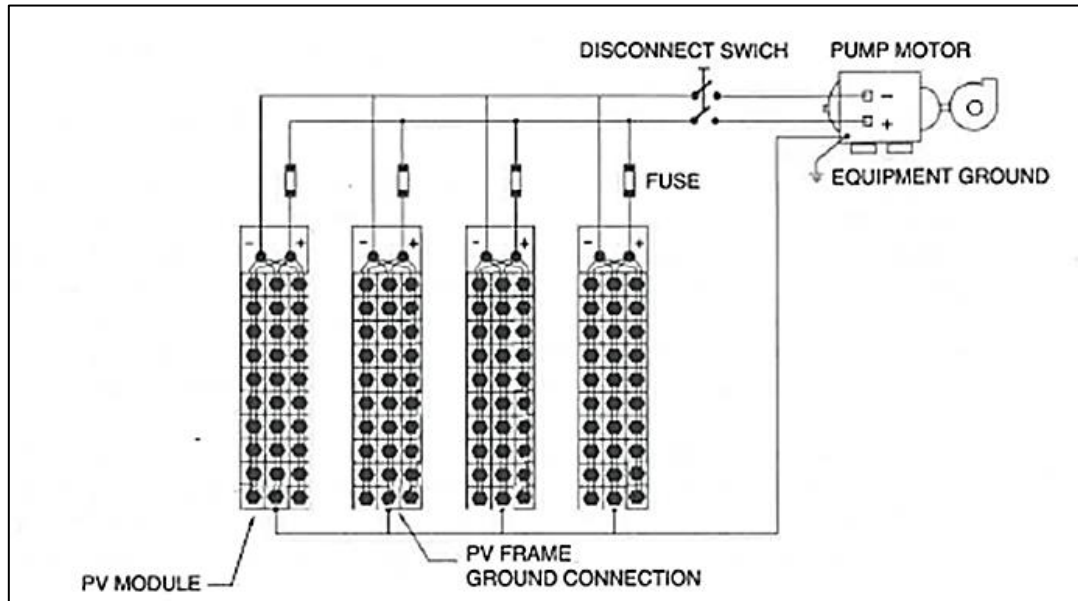


Figure 3-2 Directly connected solar power DC pump diagram.

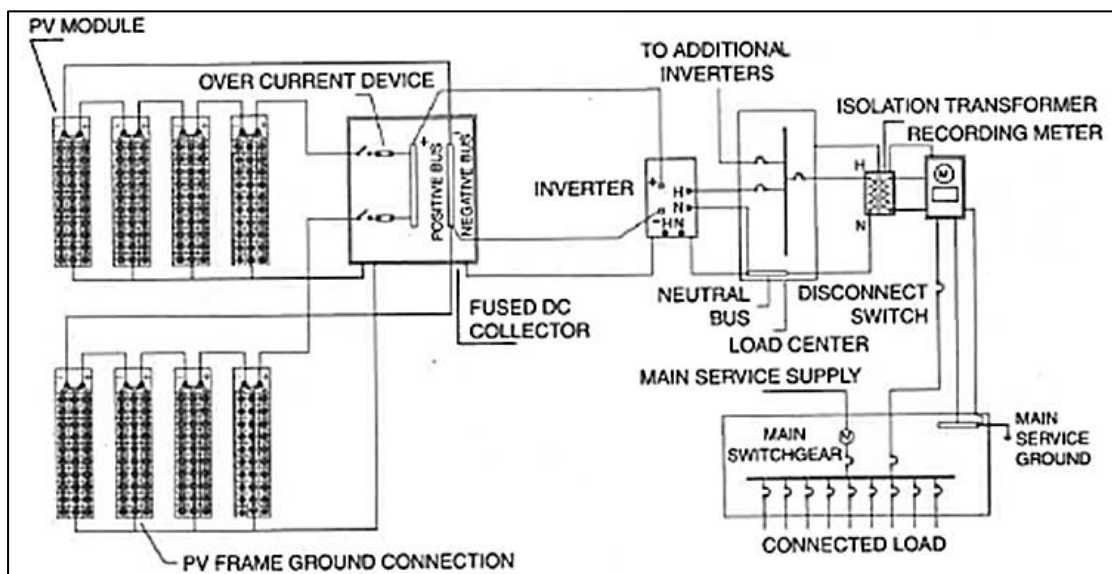


Figure 3-3 A typical grid-connected solar power system.



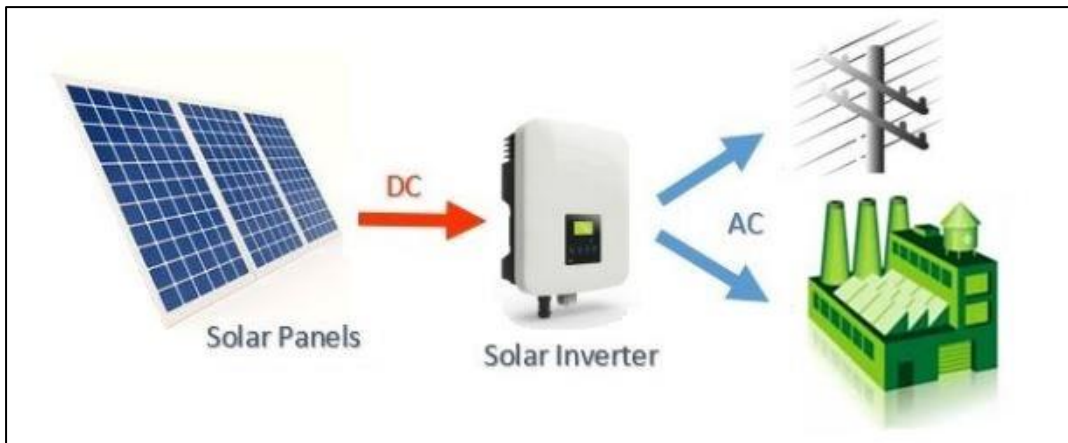


Figure 3-4 Simplified diagram of an on-grid solar system.



Figure 3-5 Main equipment and tools for electrical system  
(solar panel, solar inverter, control board and transformer)



Figure 3-6 Solar power plant civil work preparation.



Figure 3-7 Mechanical system for supply water in solar power plant area.



Figure 3-8 Low voltage transmission line.

### **Study the Financial Analysis**

Financial Analysis is a general term that refers to using financial data to make business and investment decisions more efficiently and thus more profitably by using financial analysis tool such as Break-Even Point, Net Present Value, Internal Rate of Return, Return on Investment,

Debt to Equity Ratio, Etc.

### Gather information for preparing the feasibility study of Solar Power Plant

Study the solar radiation of each location selected from Department of Alternative Energy Development and Efficiency (DEDE) to calculate plant factor of power plant.

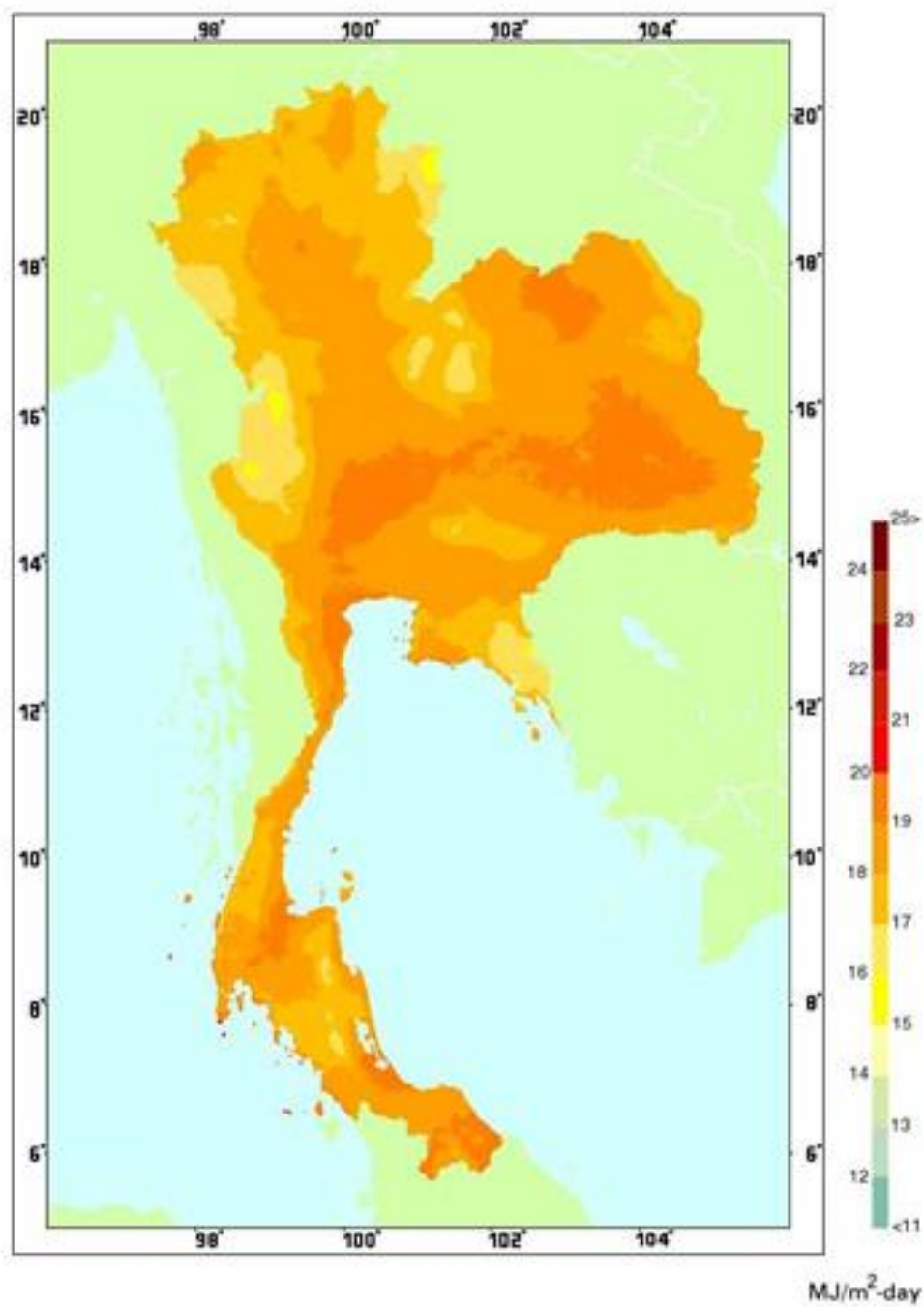


Figure 3-9 Solar map of Thailand from DEDE.

Solar Radiation Measurement Station		Region	Latitude	Longitude	Averaged Solar Radiation per Month (MJ/m <sup>2</sup> -day)												Averaged per Year
Province	Region				January	February	March	April	May	June	July	August	September	October	November	December	
Nakhon Sawan	Nakhon Sawan	Central	15.67	100.12	14.331	19.194	22.142	21.723	19.087	22.735	18.626	19.064	19.232	16.791	14.854	14.583	18.530
Phetchabun	Phetchabun	Central	16.43	101.15	15.928	20.018	21.091	22.025	18.925	18.825	15.243	17.822	17.199	16.918	16.008	15.668	17.973
Lop Buri	Lop Buri	Central	14.83	100.62	15.783	19.554	20.397	21.499	18.074	18.764	16.253	18.145	17.795	16.749	15.359	15.489	17.813
Bangkok	Bangkok	Central	13.75	100.50	13.729	18.220	19.127	20.290	16.317	18.491	16.838	17.321	-	-	-	-	17.579
Phitsanulok	Phitsanulok	Central	16.78	100.27	14.317	18.841	20.458	20.732	19.328	18.654	16.316	17.051	17.767	16.042	15.356	15.122	17.499
Prachap Khiri Khan	Prachap Khiri Khan	West	11.83	99.83	14.212	21.222	22.316	21.531	18.019	19.447	14.133	18.886	18.658	18.414	13.862	17.219	18.160
Prachap Khiri Khan (Nong Phub)	Prachap Khiri Khan	West	12.588	99.731	13.514	19.904	20.198	21.040	16.103	19.441	15.191	18.196	18.341	16.315	12.403	14.199	17.070
Kanchanaburi (Meteorological Station)	Kanchanaburi	West	14.02	99.53	14.992	19.660	-	-	-	-	-	-	-	-	-	-	17.026
Kanchanaburi (Thong Pha Phum)	Kanchanaburi	West	14.73	98.63	15.672	20.688	-	-	17.944	16.587	13.539	16.166	19.248	17.487	16.111	16.583	17.003
Tak	Tak	West	16.80	98.90	15.633	21.640	22.851	20.974	18.362	14.963	11.211	12.165	16.927	14.519	15.527	15.560	16.694
Trat	Trat	East	11.77	102.88	19.504	21.745	21.438	14.492	-	-	-	-	-	-	-	-	19.295
Prachin Buri	Prachin Buri	East	13.97	101.70	15.740	18.489	18.100	18.420	18.423	19.570	15.777	17.743	19.190	17.490	15.154	15.863	17.497
Sa Kaeo (Anayprathab)	Sa Kaeo	East	13.70	102.29	15.858	18.732	18.009	20.347	18.340	18.920	15.980	18.018	17.889	16.998	13.863	15.769	17.369
Chon Buri	Chon Buri	East	13.37	100.97	14.935	18.203	17.434	18.639	15.202	18.022	15.627	17.680	16.834	16.221	13.179	14.472	16.371
Roi Et	Roi Et	North East	16.07	103.00	17.847	20.117	18.994	22.257	19.025	19.069	16.549	18.853	18.353	18.476	17.435	16.557	18.628
Surin	Surin	North East	14.88	103.50	17.908	19.612	19.449	20.500	17.128	20.565	17.626	19.705	18.688	17.937	16.548	17.014	18.557
Khon Kaen	Khon Kaen	North East	16.19	102.80	17.036	20.385	19.174	22.335	19.772	18.866	16.395	18.622	17.813	16.911	17.814	17.385	18.534
Ubon Ratchaburi	Ubon Ratchaburi	North East	15.28	105.14	18.517	21.216	19.261	21.259	19.224	18.233	15.417	19.035	17.596	15.766	15.869	17.988	18.281
Nong Khai	Nong Khai	North East	17.87	102.72	16.058	19.067	18.371	21.198	19.335	18.523	15.488	18.523	17.497	17.457	17.745	15.072	17.844
Nakhon Ratchasima	Nakhon Ratchasima	North East	14.97	102.08	15.857	19.329	19.330	21.628	18.546	19.663	16.603	17.982	17.524	15.426	15.134	15.941	17.747
Nakhon Phanom	Nakhon Phanom	North East	16.97	104.73	17.603	19.702	17.961	20.184	19.846	16.503	13.041	16.462	17.032	17.579	16.975	16.448	17.445
Loei	Loei	North East	17.40	101.00	14.814	19.021	18.266	19.608	17.338	16.410	15.407	16.733	17.228	15.039	15.441	14.097	16.617
Phuket	Phuket	South	8.13	98.30	16.907	22.445	22.918	19.985	15.148	18.369	18.598	17.732	16.297	19.547	16.212	17.719	18.490
Narathiwat	Narathiwat	South	6.40	101.82	-	18.173	21.452	21.977	18.681	19.025	18.512	19.252	19.270	17.438	12.730	11.807	18.029
Songkhla	Songkhla	South	6.92	100.43	14.099	20.464	21.745	19.685	18.014	18.389	18.806	18.410	17.308	18.130	12.223	13.215	17.541
Trang	Trang	South	7.52	99.62	18.944	21.370	20.449	17.487	16.820	17.551	18.025	16.935	16.159	17.320	13.588	15.078	17.477
Samui Island	Samui Island	South	9.47	100.05	11.794	19.012	22.016	19.014	18.440	18.993	17.602	19.348	17.935	16.926	13.125	13.751	17.330
Surat Thani (Phu Phun)	Surat Thani	South	9.13	99.15	10.993	17.381	19.591	18.294	17.357	18.117	17.305	17.521	17.097	16.804	11.523	13.280	16.255
Chumphon	Chumphon	South	10.40	99.18	12.249	20.043	20.690	18.747	15.315	15.484	13.345	17.206	17.267	16.063	12.723	14.309	16.120
Ranong	Ranong	South	9.98	98.62	12.058	18.761	20.059	18.965	15.529	16.357	13.099	15.176	15.219	15.206	12.429	14.793	15.688
Chiang Mai	Chiang Mai	North	18.83	98.88	14.741	19.903	21.753	20.678	20.569	18.630	16.818	17.316	17.190	16.330	15.692	15.406	17.911
Phrae	Phrae	North	18.06	100.06	14.316	19.486	19.767	-	20.895	19.365	17.227	17.382	18.114	15.857	15.390	14.940	17.522
Nan	Nan	North	18.72	100.75	14.773	18.767	19.299	-	18.370	18.628	15.232	16.242	17.444	16.403	16.047	14.714	16.874
Doi Inthanon (radar)	Chiang Mai	North	18.59	98.49	16.646	22.204	26.177	20.007	15.879	13.506	11.271	11.904	14.174	11.506	-	-	16.327
Mae Sot	Mae Hong Son	North	18.17	97.93	15.711	18.777	-	-	19.234	16.173	13.910	14.485	16.247	16.528	15.433	14.809	16.131
Chiang Rai	Chiang Rai	North	20.08	99.88	14.083	18.653	-	-	18.052	18.181	14.705	14.855	15.559	15.100	14.754	14.438	15.838
Mae Hong Son	Mae Hong Son	North	19.48	97.95	15.547	18.163	-	-	16.564	14.850	12.906	12.680	15.495	16.633	15.763	14.848	15.345
Doi Inthanon (Office)	Chiang Mai	North	18.54	98.52	12.229	18.992	-	-	-	17.329	13.362	12.814	14.518	10.808	10.563	11.052	13.596

Table 3-1 Solar radiation rating of Thailand from DEDE.

Region	Averaged Solar Radiation per year (MJ/m <sup>2</sup> -day)	Ranking
Northeast	17.956	1 <sup>st</sup>
Central	17.879	2 <sup>nd</sup>
East	17.633	3 <sup>rd</sup>
West	17.191	4 <sup>th</sup>
South	17.110	5 <sup>th</sup>
North	16.193	6 <sup>th</sup>

Table 3-2 Solar radiation raking by region.

### **Assess and select location and area of the project**

Assess and select location and area of the project responding to the solar radiation ranking and demand/supply of electricity consumption. By using google earth to select the area comply with area requirement from calculation and consumer information from industrial estate Authority of Thailand.



Industrial Estate	Province	Region	Averaged Solar Radiation per Year per Region	Power Supply Capability	Total Area
Udon Thani Industrial Estate	Udon Thani	Northeast	Rank 1	Insufficient Information	-
Nong Khai Industrial Estate	Nong Khai	Northeast	Rank 1	Under Development	-
Bangpoo Industrial Estate	Samut Prakan	Central	Rank 2	218.88 MW	5,472 Rai
Lat Krabang Industrial Estate	Bangkok	Central	Rank 2	180 MW	2,559 Rai
Bangplee Industrial Estate	Samut Prakan	Central	Rank 2	120 MW	1,004 Rai
Ban Wa (Hi-Tech) Industrial Estate	Ayutthaya	Central	Rank 2	80 MW	2,379 Rai
Nong Khae Industrial Estate	Saraburi	Central	Rank 2	80 MW	2,042 Rai
Bang Pa-in Industrial Estate	Ayutthaya	Central	Rank 2	80 MW	1,962 Rai
Samut Sakhon Industrial Estate	Samut Sakhon	Central	Rank 2	80 MW	1,763 Rai
Saha Rattana Nakorn Industrial Estate	Ayutthaya	Central	Rank 2	80 MW	1,441 Rai
Phichit Industrial Estate	Phichit	Central	Rank 2	80 MW	1,100 Rai
Kaeng Khoi Industrial Estate	Saraburi	Central	Rank 2	50 MW	579.29 Rai
Sinsakhon Industrial Estate	Samut Sakhon	Central	Rank 2	42 MW	840 Rai
Bangchan Industrial Estate	Bangkok	Central	Rank 2	Insufficient Information	-
Gemopolis Industrial Estate	Bangkok	Central	Rank 2	Insufficient Information	-
Asia Industrial Estate (Suvannabhumi)	Samut Prakan	Central	Rank 2	Insufficient Information	-
Maharaj Nakorn Industrial Estate	Samut Sakhon	Central	Rank 2	Insufficient Information	-
Map Ta Phut Industrial Estate	Rayong	East	Rank 3	1,545 MW	6,949 Rai
Wellgrow Industrial Estate	Chachoengsao	East	Rank 3	200 MW	3,508 Rai
Gateway City Industrial Estate	Chachoengsao	East	Rank 3	150 MW	5,153 Rai
Asia Industrial Estate	Rayong	East	Rank 3	130 MW	3,220 Rai
Amata City Chonburi Industrial Estate	Chonburi	East	Rank 3	100 MW	8,634 Rai
Amata City Chonburi Industrial Estate (Project 2)	Chonburi	East	Rank 3	80 MW	3,867 Rai
Laem Chabang Industrial Estate	Chonburi	East	Rank 3	80 MW	3,556 Rai
WHA Chonburi Industrial Estate	Chonburi	East	Rank 3	80 MW	3,482.45 Rai
WHA Rayong 36 Industrial Estate	Rayong	East	Rank 3	76.88 MW	1,281.35 Rai
WHA Eastern Industrial Estate (Map Ta Phut)	Rayong	East	Rank 3	50 MW	3,741.32 Rai
Hi-Tech Kabin Industrial Estate	Prachinburi	East	Rank 3	40 MW	1,075 Rai
Pinthong Industrial Estate	Chonburi	East	Rank 3	10 MW	633 Rai
Padaeng Industrial Estate	Rayong	East	Rank 3	Insufficient Information	-
Rayong Industrial Estate (Ban Khai)	Rayong	East	Rank 3	Insufficient Information	-
Luckchai Rubber Industrial Estate	Rayong	East	Rank 3	Insufficient Information	-
Eastern Seaboard Industrial Estate (Rayong)	Rayong	East	Rank 3	Insufficient Information	-
WHA Eastern Seaboard Industrial Estate 2	Rayong	East	Rank 3	Insufficient Information	-
RIL Industrial Estate	Rayong	East	Rank 3	Insufficient Information	-
TFD Industrial Estate	Chachoengsao	East	Rank 3	Insufficient Information	-
TFD2 Industrial Estate	Chachoengsao	East	Rank 3	Insufficient Information	-
Ban Bueng Industrial Estate	Chonburi	East	Rank 3	Insufficient Information	-
Pinthong Industrial Estate (Project 3)	Chonburi	East	Rank 3	Insufficient Information	-
Pin Thong Industrial Estate (Project 4)	Chonburi	East	Rank 3	Insufficient Information	-
Pin Thong Industrial Estate (Project 5)	Chonburi	East	Rank 3	Insufficient Information	-
Pinthong (Laem Chabang) Industrial Estate	Chonburi	East	Rank 3	Insufficient Information	-
Yamato Industries Industrial Estate	Chonburi	East	Rank 3	Insufficient Information	-
WHA Eastern Seaboard Industrial Estate 3	Rayong	East	Rank 3	Under Development	-
WHA Eastern Seaboard Industrial Estate 4	Rayong	East	Rank 3	Under Development	-

Table 3-3 Industrial Estate Selected Criteria.

Industrial Estate	Province	Region	Average Radiation per Year per Region	Power Supply Capability	Total Area
Udon Thani Industrial Estate	Udon Thani	Northeast	Rank 1	Insufficient Information	-
Nong Khai Industrial Estate	Nong Khai	Northeast	Rank 1	Under Development	-
Bangpoo Industrial Estate	Samut Prakan	Central	Rank 2	218.88 MW	5,472 Rai
Map Ta Phut Industrial Estate	Rayong	East	Rank 3	1,545 MW	6,949 Rai

Table 3-4 Top 3 Industrial Estate Selected Information.

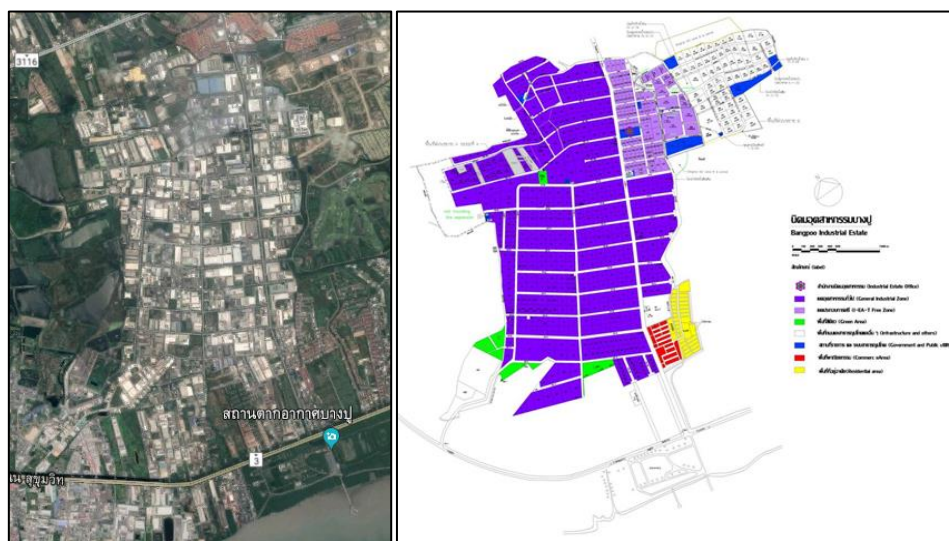


Figure 3-10 Bangpoo industrial estate area.

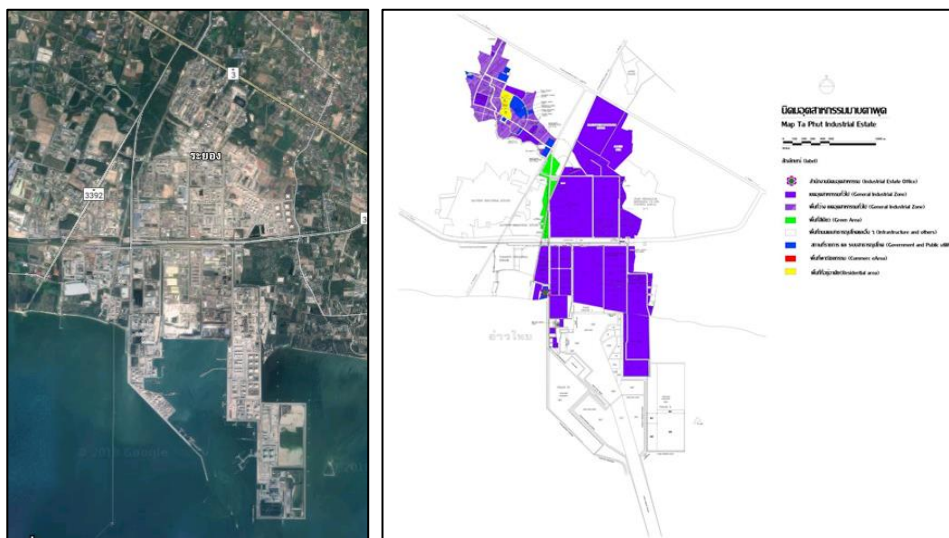


Figure 3-11 Maptaphut industrial estate area.



## Estimate cost of project and analyse the feasibility of project using financial model

Gathering all equipment cost for estimate the cost of project.

No.	Description	Quantity	Unit	Cost (THB)	Cost (USD)	Total Cost (THB)	Import TAX (THB)	Transportation 5% (THB)	Installation 5% (THB)	Total Cost + T&I (THB)	LC (DIR)	IC (DIR)
1	PV Modules (e-Si type)	10,500,000.00	Wp	-	0.35	134,137,500.00	13,413,750.00	6,706,875.00	6,706,875.00	147,551,250.00	-	147.55
2	PV Modules Structure (Screw Pile)	10,500,000.00	Wp	3.84	-	40,320,000.00	-	2,016,000.00	2,016,000.00	44,352,000.00	44.35	-
3	PV System											
3.1	Inverter	8,076,924.00	Wac	-	0.05	14,740,386.30	1,474,038.63	737,019.32	737,019.32	16,214,424.93	-	16.21
3.2	String Monitoring Box	61.00	Set	-	1,530.00	3,406,545.00	340,654.50	170,327.25	170,327.25	3,747,199.50	-	3.75
3.3	PV Plant Monitoring System	2.00	Set	1,800,000.00	-	3,600,000.00	-	180,000.00	180,000.00	3,960,000.00	3.96	-
3.4	Metereological Equipment	2.00	Set	400,000.00	-	800,000.00	-	40,000.00	40,000.00	880,000.00	0.88	-
<i>Total Cost (3)</i>											4.84	19.96
4	Electrical System											
4.1	22 kV Transformer Step-Up (2.5 MVA)	4.00	Set	1,625,000.00	-	6,500,000.00	-	325,000.00	325,000.00	7,150,000.00	7.15	-
4.2	Transformer for Utility & Station Service (100KVA)	6.00	Set	120,000.00	-	720,000.00	-	36,000.00	36,000.00	792,000.00	0.79	-
4.3	22 kV Switchgear	2.00	Set	2,500,000.00	-	5,000,000.00	-	250,000.00	250,000.00	5,500,000.00	5.50	-
4.4	22 kV River Pole with Reverse Meter	1.00	Set	500,000.00	-	500,000.00	-	25,000.00	25,000.00	550,000.00	0.55	-
4.5	Control Box AC/DC Board	6.00	Set	18,000.00	-	108,000.00	-	5,400.00	5,400.00	118,800.00	0.12	-
4.6	Other Control Box	4.00	Set	50,000.00	-	200,000.00	-	10,000.00	10,000.00	220,000.00	0.22	-
4.7	Cable	6,000.00	m	3,200.00	-	19,200,000.00	-	960,000.00	960,000.00	21,120,000.00	21.12	-
4.8	Communication System, Monitoring, Equipment	10,500,000.00	Wp	0.10	-	1,050,000.00	-	52,500.00	52,500.00	1,155,000.00	1.16	-
4.9	Lightning Protection & Grounding System	10.50	MWp	500,000.00	-	5,250,000.00	-	262,500.00	262,500.00	5,775,000.00	5.78	-
4.10	Spare (approx. 10%)	1.00	Set	-	-	3,852,800.00	-	192,640.00	192,640.00	4,238,080.00	4.24	-
<i>Total Cost (4)</i>											46.62	-
5	Civil Work											
5.1	Site Preparation	105.00	Rai	5,000.00	-	525,000.00	-	26,250.00	26,250.00	577,500.00	0.58	-
5.2	Cut & Fill	105.00	Rai	250,000.00	-	26,250,000.00	-	1,312,500.00	1,312,500.00	28,875,000.00	28.88	-
5.3	Drainage System	105.00	Rai	84,000.00	-	8,820,000.00	-	441,000.00	441,000.00	9,702,000.00	9.70	-
5.4	Underground Ductbank & Manhole & Handhole	10,500,000.00	Wp	0.50	-	5,250,000.00	-	262,500.00	262,500.00	5,775,000.00	5.78	-
5.5	Main Control Building	150.00	m2	25,000.00	-	3,750,000.00	-	187,500.00	187,500.00	4,125,000.00	4.13	-
5.6	Inverter Container	9.00	Set	250,000.00	-	2,250,000.00	-	112,500.00	112,500.00	2,475,000.00	2.48	-
5.7	Workshop	1.00	Room	300,000.00	-	300,000.00	-	15,000.00	15,000.00	330,000.00	0.33	-
5.8	Spare (approx. 5%)	1.00	Set	-	-	2,357,250.00	-	117,862.50	117,862.50	2,592,975.00	2.59	-
<i>Total Cost (5)</i>											54.45	-
6	On-Grid Connection											
6.1	22 kV Extension		km	2,500,000.00	-	-	-	-	-	-	-	-
6.2	Other Connection	1.00	Set	1,000,000.00	-	1,000,000.00	-	-	-	1,000,000.00	1.00	-
<i>Total Cost (6)</i>											1.00	-
7	Mechanical System											
7.1	Piping System & Water Supply (Module Cleaning)	10,500,000.00	Wp	0.35	-	3,675,000.00	-	183,750.00	183,750.00	4,042,500.00	4.04	-
7.2	Fire Alarm System	1.00	System	1,000,000.00	-	1,000,000.00	-	50,000.00	50,000.00	1,100,000.00	1.10	-
<i>Total Cost (7)</i>											5.14	-
8	Engineering & Construction Management	1.00	Work	6,478,374.59	-	6,478,374.59	-	-	-	6,478,374.59	6.48	-
<b>Total Cost (DIR)</b>							<b>15.23</b>			<b>330.40</b>	<b>162.88</b>	<b>167.51</b>

Table 3-5 Bangpoo industrial estate equipment cost.

No.	Description	Quantity	Unit	Cost (THB)	Cost (USD)	Total Cost (THB)	Import TAX (THB)	Transportation 5% (THB)	Installation 5% (THB)	Total Cost + T&I (THB)	LC (MB)	IC (MB)
1	PV Modules (c-Si type)	32,500,000.00	Wp	-	0.35	415,187,500.00	41,518,750.00	20,759,375.00	20,759,375.00	456,706,250.00	-	456.71
2	PV Modules Structure (Screw Pile)	32,500,000.00	Wp	3.84	-	124,800,000.00	-	6,240,000.00	6,240,000.00	137,280,000.00	137.28	-
3	PV System											
3.1	Inverter	25,000,000.00	Wac	-	0.05	45,625,000.00	4,562,500.00	2,281,250.00	2,281,250.00	50,187,500.00	-	50.19
3.2	String Monitoring Box	188.00	Set	-	1,530.00	10,498,860.00	1,049,886.00	524,943.00	524,943.00	11,548,746.00	-	11.55
3.3	PV Plant Monitoring System	5.00	Set	1,800,000.00	-	9,000,000.00	-	450,000.00	450,000.00	9,900,000.00	9.90	-
3.4	Meteorological Equipment	5.00	Set	400,000.00	-	2,000,000.00	-	100,000.00	100,000.00	2,200,000.00	2.20	-
Total Cost (3)											12.10	61.74
4	Electrical System											
4.1	22 kV Transformer Step-Up (2.5 MVA)	10.00	Set	1,625,000.00	-	16,250,000.00	-	812,500.00	812,500.00	17,875,000.00	17.88	-
4.2	Transformer for Utility & Station Service (100kVA)	14.00	Set	120,000.00	-	1,680,000.00	-	84,000.00	84,000.00	1,848,000.00	1.85	-
4.3	22 kV Switchgear	2.00	Set	2,500,000.00	-	5,000,000.00	-	250,000.00	250,000.00	5,500,000.00	5.50	-
4.4	22 kV Riser Pole with Revenue Meter	1.00	Set	500,000.00	-	500,000.00	-	25,000.00	25,000.00	550,000.00	0.55	-
4.5	Control Box AC/DC Board	14.00	Set	18,000.00	-	252,000.00	-	12,600.00	12,600.00	277,200.00	0.28	-
4.6	Other Control Box	10.00	Set	50,000.00	-	500,000.00	-	25,000.00	25,000.00	550,000.00	0.55	-
4.7	Cable	780.00	m	3,200.00	-	2,496,000.00	-	124,800.00	124,800.00	2,745,600.00	2.75	-
4.8	Communication System, Monitoring, Equipment	32,500,000.00	Wp	0.10	-	3,250,000.00	-	162,500.00	162,500.00	3,575,000.00	3.58	-
4.9	Lightning Protection & Grounding System	32.50	MWp	500,000.00	-	16,250,000.00	-	812,500.00	812,500.00	17,875,000.00	17.88	-
4.10	Spare (approx. 10%)	1.00	Set	-	-	4,617,800.00	-	230,890.00	230,890.00	5,079,580.00	5.08	-
Total Cost (4)											55.88	-
5	Civil Work											
5.1	Site Preparation	325.00	Rai	5,000.00	-	1,625,000.00	-	81,250.00	81,250.00	1,787,500.00	1.79	-
5.2	Cut & Fill	325.00	Rai	250,000.00	-	8,125,000.00	-	4,062,500.00	4,062,500.00	8,937,500.00	89.38	-
5.3	Drainage System	325.00	Rai	84,000.00	-	27,300,000.00	-	1,365,000.00	1,365,000.00	30,030,000.00	30.03	-
5.4	Underground Ductbank & Manhole & Handhole	32,500,000.00	Wp	0.50	-	16,250,000.00	-	812,500.00	812,500.00	17,875,000.00	17.88	-
5.5	Main Control Building	150.00	m2	25,000.00	-	3,750,000.00	-	187,500.00	187,500.00	4,125,000.00	4.13	-
5.6	Inverter Container	25.00	Set	250,000.00	-	6,250,000.00	-	312,500.00	312,500.00	6,875,000.00	6.88	-
5.7	Workshop	1.00	Room	300,000.00	-	300,000.00	-	15,000.00	15,000.00	330,000.00	0.33	-
5.8	Spare (approx. 5%)	1.00	Set	-	-	6,836,250.00	-	341,812.50	341,812.50	7,519,875.00	7.52	-
Total Cost (5)											157.92	-
6	On-Grid Connection											
6.1	22 kV Extension		km	2,500,000.00	-	-	-	-	-	-	-	-
6.2	Other Connection	1.00	Set	1,000,000.00	-	1,000,000.00	-	-	-	1,000,000.00	1.00	-
Total Cost (6)											1.00	-
7	Mechanical System											
7.1	Piping System & Water Supply (Module Cleaning)	32,500,000.00	Wp	0.35	-	11,375,000.00	-	568,750.00	568,750.00	12,512,500.00	12.51	-
7.2	Fire Alarm System	1.00	System	1,000,000.00	-	1,000,000.00	-	50,000.00	50,000.00	1,100,000.00	1.10	-
Total Cost (7)											13.61	-
8	Engineering & Construction Management	1.00	Work	#####	-	17,924,555.02	-	-	-	17,924,555.02	17.92	-
Total Cost (MB)							47.13			914.15	395.71	518.44

Table 3-6 Maptaphut industrial estate equipment cost.

Estimate cost of project and analyse the feasibility of project using financial model such as cash flow report, income statement, debt profile, project financing, and etc.

No.	Description	Total		Total
		Local	Import	
1	PV Modules	-	147.55	147.55
2	PV Modules Structure	44.35	-	44.35
3	PV System	14.52	19.96	34.48
4	Electrical System	46.62	-	46.62
5	Civil Work	58.22	-	58.22
6	On-Grid Connection	1.00	-	1.00
7	Other	5.14	-	5.14
	<b>Subtotal</b>	<b>169.85</b>	<b>167.51</b>	<b>337.36</b>
8	Engineering & Construction Management	6.75	-	6.75
9	Import TAX	15.23	-	15.23
10	Contingency (approx. 5%)	8.49	8.38	16.87
11	Escalation (approx. 1.6%)	2.72	2.68	5.40
12	Energy Fund (approx. 0.16%)	0.27	0.27	0.54
13	Interest during Construction	10.40	-	10.40
14	Financing Fee	4.30	-	4.30
	<b>Total Cost (MB)</b>	<b>218.01</b>	<b>178.84</b>	<b>396.85</b>

Table 3-7 Bangpoo industrial estate estimated project cost.

No.	Description	Total		Total
		Local	Import	
1	PV Modules	-	456.71	456.71
2	PV Modules Structure	137.28	-	137.28
3	PV System	12.10	61.86	73.96
4	Electrical System	57.82	-	57.82
5	Civil Work	157.92	-	157.92
6	On-Grid Connection	1.00	-	1.00
7	Other	13.61	-	13.61
	<b>Subtotal</b>	<b>379.73</b>	<b>518.57</b>	<b>898.30</b>
8	Engineering & Construction Management	17.97	-	17.97
9	Import TAX	47.14	-	47.14
10	Contingency (approx. 5%)	18.99	25.93	44.91
11	Escalation (approx. 1.6%)	6.08	8.30	14.37
12	Energy Fund (approx. 0.16%)	0.61	0.83	1.44
13	Interest during Construction	27.88	-	27.88
14	Financing Fee	11.52	-	11.52
	<b>Total Cost (MB)</b>	<b>509.91</b>	<b>553.62</b>	<b>1,063.53</b>

Table 3-8 Map Ta Phut industrial estate estimated project Cost.

## Process and analyse the research result

Study the EGAT Financial Report to determine debt:equity ratio.

**ELECTRICITY GENERATING AUTHORITY OF THAILAND AND ITS SUBSIDIARIES**  
**STATEMENTS OF FINANCIAL POSITION**  
**AS AT DECEMBER 31, 2017**

		Unit : Baht		
	Notes	Separate financial statements		
		Dec 31, 17	Dec 31, 16 (Restated)	Jan 1, 16 (Restated)
<b>LIABILITIES AND EQUITY</b>				
<b>CURRENT LIABILITIES</b>				
Trade accounts payable-others	6.18	45,003,712,892	40,392,521,549	45,716,636,792
Trade accounts payable-related parties	6.4.3	17,714,813,591	18,958,934,334	16,559,695,125
Other accounts payable		12,977,491,945	10,057,725,363	9,666,654,151
Surplus revenue from electric energy sales according to automatic tariff adjustment (F)	6.5	14,572,191,919	14,525,610,887	7,022,818,454
Accrued interest expenses		1,147,028,254	1,169,559,394	1,128,913,791
Accrued remittance to the Ministry of Finance	6.19	11,890,711,826	8,100,393,438	6,213,985,440
Accrued expenses		5,526,142,690	5,368,211,956	5,710,022,905
Current portion of long-term loans	6.20	7,552,007,512	3,118,844,470	5,584,598,046
Current portion of loan from infrastructure fund	12	716,105,266	570,298,669	414,476,205
Current portion of finance lease liabilities-power plants	6.22	20,098,397,162	20,321,636,038	17,634,913,589
Current portion of finance lease liabilities-others		196,489,871	90,156,647	9,831,130
<b>Total current liabilities</b>		<b>137,395,092,928</b>	<b>122,673,892,745</b>	<b>115,662,545,628</b>
<b>NON-CURRENT LIABILITIES</b>				
Long-term loans	6.20	61,987,486,566	51,824,269,556	50,607,867,530
Loan from infrastructure fund	12	19,235,447,737	19,709,830,022	20,440,523,795
Non-current provisions for employee benefits	6.21	16,478,108,185	15,428,834,122	15,269,984,842
Deferred revenue for electricity compensation	6.5	5,413,098,633	7,991,250,720	7,552,733,132
Finance lease liabilities-power plants	6.22	284,152,801,797	316,449,155,674	273,691,700,462
Finance lease liabilities-others		586,906,291	324,437,342	41,430,378
Provision liabilities for mine reclamation	6.23	2,225,773,065	2,189,672,181	2,169,269,052
Other non-current liabilities	6.24	19,427,382,527	15,940,901,163	12,918,151,932
<b>Total non-current liabilities</b>		<b>409,507,004,801</b>	<b>429,858,350,780</b>	<b>382,691,661,123</b>
<b>TOTAL LIABILITIES</b>		<b>546,902,097,729</b>	<b>552,532,243,525</b>	<b>498,354,206,751</b>
<b>EQUITY</b>				
Contribution from the government	6.25	8,752,646,764	8,814,979,527	8,877,312,290
Surplus from royalty on state property service		194,873,609	201,210,965	207,548,321
Retained earnings				
Appropriated				
Capital expenditure appropriation		80,186,366,913	80,186,366,913	80,186,366,913
Unappropriated		264,608,468,458	239,336,836,549	223,111,124,442
Other components of equity		459,852,750	355,577,750	156,412,500
<b>TOTAL EQUITY ATTRIBUTABLE TO EGAT</b>		<b>354,202,208,494</b>	<b>328,894,971,704</b>	<b>312,538,764,466</b>
<b>TOTAL EQUITY</b>		<b>354,202,208,494</b>	<b>328,894,971,704</b>	<b>312,538,764,466</b>
<b>TOTAL LIABILITIES AND EQUITY</b>		<b>901,104,306,223</b>	<b>881,427,215,229</b>	<b>810,892,971,217</b>

Notes to the financial statements are an integral part of these financial statements.

Figure 3-12 EGAT Financial Report year 2017.

	<i>Debt</i>	<i>Equity</i>
	60.00%	40.00%
<b>Cost of Debt</b>		
Interest Rate	5.50%	
Estimated Cost of Debt (After TAX)	4.40%	
<b>Cost of Equity</b>		
Thai Government Bond (Rf)	4.26%	
Income TAX	20.00%	
Unlevered Beta	0.630	
Levered Beta	0.756	
Market Risk Premium	18.30%	
Estimated Cost of Equity	18.09%	
<b>WACC</b>	<b>9.88%</b>	

Table 3-9 EGAT Power Plant Project Weight Average Cost of Capital

## Bangpoo Project

INPUT DATA	
Installed Capacity	10.50 MWdc
Sensitivity Power Factor	19.25%
Net Energy Generated	17.71 GWh/yr
% Auxiliary	0.85%
Net Energy to Grid	17.56 GWh/yr
Annual Derating	0.50%
Average Energy to Grid	16.54 GWh/yr
Plant Life	25 Years
COST	
EPC (Inc. Grid Connection)	323.92 MB
Engineering & Construction Management	6.48 MB
Import TAX	15.23 MB
Contingency	16.20 MB
Escalation	5.18 MB
Energy Fund	0.52 MB
Interest during Construction	10.01 MB
Financing Fee	4.13 MB
<b>Total Project Cost</b>	<b>381.66 MB</b>
O & M & Admin Cost (0.5% of Project Cost)	1.91 MB
Energy Fund	0.01 MB/GWh
Area	105.00 Rai
FINANCING COST	
Loan Amount	60.00% of Total Project Cost
Debt/Equity Ratio	60:40
Term of Loan (Inc. Grace Period)	12 Years
Grace Period	2 Years
Loan Repayment	10 Years
Interest Rate	5.50%
Front-End Fee	1.50%
Commitment Fee	0.375%
WACC	9.88%
Exchange Rate	36.50 THB/USD
Income TAX	20.00%
Levelized Electricity Sale Price	2.89 THB/kWh
Levelized Production Cost	2.62 THB/kWh
ROIC	9.91%

	Year	2019	2020	2021
<b>CAPITAL COST</b>				
Debt	60.00%			
Interest	5.50%			
Front-End Fee	1.50%			
Commitment Fee	0.375%			
		Annual Proportion		
<i>Unit: Million THB</i>		0.20	0.70	0.10
Power Plant+Transmission	323.92	64.78	226.74	32.39
Engineering & Construction Management	6.48	1.30	4.53	0.65
Import TAX	15.23	3.05	10.66	1.52
Contingency	16.20	3.24	11.34	1.62
Escalation	5.18	1.04	3.63	0.52
Energy Fund	0.52	0.10	0.36	0.05
<b>Total Plant Cost</b>	<b>367.52</b>	<b>73.50</b>	<b>257.27</b>	<b>36.75</b>
Interest during Construction	10.01	1.21	8.79	-
Front-End Fee	3.31	3.31	-	-
Commitment Fee	0.83	0.83	-	-
<b>Total Project Cost</b>	<b>381.66</b>	<b>78.85</b>	<b>266.06</b>	<b>36.75</b>
Debt	220.51	44.10	154.36	22.05
Equity	147.01	29.40	102.91	14.70

Table 3-10 Bangpoo Capital Cost

## DEBT PROFILE

	Unit: Million THB													
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
<b>Total</b>	44.10	154.36	22.05											
Debt	44.10	154.36	22.05											
Equity	29.40	102.91	14.70											
Repayment														
5.00%														
<b>1st Half</b>														
Beginning - Jan	-	44.10	198.46	198.46	176.41	154.36	132.31	110.26	88.21	66.15	44.10	22.05	-	0.00
Draw - Jun	-	77.18	22.05	-	-	-	-	-	-	-	-	-	-	-
Repay - 30 Jun	-	-	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	-
Ending - Jun	-	121.28	209.49	187.44	165.39	143.33	121.28	99.23	77.18	55.13	33.08	11.03	-	0.00
Interest Payment	-	3.34	6.06	5.46	4.85	4.24	3.64	3.03	2.43	1.82	1.21	0.61	-	0.00
<b>2nd Half</b>														
Beginning - Jul	-	121.28	209.49	187.44	165.39	143.33	121.28	99.23	77.18	55.13	33.08	11.03	-	0.00
Draw - Jul	44.10	77.18	-	-	-	-	-	-	-	-	-	-	-	-
Repay - 30 Dec	-	-	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	(11.03)	-
Ending - Dec	44.10	198.46	198.46	176.41	154.36	132.31	110.26	88.21	66.15	44.10	22.05	-	0.00	0.00
Interest Payment	1.21	5.46	5.76	5.15	4.55	3.94	3.34	2.73	2.12	1.52	0.91	0.30	-	0.00
Repayment	-	-	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	(22.05)	-
Interest during Construction	1.21	8.79												
Interest during Operation			11.83	10.61	9.40	8.19	6.97	5.76	4.55	3.34	2.12	0.91		

Table 3-11 Bangpoo Debt Profile.

## CASH FLOW

	Year																				2045							
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	
<b>CASH INFLOW</b>																												
<b>REVENUE</b>																												
Energy Sales (GWH)	-	-	17.56	17.47	17.38	17.29	17.21	17.12	17.04	16.95	16.87	16.78	16.70	16.61	16.53	16.45	16.37	16.28	16.20	16.12	16.04	15.96	15.88	15.80	15.72	15.64	15.57	
Electricity Sales Price (TWh/Wh)	-	-	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	
Total Revenue	-	-	50.74	50.48	50.23	49.98	49.73	49.48	49.23	48.99	48.74	48.50	48.26	48.01	47.77	47.54	47.30	47.06	46.83	46.59	46.36	46.13	45.90	45.67	45.44	45.21	44.99	
<b>LOAN</b>																												
Loan Drawdown	44.10	154.36	22.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Loan	44.10	154.36	22.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>TOTAL CASH INFLOW</b>	44.10	154.36	72.79	50.48	50.23	49.98	49.73	49.48	49.23	48.99	48.74	48.50	48.26	48.01	47.77	47.54	47.30	47.06	46.83	46.59	46.36	46.13	45.90	45.67	45.44	45.21	44.99	
<b>CASH OUTFLOW</b>																												
<b>COST</b>																												
Investment Cost	68.02	238.08	34.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Cost	1.30	4.53	0.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Engineering & Construction Management	3.05	10.66	1.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Import TAX	1.04	3.63	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Escalation	0.10	0.36	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Fund	1.21	8.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest during Construction	3.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Front-End Fee	0.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Commitment Fee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fixed O&M Expense	-	-	1.91	1.93	1.95	1.97	1.99	2.01	2.03	2.05	2.07	2.09	2.11	2.13	2.15	2.17	2.19	2.22	2.24	2.26	2.28	2.31	2.33	2.35	2.38	2.40	2.42	
Energy Fund	-	-	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	
Total Cost	78.85	266.06	38.84	2.10	2.12	2.14	2.16	2.18	2.20	2.22	2.24	2.25	2.27	2.30	2.32	2.34	2.36	2.38	2.40	2.42	2.44	2.47	2.49	2.51	2.53	2.56	2.58	
<b>DEBT FINANCING EXPENSES</b>																												
Repayment of Principal	-	-	22.05	22.05	22.05	22.05	22.05	22.05	22.05	22.05	22.05	22.05	22.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	-	-	11.83	10.61	9.40	8.19	6.97	5.76	4.55	3.34	2.12	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Financing	-	-	33.88	32.66	31.45	30.24	29.03	27.81	26.60	25.39	24.17	22.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>TOTAL CASH OUTFLOW</b>	78.85	266.06	72.71	34.77	33.57	32.38	31.18	29.99	28.80	27.60	26.41	25.22	2.27	2.30	2.32	2.34	2.36	2.38	2.40	2.42	2.44	2.47	2.49	2.51	2.53	2.56	2.58	
<b>Net Cashflow for ROE</b>	-34.75	-111.70	0.07	15.72	16.66	17.60	18.55	19.49	20.44	21.38	22.33	23.28	24.23	25.18	26.13	27.08	28.03	28.98	29.93	30.88	31.83	32.78	33.73	34.68	35.63	36.58	37.53	
Sum Investment Cost for LCOE	78.85	266.06	36.75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Cashflow for IRR	-78.85	-266.06	11.90	48.38	48.11	47.84	47.57	47.30	47.04	46.77	46.51	46.24	45.98	45.72	45.46	45.20	44.94	44.68	44.43	44.17	43.92	43.66	43.41	43.16	42.91	42.66	42.41	
Cumulative Net Cashflow for ROE	-34.75	-146.45	-130.66	-114.00	-96.40	-77.85	-58.36	-37.92	-16.54	5.79	29.08	75.06	120.77	166.23	211.43	256.37	301.05	345.48	389.65	433.57	477.23	520.64	563.79	606.70	649.36	691.76		
Payback Period																												

Table 3-12 Bangpoo Cash Flow.





### Maptaphut Project

<b>INPUT DATA</b>	
Installed Capacity	32.50 MWdc
Sensitivity Power Factor	18.33%
Net Energy Generated	52.20 GWh/yr
% Auxiliary	0.82%
Net Energy to Grid	51.77 GWh/yr
Annual Derating	0.50%
Average Energy to Grid	48.78 GWh/yr
Plant Life	25 Years
<b>COST</b>	
EPC (Inc. Grid Connection)	896.23 MB
Engineering & Construction Management	17.92 MB
Import TAX	47.13 MB
Contingency	44.81 MB
Escalation	14.34 MB
Energy Fund	1.43 MB
Interest during Construction	27.82 MB
Financing Fee	11.50 MB
Total Project Cost	1,061.18 MB
O & M & Admin Cost (0.5% of Project Cost)	5.31 MB
Energy Fund	0.01 MB/GWh
Area	325.00 Rai
<b>FINANCING COST</b>	
Loan Amount	60.00% of Total Project Cost
Debt/Equity Ratio	60:40
Term of Loan (Inc. Grace Period)	12 Years
Grace Period	2 Years
Loan Repayment	10 Years
Interest Rate	5.50%
Front-End Fee	1.50%
Commitment Fee	0.375%
WACC	9.88%
Exchange Rate	36.50 THB/USD
Income TAX	20.00%
Levelized Electricity Sale Price	2.73 THB/kWh
Levelized Production Cost	2.47 THB/kWh
ROIC	9.94%

	Year	2019	2020	2021
<b>CAPITAL COST</b>				
Debt	60.00%			
Interest	5.50%			
Front-End Fee	1.50%			
Commitment Fee	0.375%			
		Annual Proportion		
<i>Unit: Million THB</i>		0.20	0.70	0.10
Power Plant+Transmission	896.23	179.25	627.36	89.62
Engineering & Construction Management	17.92	3.58	12.55	1.79
Import TAX	47.13	9.43	32.99	4.71
Contingency	44.81	8.96	31.37	4.48
Escalation	14.34	2.87	10.04	1.43
Energy Fund	1.43	0.29	1.00	0.14
<b>Total Plant Cost</b>	<b>1,021.87</b>	<b>204.37</b>	<b>715.31</b>	<b>102.19</b>
Interest during Construction	27.82	3.37	24.45	-
Front-End Fee	9.20	9.20	-	-
Commitment Fee	2.30	2.30	-	-
<b>Total Project Cost</b>	<b>1,061.18</b>	<b>219.24</b>	<b>739.76</b>	<b>102.19</b>
Debt	613.12	122.62	429.18	61.31
Equity	408.75	81.75	286.12	40.87

Table 3-14 Maptaphut Capital Cost

## DEBT PROFILE

	Unit: Million THB														
	Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Debt	613.12	122.62	429.18	61.31											
Equity	408.75	81.75	286.12	40.87											
Repayment	5.00%														
<b>1st Half</b>															
Beginning - Jan	-	122.62	551.81	551.81	490.50	429.18	367.87	306.56	245.25	183.94	122.62	61.31	0.00	0.00	
Draw - Jan	-	214.59	61.31												
Repay - 30 Jun	-	-	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)		
Ending - Jun	-	337.22	582.47	521.15	459.84	398.53	337.22	275.90	214.59	153.28	91.97	30.66	0.00	0.00	
Interest Payment	-	9.27	16.86	15.17	13.49	11.80	10.12	8.43	6.74	5.06	3.37	1.69	0.00	0.00	
<b>2nd Half</b>															
Beginning - Jul	-	337.22	582.47	521.15	459.84	398.53	337.22	275.90	214.59	153.28	91.97	30.66	0.00	0.00	
Draw - Jul	122.62	214.59													
Repay - 30 Dec	-	-	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)	(30.66)		
Ending - Dec	122.62	551.81	551.81	490.50	429.18	367.87	306.56	245.25	183.94	122.62	61.31	0.00	0.00	0.00	
Interest Payment	3.37	15.17	16.02	14.33	12.65	10.96	9.27	7.59	5.90	4.22	2.53	0.84	0.00	0.00	
Repayment	-	-	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)	(61.31)		
Interest during Construction	3.37	24.45													
Interest during Operation				32.88	29.51	26.13	22.76	19.39	16.02	12.65	9.27	5.90	2.53		

Table 3-15 Maptaphut Debt Profile

CASH FLOW

	Year																				Unir. Million THB							
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	
<b>CASH INFLOW</b>																												
<b>REVENUE</b>																												
Energy Sales (GWH)	-	-	51.77	51.51	51.25	50.99	50.74	50.49	50.23	49.98	49.73	49.48	49.24	48.99	48.74	48.50	48.26	48.02	47.78	47.54	47.30	47.06	46.83	46.59	46.36	46.13	45.90	
Electricity Sales Price (THB/kWh)	-	-	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	
Total Revenue	-	-	141.32	140.62	139.91	139.21	138.52	137.83	137.14	136.45	135.77	135.09	134.41	133.74	133.07	132.41	131.75	131.09	130.43	129.78	129.13	128.49	127.84	127.20	126.57	125.94	125.31	
<b>LOAN</b>																												
Loan Drawdown	122.62	429.18	61.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Loan	122.62	429.18	61.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>TOTAL CASH INFLOW</b>	122.62	429.18	202.64	140.62	139.91	139.21	138.52	137.83	137.14	136.45	135.77	135.09	134.41	133.74	133.07	132.41	131.75	131.09	130.43	129.78	129.13	128.49	127.84	127.20	126.57	125.94	125.31	
<b>CASH OUTFLOW</b>																												
<b>COST</b>																												
Investment Cost	188.21	658.73	94.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Plant Cost	3.58	12.55	1.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Engineering & Construction Management	9.43	32.99	4.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Import TAX	2.87	10.04	1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Escalation	0.29	1.00	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Energy Fund	3.37	24.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Interest during Construction	9.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Front-End Fee	2.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Commitment Fee	-	-	5.31	5.36	5.41	5.47	5.52	5.58	5.63	5.69	5.75	5.80	5.86	5.92	5.98	6.04	6.10	6.16	6.22	6.28	6.35	6.41	6.47	6.54	6.60	6.67	6.74	
Fixed O&M Expense	-	-	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	
Energy Fund	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Cost	219.24	739.76	108.01	5.87	5.93	5.98	6.03	6.08	6.13	6.19	6.24	6.30	6.35	6.41	6.47	6.52	6.58	6.64	6.70	6.76	6.82	6.88	6.94	7.00	7.07	7.13	7.20	
<b>DEBT FINANCING EXPENSES</b>																												
Repayment of Principal	-	-	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	61.31	
Interest	-	-	32.88	29.51	26.13	22.76	19.39	16.02	12.65	9.27	5.90	2.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Debt Financing	-	-	94.19	90.82	87.45	84.07	80.70	77.33	73.96	70.59	67.21	63.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>TOTAL CASH OUTFLOW</b>	219.24	739.76	202.20	96.69	93.37	90.05	86.73	83.41	80.09	76.77	73.46	70.14	63.35	64.1	64.7	65.2	65.8	6.64	6.70	6.76	6.82	6.88	6.94	7.00	7.07	7.13	7.20	
<b>Net Cashflow for ROE</b>	-	96.62	-310.57	0.43	43.92	46.54	49.16	51.79	54.41	57.04	59.68	62.31	64.95	128.06	127.33	126.61	125.88	125.16	124.45	123.73	123.02	122.31	121.60	120.90	120.20	119.50	118.80	118.11
<b>Net Cashflow for LCOE</b>	219.24	739.76	102.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Net Cashflow for IRR</b>	-219.24	-739.76	33.31	134.74	133.99	133.24	132.49	131.74	131.00	130.26	129.53	128.79	128.06	127.33	126.61	125.88	125.16	124.45	123.73	123.02	122.31	121.60	120.90	120.20	119.50	118.80	118.11	
<b>Cumulative Net Cashflow for ROE</b>	-	96.62	-407.19	-406.75	-362.83	-316.29	-267.12	-215.34	-160.92	-103.88	-44.20	18.11	83.06	211.13	338.46	465.07	590.95	716.12	840.56	964.30	1,087.32	1,209.63	1,331.23	1,452.13	1,572.33	1,691.83	1,810.64	1,928.75
Payback Period																												

Table 3-16 Maptaphut Cash Flow.

**INCOME STATEMENT**

	Year														Unit, Million TWh														
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032		2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	
<b>REVENUE</b>																													
Energy Sales (GWH)	-	-	51.77	51.51	51.25	50.99	50.74	50.49	50.23	49.98	49.73	49.48	49.24	48.99	48.74	48.50	48.26	48.02	47.78	47.54	47.30	47.06	46.83	46.59	46.36	46.13	45.90		
Electricity Sales Price (THB/KWh)	-	-	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73		
Total Revenue	-	-	141.32	140.62	139.91	139.21	138.52	137.83	137.14	136.45	135.77	135.09	134.41	133.74	133.07	132.41	131.75	131.09	130.43	129.78	129.13	128.49	127.84	127.20	126.57	125.94	125.31		
<b>OPERATING EXPENSES</b>																													
Fixed O&M Expense	-	-	5.31	5.36	5.41	5.47	5.52	5.58	5.63	5.69	5.75	5.80	5.86	5.92	5.98	6.04	6.10	6.16	6.22	6.28	6.35	6.41	6.47	6.54	6.60	6.67	6.74		
Energy Fund	-	-	0.52	0.52	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46		
Depreciation	-	-	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45	42.45		
Loan Interest	-	-	32.88	29.51	26.13	22.76	19.39	16.02	12.65	9.27	5.90	2.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Operating Expenses	-	-	81.15	77.83	74.51	71.19	67.87	64.55	61.23	57.91	54.59	51.27	48.80	48.86	48.91	48.97	49.03	49.09	49.15	49.21	49.27	49.33	49.39	49.45	49.52	49.58	49.64		
<b>NET INCOME BEFORE TAX</b>	-	-	60.17	62.79	65.41	68.03	70.65	73.28	75.91	78.54	81.18	83.82	85.61	84.89	84.16	83.44	82.72	82.00	81.29	80.57	79.86	79.16	78.45	77.75	77.05	76.36	75.66		
Income TAX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<b>NET INCOME AFTER TAX</b>	-	-	60.17	62.79	65.41	68.03	70.65	73.28	75.91	78.54	81.18	83.82	85.61	84.89	84.16	83.44	82.72	82.00	81.29	80.57	79.86	79.16	78.45	77.75	77.05	76.36	75.66		
Beginning Cap	-	-	1,061.18	1,018.74	976.29	933.84	891.40	848.95	806.50	764.05	721.61	679.16	636.71	594.26	551.82	509.37	466.92	424.47	382.03	339.58	297.13	254.68	212.24	169.79	127.34	84.89	42.45		
	-	-	1,018.74	976.29	933.84	891.40	848.95	806.50	764.05	721.61	679.16	636.71	594.26	551.82	509.37	466.92	424.47	382.03	339.58	297.13	254.68	212.24	169.79	127.34	84.89	42.45	0.00		
																												<b>9.94%</b>	<b>ROIC</b>

Table 3-17 Maptaphut Income Statement

## CHAPTER 4

### RESULT AND DISCUSSIONS

#### Result of the Model

Use all data and parameter on financial analysis model to process and analyse selected project results.

<b>PLANT PARAMETERS</b>		<b>COST PARAMETERS</b>	
Net Capacity	8.08 MW	Investment Cost	
Average Net Energy to Grid	16.54 GWh/yr	Plant Cost	346.59 MB
Capacity Factor	19.25%	Import TAX	15.23 MB
Plant Life	25 Years	Escalation	5.18 MB
		Energy Fund	0.52 MB
<b>REVENUE PARAMETER</b>		Interest during Construction	10.01 MB
Levelized Electricity Sale Price	2.89 THB/kWh	Financing Fee	4.13 MB
		Total Project Cost	381.66 MB
<b>FINANCIAL PARAMETERS</b>		O & M & Admin Cost (% of Plant Cost)	0.50%
Total Project Cost	381.66 MB	Energy Fund	0.01 MB
Debt/Equity Ratio	60:40		
Loan Amount	220.51 MB	<b>RESULT</b>	
Depreciation of Power Plant	15.27 MB/yr	Levelized Production Cost	2.62 THB/kWh
Exchange Rate	36.50 THB/USD	Investment Cost	2.49 THB/kWh
WACC	9.88%	Fixed O&M Expenses	0.12 THB/kWh
		Energy Fund	0.01 THB/kWh
		Project IRR	11.25%
		Project NPV	37.66 MB
		Payback Period	10 Years
		ROIC	9.91%

Figure 4-1 Assumption and Result of Bangpoo Project.

PLANT PARAMETERS		COST PARAMETERS	
Net Capacity	25.00 MW	Investment Cost	
Average Net Energy to Grid	48.78 GWh/yr	Plant Cost	958.96 MB
Capacity Factor	18.33%	Import TAX	47.13 MB
Plant Life	25 Years	Escalation	14.34 MB
		Energy Fund	1.43 MB
		Interest during Construction	27.82 MB
		Financing Fee	11.50 MB
		Total Project Cost	1,061.18 MB
REVENUE PARAMETER			
Levelized Electricity Sale Price	2.73 THB/kWh	O & M & Admin Cost (% of Plant Cost)	0.50%
		Energy Fund	0.01 MB
FINANCIAL PARAMETERS			
Total Project Cost	1,061.18 MB		
Debt/Equity Ratio	60:40		
Loan Amount	613.12 MB		
Depreciation of Power Plant	42.45 MB/yr		
Exchange Rate	36.50 THB/USD		
WACC	9.88%		
		RESULT	
		Levelized Production Cost	2.47 THB/kWh
		Investment Cost	2.35 THB/kWh
		Fixed O&M Expenses	0.11 THB/kWh
		Energy Fund	0.01 THB/kWh
		Project IRR	11.28%
		Project NPV	106.53 MB
		Payback Period	10 Years
		ROIC	9.94%

Figure 4-2 Assumption and Result of Maptaphut Project.

Increase net capacity from 8.08 -> 25.00 MW

Will reduce electricity sale price by 5.54% from 2.89 -> 2.73 (THB/kWh)

According to the result shows that higher MW capacity (power energy) give higher return/lower electricity sale price due to the economy of scale.

### Discussion of financial model

Description	Levelized Production Cost (THB/kWh)	
	Base Case	2.62
Percentage Change	Plant Factor Change	Investment Cost Change
+20%	2.19	3.10
+10%	2.39	2.86
Base Case	2.62	2.62
-10%	2.91	2.38
-20%	3.28	2.15

Table 4-1 Sensitivity analysis Bangpoo project.

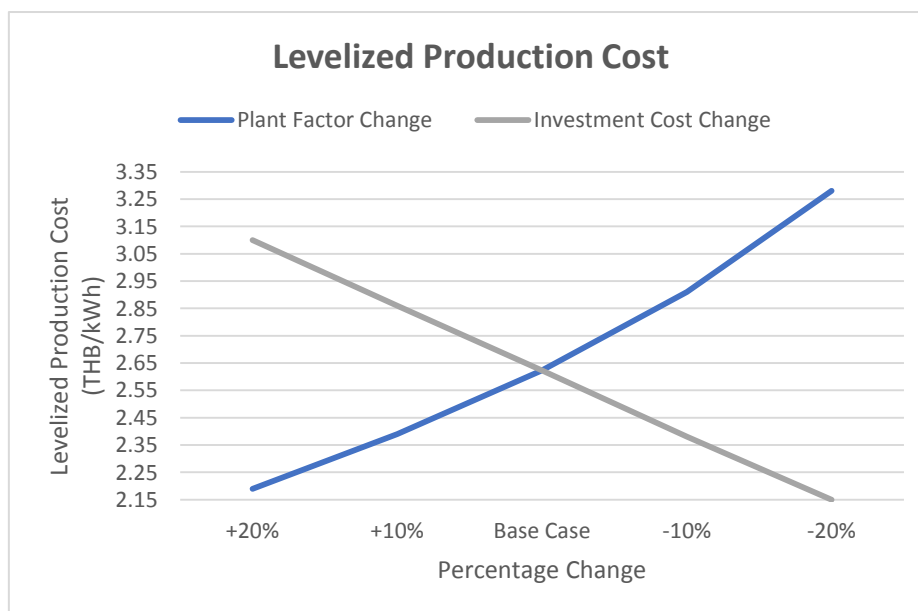


Figure 4-3 Sensitivity analysis – Bangpoo Project.



Description		Levelized Production Cost (THB/kWh)	
		Plant Factor Change	Investment Cost Change
Base Case		2.47	2.47
Percentage Change			
+20%		2.06	2.92
+10%		2.25	2.70
Base Case		2.47	2.47
-10%		2.75	2.25
-20%		3.09	2.02

Table 4-2 Sensitivity analysis – Map Ta Phut project.

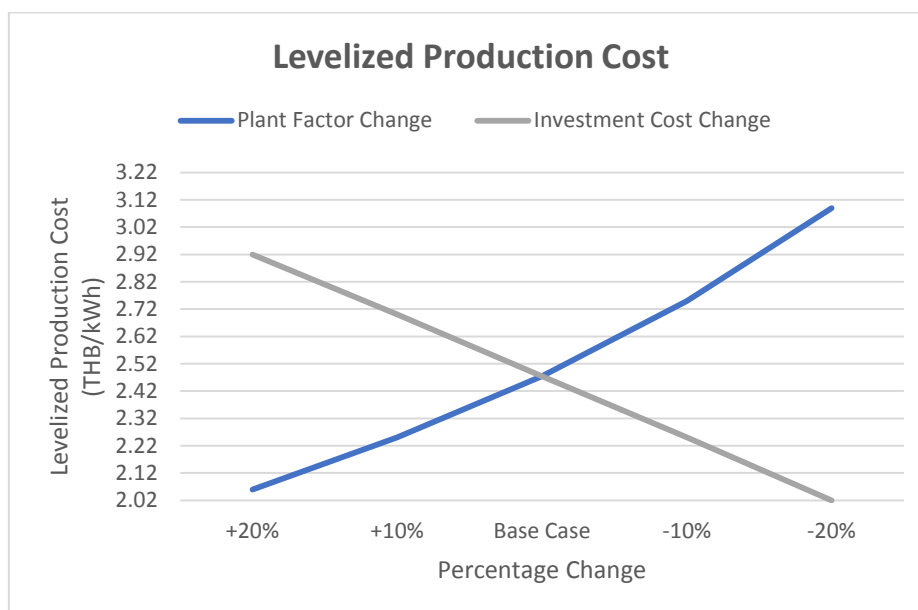


Figure 4-4 Sensitivity analysis – Map Ta Phut Project

This sensitivity analysis compares changing of percentage of plant factor and investment cost to cross check the project financial. The analysis shows that when plant factor increase it will reduce the production cost. In the other hands, if an investment cost increase it will increase the production cost which it makes sense by itself.

## PRICING COMPARISON BETWEEN NORMAL CONDITION VS. NEW CONDITION

Generally EGAT supply electric power then only sell those units to PEA or MEA follows government policy which unit pricing from solar energy must not over 2.40 baht.

In this study shows that pricing 2.40 baht/unit will make ROIC less than WACC which means value is actually destroyed as the company invests more capital; for every baht of investment the company attracts it pays out more than it earns with it.

@Levelized Electricity Sale Price: 2.40 THB/kWh

WACC: 9.88%

ROIC:

Bangpoo Project = 6.81%

Maptaphut Project = 7.72%

According to the new method EGAT subsidiary company might take the project and sells electricity power directly to an Industrial Estate with higher price to make an investment possible and make a profit to EGAT.

## TARIFF PRICING

### ประเภทที่ 4 กิจการขนาดใหญ่

**ลักษณะการใช้** สำหรับการใช้ไฟฟ้าเพื่อประกอบธุรกิจ อุตสาหกรรม หน่วยราชการ สำนักงาน หรือหน่วยงานอื่นใดของรัฐ องค์การปกครองส่วนท้องถิ่น หน่วยงานรัฐวิสาหกิจ สถานที่ทำการเกี่ยวกับการของต่างชาติ และสถานที่ทำการขององค์การระหว่างประเทศ ตลอดจนบริเวณที่เกี่ยวข้อง ซึ่งมีความต้องการพลังไฟฟ้าเฉลี่ยใน 15 นาทีที่สูงสุด ตั้งแต่ 1,000 กิโลวัตต์ขึ้นไป หรือ มีปริมาณการใช้พลังงานไฟฟ้าเฉลี่ย 3 เดือน เกินกว่า 250,000 หน่วยต่อเดือน โดยต่อผ่านเครื่องวัดหน่วยไฟฟ้าเครื่องเดียว

#### 4.1 อัตราตามช่วงเวลาของวัน (Time of Day Tariff : TOD Tariff )

##### อัตรารายเดือน

แรงดัน	ค่าความต้องการพลังไฟฟ้า (บาท/กิโลวัตต์)			ค่าพลังงานไฟฟ้า (บาท/หน่วย) ทุกช่วงเวลา	ค่าบริการ (บาท/เดือน)
	On Peak	Partial Peak	Off Peak		
4.1.1 69 กิโลวัตต์ขึ้นไป	224.30	29.91	0	3.1355	312.24
4.1.2 12 - 24 กิโลวัตต์	285.05	58.88	0	3.1729	312.24
4.1.3 ต่ำกว่า 12 กิโลวัตต์	332.71	68.22	0	3.2009	312.24

On Peak : เวลา 18.30-21.30 น. ของทุกวัน

Partial Peak : เวลา 08.00-18.30 น. ของทุกวัน คิดค่าความต้องการพลังไฟฟ้าเฉพาะส่วนที่เกินจากช่วง On Peak

Off Peak : เวลา 21.30-08.00 น. ของทุกวัน ไม่คิดค่าความต้องการพลังไฟฟ้า

PEA tariff @12-24 kV = 3.17 THB/kWh

New tariff pricing

Bangpoo Project = 2.89 THB/kWh

reduced by 9.69%

Maptaphut Project = 2.73 THB/kWh

reduced by 16.12%

Figure 4-5 PEA Tariff

## **CHAPTER 5**

### **SUMMARY OF RESULTS AND PROBLEMS ENCOUNTERED**

#### **LOCATION SELECTING**

Regarding the information came from internet and government website which using an old data and somehow inadequate information which might causes the evaluate inaccurate.

#### **SOLAR RADIATION INFORMATION**

An averaged solar radiation in Thailand published by DEDE, was measured by solar station in each location and it has been used as a reference for wide area. Therefore, the data may not be precisely.

#### **ESTIMATED PROJECT COST**

Those information was referenced from EGAT research project which it is a small size project. Their might has some differentiated with this big size project.

## REFERENCES

- Erich A. Helfert. (2001). *Financial Analysis Tools and Techniques*. New York: McGraw-Hill
- A.R. Jha. (2010). *Solar Cell Technology and Applications*. New York: CRC Press Taylor & Francis Group
- Albie Fong. (2013). *Project Development in the Solar Industry*. London: CRC Press Taylor & Francis Group
- Dan Chiras. (2009). *Power from the sun achieving energy independence*. Gabriola Island: New Society Publishers
- Peter Gevorkian. (2011). *Large Scale Solar Power System Design An Engineering Guide for Grid Connected Solar Power Generation*. New York: McGraw-Hill
- Zhen-YuZhao, Yu-Long Chen, John Douglas Thomson (2017). Levelized cost of energy modeling for concentrated solar power projects: A China study, *Journal of Energy* 120 (117-127)
- Alireza Haghghat Mamaghani, Sebastian Alberto Avella Escandon, Behzad Najafi, Ali Shirazi, Fabio Rinaldi (2016). Techno-economic feasibility of photovoltaic, wind, diesel and hybrid electrification systems for off-grid rural electrification in Colombia, *Journal of Renewable Energy* 97 (293-305)
- Abdul Ghafoor, Anjum Munir (2015). Design and economics analysis of an off-grid PV system for household electrification, *Journal of Renewable and Sustainable Energy Reviews* 42 (496- 502)
- Shafiqur Rehman, Ibrahim El-Amin (2012). Performance evaluation of an off-grid photovoltaic system in Saudi Arabia, *Journal of Energy* 46 (451-459)
- [www.dede.go.th](http://www.dede.go.th)
- [www.egat.co.th](http://www.egat.co.th)
- [www.cleanenergyreviews.info/blog/2014/5/4/how-solar-works](http://www.cleanenergyreviews.info/blog/2014/5/4/how-solar-works)
- [www.pennarindia.com/systems-products-solar-po-mount.html](http://www.pennarindia.com/systems-products-solar-po-mount.html)
- [www.evergreensolar.com/how/cleaning/](http://www.evergreensolar.com/how/cleaning/)

**APPENDIX**

**CURRICULUM VITAE**

<b>NAME</b>	Ms. Romnalin Chiradejnant
<b>DATE OF BIRTH</b>	21 April 1990
<b>BIRTH PLACE</b>	Bangkok, Thailand
<b>EDUCATION</b>	Industrial Engineer (B.Eng.)
<b>WORK EXPERIENCE</b>	Engineer, Spansion company Engineer, Electricity Generating Authority of Thailand