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Estimation Of Cost Analysis For 500kw Grid Connected Solar Photovoltaic Power Plant By LCOE Simulation.

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Abstract: Solar energy is radiant and heat energy from the sun which is harnessed using variety of technologies including thermal and photovoltaic. It is most reliable and important form of renewable energy which is present in abundance in earth. The high average solar radiation in India and continuous depletion of conventional resources has lead on the urge of utilizing the solar energy as an alternating energy resource to meet up the required demands. therefore, to meet the load demands solar and other renewable energies are tied up with grid. The objective of this work is to estimate the cost for 500kW on-grid solar photovoltaic power plant with the LCOE simulation. The specifications of the data and equipment are provided based on the availability of information in India. The profit is calculated on LCOE and payback period.

Keywords: Solar photovoltaic (SPV), LCOE (levelized cost of electricity), DC (direct current),kW (kilo watt), PPA (power purchase agreement), PV (photovoltaic).

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I. INTRODUCTION

Being a developing country with burden of fuel import, the need of solar energy cannot be over-emphasized. The geographical location of India is vast and favourable for solar energy implementation for use. Electricity harnessed by photovoltaic system is reliable, cost effective and clean as compared to other renewable or non- renewable resources of energy. Solar cells are used to convert light into electricity by the photovoltaic effect.

Further the cells are converted into solar panels further connecting various components like inverters, batteries, controllers etc. With the change in time solar technologies are also evolving in every aspect and it is anticipated that photovoltaic systems will experience an enormous increase in the decades to come. Grid connected, or on-grid PV power generation system has number of advantages over off-grid system and more effective utilization of generated power. Whereas the technical requirements from both the utility power generation system grid side and the photovoltaic system installer and the reliability of the utility grid.

In electricity section the important fundamentals yardsticks are used for cost comparisons, initial capital cost and the levelized cost of electricity. The lifecycle cost analysis of a power plant that is carried on assumptions about the future value of money to convert cost and revenues into the ongoing prices. LCOE is widely used in the power industry but have significant ability to handle risk

II. SOLAR ENERGY & TECHNOLOGY

Term solar energy defines the formation of electricity from the sun that is done with the help of photovoltaic effect processed in solar cell. The working principle of solar cell can be described in the form of P-N junction concept. When the solar cell is exposed under sunlight, the energy from the light is absorbed in depletion region, resulting in movement in holes and free electrons which move in their respective n –type and p-type material. finally, electric power is generated because of electron flow in P-N junction and thus the voltage is produced in depletion region.

Semiconductors are basically used in the formation of solar cells and the crystalline silicone is dominantly used in market because of abundant presence of silicone in our earth. Some other semiconductors which are also used in formation of solar cell are Gallium arsenide (Ga-As) which has a quite effective efficiency in market that is 28.8%, cadmium telluride (CdTe), copper indium gallium serenade (CIGS) etc are some commonly used semiconductors for solar cells.

A photovoltaic system consists of various components named as panels, inverters, cables, transformers, controllers and human resources to make it a complete working model. Further photovoltaic system is divided in two varieties that is on-grid solar photovoltaic power plant and off-grid solar photovoltaic power plant. As per terms itself on-grid power plant is a kind which is connected to the area grid for the power backup and have no

batteries whereas the off-grid solar photovoltaic power plant is standalone system which has no power backup from grid and connects batteries for off time.

Solar energy is also being generated in terms of solar thermal energy, in solar thermal energy the heat from sunlight is being absorbed to heat a medium which is a fluid named water or oil. Fluid absorbs the heat and form steam which is stored, and further later stored steam is used to run the turbines and turn it to mechanical energy resulting in creation of electricity. There are types of solar thermal technology e.g., Parabolic trough, linear Fresnel reflector, parabolic dish, solar towers, etc.

1.1 Photovoltaic

The assumed solar power plant designing is been shown in the table:1 [1] the table is configured with the system advisor module, software which is developed by the National Renewable Energy Laboratory (NREL).

Module: Sun Power SPR-300-WHT-D	
Material	Monocrystalline
Nominal Efficiency	18.4122%
Maximum Power(ppm)	300.303 wdc
Inverter: Power One PVI-CENTRAL-50-US (480) 480 INVERTER	
Maximum AC output	50000 wdc
Manufacturer Efficiency	95.105%
DC to AC ratio	1.1

Table1: Specifications of Power Plant

Irradiance Losses	
Average Soling Losses	5%
DC Losses	
Module and Mismatch	2%
Diode and Connection	0.5%
DC Wiring	2%
AC Losses	
AC Wiring	1%
Step-up Transformer	1%
Availability	
Constant Loss	6%

Table 2: Losses of PV System

Losses in photovoltaic plants are divided in terms like irradiance losses AC losses, DC losses, modules mismatch, constant loss wiring losses etc. the details are given in the table:2 below

2. LCOE MODEL & SCENARIO

In terms of calculating economic feasibility of various generation of electricity for levelized cost of electrify simulation is used. LCOE stands for levelized cost of electrify, it is defined as the price of a unit of energy generated by a certain technology at a time when the present value of the revenues are equals the present value of the total cost during the whole lifetime [2]. To get the economic feasibility in both the on-grid and off-grid solar PV plant LCOE simulation is being used.

Levelized cost of energy (LCOE) also stated as levelized energy cost (LCE) is economic assessment for the setup of power plants by visually assuming the effective values such as lifetime period of power plant initial cost which will be required after considering various auxiliaries involved in the process and the reliefs provide by the government in the form of subsidies which vary for different investment slabs. It is considered as the LCOE is the minimum amount for the establishment of the solar power plant and at which the energy must be sold after the establishment of the power plant. Typically, LCOEs are calculated for a long period of time such as 25-30 years as per the provided data for the per kW cost.

$$LCOE_{residential} \approx \frac{PC - CBI - PVPBI + \sum_{n=1}^{N} \frac{LP_n}{(1+d)^n} - \sum_{n=1}^{N} \frac{INT_n}{(1+d)^n} * ETR + \sum_{n=1}^{N} \frac{OM_n}{(1+d)^n}}{\sum_{n=1}^{N} \frac{EO_n}{(1+d)^n}}$$

LCOE= Levelized Cost of Electricity
PC= Project cost in initial year
CBI= Cost based incentive
OM_n= Operations & maintenance (e.g., Inverter replacement cost) in period n
EO_n= Energy output in period n
d= Discount rate
PVPBI= Present value of performance benefit incentive
LP_n= Loan period in period n
INT_n= Interest payment in period n
ETR= Effective tax rate
n= Expected lifetime of plant

2.1 LCOE Input:

System Inputs	
Initial Cost Inputs	Rs85,84,000
System Size (KW-DC)	500
1st Year Production (kWh)	7,25,000
Annual Degradation	0.80%
Direct Purchase Inputs	
Cost (Rs/W)	Rs 17.168
Initial Rebate/Incentives	Rs 12,01,760
O&M Cost	Rs 2,230
O&M Escalator (%)	5%
PPA Inputs	
PPA Rates (Rs/kW)	Rs 6.86
PPA Escalator	0.01%

2.2 LCOE Output:

Direct Purchase	
20 Years	Rs 3.29023
25 Years	Rs 3.67546
PPA	
20 Years	Rs 9.14435
25 Years	Rs 9.88240

3.3 Payback Period Calculation:

Payback period is be defined as the period in which we earn the initial input cost it is simply denoted as X/Y. where, X- stands for total cost for PV system with all the auxiliary equipment. Y-total annual cost saving after installation of PV system. Payback period is 9 years.

3.4 Profit After Payback Period Till Useful Life Of SPV

The useful period of SPV system is of about 25years and we calculated the payback period of 9 years, so calculation the useful years is 15 years and the by multiplying the profit per year after payback years is roughly 39crores.

III. CONCLUSION:

The LCOE simulation calculated for 25 years is Rs 3.29023. in which the payback period calculated was 9 years, which means the initial capital invested in the SPV will get played in first 9 years itself rest calculated 15 years which is stated as profit after payback period till useful life of SPV is period in which the SPV will earn the profit other than the initial capital. The methodology adopted seems satisfactory for determining the plant capacity for as calculated 65,714.8 m^2.

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REFERENCES:

[1]. Zoheb Hasan khan, Savita Maurya, Ramayna, Swati Agariya.
[2]. Vinay Janarsan Shetty and Keerti Kulkarni “Cost analysis estimation of 500kw grid connected solar photovoltaic plant: a case study” India 2014.
[3]. Normaz Lina Mat Isa, Chee Wei Tan, AHM Yatim “A technoeconomic assessment of grid connected photovoltaic system for hospital building” 2016.
[4]. K. Azizian, M. Yoghoubi, R. Hesami, P. Kanan “Design analysis for Shizan Solar power plant to 500kW power generation capacity” 2011.
[5]. Tarjanne Risto, Kivisto Aija “Comparison of electricity generation costs”.2008.
[6]. Seth B. Arling, Fengiqui You, Thomas Veselka and Alfonso Velosa “Assumptions of photovoltaic system and the levelized cost of energy".

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