

# PREFEASIBILITY ANALYSIS OF GRID-CONNECTED DUAL AXIS TRACKER PV SYSTEM

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**Abstract:** Utility coupled PV systems, however the quickest developing sustainable power source innovation on the planet, have not been completely use in India; one reason being the high starting cost. Costs of sunlight based PV system have however been on a decrease for as far back as couple of years because of mechanical developments which have prompted changes in cell efficiencies and the economies of scale coming about because of increment underway. The primary reason for this paper is to show a specialized and financial examination of matrix associated sun based photovoltaic power system for the Bhopal. A sun oriented resource analysis done to know the measure of sunlight based radiation accessible at Bhopal demonstrated that Bhopal gets radiation 5.08kWh/m<sup>2</sup>/day. The economic investigation helped out utilizing RETScreen through dual axis tracker and uncovered that at a grid associated sunlight based PV double axis tracker mode has 35% more output power and cost effective as compare to fixed axis tracker PV system. The reduction in the cost of green house gas is 639\$to2.The Dual axis PV system benefit to cost ration is 18, total net present cost is 311060\$ and annual life cycle saving is 22070\$.

## I. INTRODUCTION

Energy has dependably been one of the greatest challenges of sustainability. After many years of relying upon non-renewable energy sources like coal, oil and petroleum gas, our energy utilization posts immense stresses on human wellbeing and nature. The negative externalities of non-renewable energy sources happen in all procedures from the extraction of assets to the contamination discharged after utilization. While endeavouring to limit the reliance on non-renewable energy source, sustainable power sources have turned out to be more into the focal point of the stage. Other than being more clean wellsprings of energy, sustainable power sources have encountered a fast development and turn out to be more available throughout the years [1-5]. Then again, non-renewable energy sources slowly deplete and move toward becoming more costly. One of the most astounding potential sustainable power sources is sunlight based photovoltaic (PV) technology. Fig 1 shows the Basic model of grid-connected PV system.

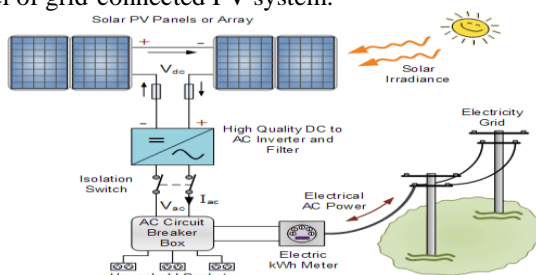


Fig.1 Basic model of grid-connected PV system

There are numerous financial assessments and studies analyzing the gainfulness and risk of PV innovation's speculation decisions and additionally applicable vitality approaches. The parts of those examinations are different and can be inexactly ordered in those concentrating on basic decision-making process [6], those fixating on net advantages of certain PV projects [7] and those concentrating on technology's [8]. Additionally, some of these examine vitality approaches and PV. Considering private speculators as the key player of PV innovation project, an evaluation on speculation decisions will give better comprehension on the way of PV innovation and speculation openings and obstructions. This will likewise reinforce the private financial specialists' techniques and the arrangement plans for better backings on PV technology.

## II. PHOTOVOLTAIC ARRANGEMENT

Solar cells are electrical devices within the kind solid which will facilitate to convert energy from solar light-weight into electric energy with the method of electrical phenomenon impact. Once varieties of solar cells are being clustered along, then they're referred to as solar arrays that along save energy from daylight and convert into electricity. Once the arrangements of solar modules are being done at an area, it results into an electrical device Associate in Nursing once modules are being done at an area then it's referred to as arrays. The energy generated from this integrated cluster of solar battery or module is understood as solar energy. The solar cells are referred as electrical phenomenon cells or the PV cells. Because the name itself suggests, exposure means that light-weight whereas voltaic see electricity. In alternative words, electrical phenomenon cells will facilitate faucet into the potential of solar power to get electrical phenomenon.

### PHOTOVOLTAIC CELL

PV cells are ordinarily product of semiconductor materials, like element and different material. In twenty-one solar cells, for making an electrical field, ordinarily skinny semiconductor wafer is employed to form positive on one facet and negative on the opposite. Once solar lightweight consisting energy strikes on the photovoltaic cell, electrons from the atoms within the semiconductor material of photovoltaic cell. If electrical conductors are connected to the positive and negative sides, forming associate degree electrical device, the electrons may be captured within the type of an electrical current - that's, electricity. This electricity will then be wont to power a load. A PV cell will either be circular or sq. in construction [9].

### PHOTOVOLTAIC MODEL

Due to the low voltage generated from a PV cell (around zero.5V), which isn't comfortable for any application thus

we'd like to use many PV cells to spice up the voltage and power thence many PV cells area unit connected nonparallel (for increasing voltage) and in parallel (for increasing current) to create a PV module or PV arrays for desired output in terms of voltage and power. Multiple diodes area unit needed to avoid reverse saturation currents, just in case of partial or total shading, and at the hours of darkness con. The p-n junctions of mono-crystalline semiconducting material cells might have adequate reverse current characteristics and these aren't necessary. Reverse currents waste power and might conjointly cause warming of shaded cells. Solar cells dwindle economical at higher temperatures and installers attempt to give smart ventilation behind solar panels [10],[11].

**PHOTOVOLTAIC ARRAY**

The power that one module will manufacture isn't adequate to satisfy the necessities of home or business. Most PV arrays use associate degree electrical converter to convert the DC power into AC that may power the motors, loads, lights etc. The modules in a very PV array square measure sometimes initial connected nonparallel to get the required voltages; the individual modules square measure then connected in parallel to permit the system to supply a lot of current [12]. Fig 2 shows the arrangement of PV system.

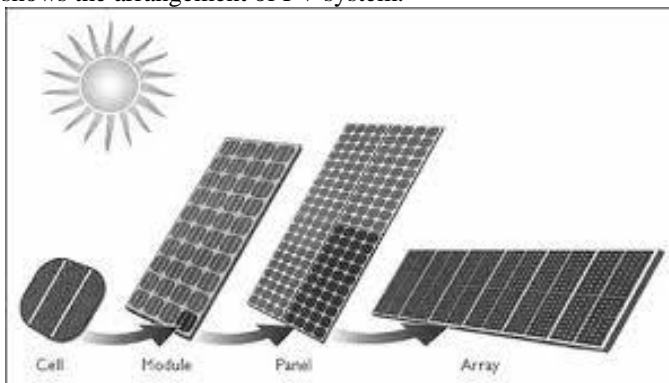


Fig 2 shows the arrangement of PV system

Details of PV used in design of grid-connected system:

The design location selected as Bhopal MP for PV system. This location has great potential of solar radiation. The climate data location at latitude 22.3N and longitude 77.4 E. The daily solar radiation horizontally is 5.08Kwh/m2/day of PV system design location. The type of PV system is mono-Si - SPR-320E-WHT has 46 unit of array to satisfy the load demand. The efficiency of the PV array is 19.6%, nominal operating cell temperature and operating co-efficient are 0 0C and 0.38% respectively. The solar collector area is 75m2 and miscellaneous losses considered as 1%. The Maximum power point tracker (MPPT) method is use to measure maximum output power of solar PV array. The design location of PV system is Bhopal, MP India. This location at latitude 23.3 North and longitude 77.4 East. The daily solar radiation horizontal is 5.08kWh/m2/d.

**III. LOAD DATA OF DESIGN LOCATION**

Load profile is considered as central-grid & internal load. The proposed grid associated PV system is helpful for both central-grid and off-grid system supply without batteries.

Power Load interest for outline of sunlight based photovoltaic system is on- grid associated which utility supply system. On-grid applications cover both central-grid & off-grid systems without batteries. The proficiency of system associated system PV system is higher as stand out from off-grid systems application in light of the fact that if PV system yield is not fulfill the load necessity in view of atmosphere condition The Peak stack – yearly is 3kW. The load profile of plan area is appeared in fig 4.



Fig 4 load profile of design location

**IV. PV SYSTEM DESIGN SOFTWARE**

The item facilitates different databases to help the customer, including an overall database of climatic conditions got from 6,700 ground-based stations and NASA's satellite data; benchmark database; wander database; hydrology database and thing database [13]. The item furthermore consolidates clean vitality extend and intelligent tool compartment, and furthermore a ton of multilingual and intuitive media free get ready material, including an electronic textbook [14]. RETScreen is an item program made by Natural Resource Canada(a) furthermore, available for open use for probability examination of clean vitality extend, including imperativeness compelling advances sustainable power source systems, for example, wind vitality, minute hydro, photovoltaic, biomass warming, sun oriented air warming, sunlight based dihydrogen monoxide heating, passive sun oriented warming, ground-source warm pump, and cumulated warmth and power ventures. RETScreen programming model stream a five-stage standard examination such as energy model, cost analysis, emission model financial summary and Sensitivity and Risk Analysis. Fig 3 shows Retscreen model of theoretical schematic diagram of advancement of preliminary arrangement parameters for a single renewable energy system.

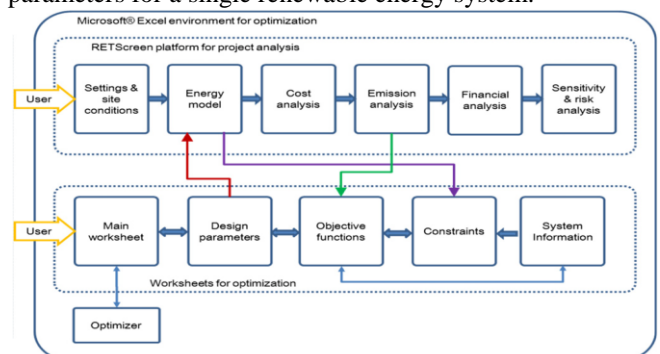


Figure 3 Theoretical schematic diagram of advancement of preliminary arrangement parameters for a single renewable energy system.

V. RESULT AND DISCUSSION

In this grid connected PV system, Dual axis tracker mode of PV is considered. A tracker is a device supporting the solar collector which moves the collector in a prescribed way to minimise the angle of incidence of beam radiation on the collector's surface. Hence incident beam radiation (i.e. solar energy collected) is maximized. Solar trackers may be classified as follows as fixed axis, one axis and dual axis. In this proposed work dual axis mode of PV system taken because it output power is more as compare fixed and one axis tracking mode of PV system.

Cumulative cash flows graph:

The model calculates the cumulative cash flows, which represent the net pre-tax flows accumulated from year 0. The net pre-tax cash flows are the yearly net flows of cash for the project before income tax.

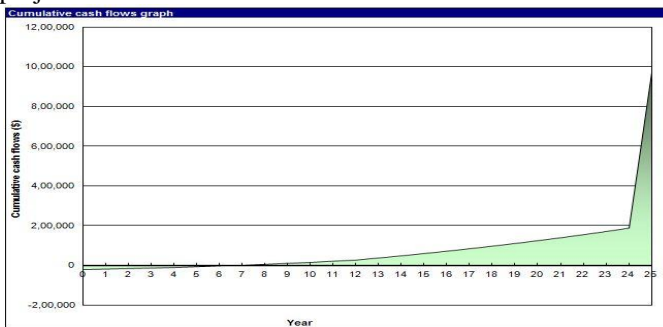


Fig 5 Cumulative cash flows graph

It represents the estimated sum of cash that will be paid or received each year during the entire life of the project. Note that the equity is assumed to occur at the end of year 0 and that year 1 is the first year of operation of the project. Annual costs, savings and income, which reflect amounts valid for year 0, are thus escalated one year in order to determine the actual costs and savings and income incurred during the first year of operation (i.e. year 1). Fig 5 clearly show that profit gain after six year and profit increase till the PV system life time as 25 years. As part of the RETScreen Clean Energy Project Analysis Software, a Sensitivity and Risk Analysis worksheet is provided to help the user estimate the sensitivity of important financial indicators in relation to key technical and financial parameters. This standard sensitivity and risk analysis worksheet contains a settings section and two main sections: Sensitivity analysis and Risk analysis. Each section provides information on the relationship between the key parameters and the important financial indicators, showing the parameters which have the greatest impact on the financial indicators. The Sensitivity analysis section is intended for general use, while the Risk analysis section, which performs a Monte Carlo simulation, is intended for users with knowledge of statistics. Both types of analysis are optional. Inputs entered in this worksheet will not affect results in other worksheets. Fig 6 & 7 shows Sensitivity and Risk Analysis. The sensitivity analysis of electricity export rate with initial cost and operation & maintenance cost. Also sensitivity analysis calculated for debt ratio with debt interest rate.

Sensitivity analysis						
Perform analysis on		After-tax IRR - equity				
Sensitivity range		20%				
Threshold		15 %				
<b>Initial costs</b>		<b>Electricity export rate</b>				
	\$	130.80	147.15	163.50	179.85	196.20
		-20%	-10%	0%	10%	20%
	48,791	27.2%	28.9%	30.7%	32.7%	34.7%
	54,890	-10%	24.5%	25.9%	27.3%	28.9%
	60,989	0%	22.4%	23.6%	24.8%	26.1%
	67,088	10%	20.8%	21.8%	22.8%	23.9%
	73,187	20%	19.5%	20.4%	21.2%	22.2%
<b>O&amp;M</b>		<b>Electricity export rate</b>				
	\$	130.80	147.15	163.50	179.85	196.20
		-20%	-10%	0%	10%	20%
	88	-20%	22.5%	23.6%	24.8%	26.1%
	99	-10%	22.5%	23.6%	24.8%	26.1%
	110	0%	22.4%	23.6%	24.8%	26.1%
	121	10%	22.4%	23.5%	24.7%	26.0%
	132	20%	22.4%	23.5%	24.7%	26.0%
<b>Debt interest rate</b>		<b>Debt ratio</b>				
	%	56%	63%	70%	77%	84%
		-20%	-10%	0%	10%	20%
	1.80%	-20%	22.2%	23.4%	25.1%	27.3%
	2.03%	-10%	22.1%	23.3%	24.9%	27.1%
	2.25%	0%	22.0%	23.2%	24.8%	26.9%
	2.48%	10%	22.0%	23.1%	24.6%	26.7%
	2.70%	20%	21.9%	23.0%	24.5%	26.5%

Fig 5 Sensitivity Analysis

Risk analysis is calculated by taking various parameters such as initial cost, O & M cost, fuel cost, debt ratio, interest rate, and debt term in the range of 20%, 15%, 5%, 15%, 5%, 30% and 0% respectively.

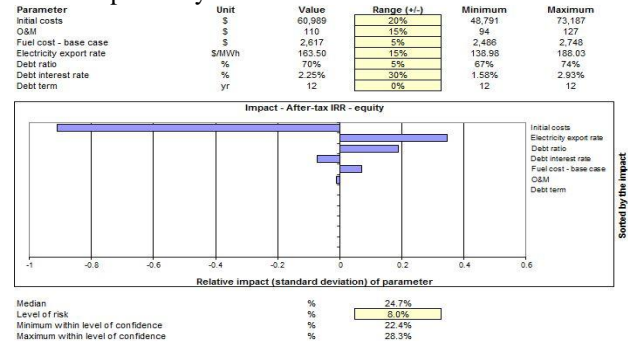


Fig 6 Risk Analysis

VI. CONCLUSION

The proposed grid connected PV system by considering dual axis tracker mode of PV. This system is more efficient and feasible to the fixed and one axis tracker mode. The RETScreen software calculate various input parameters such as cost of each design element, emission factors, load data and energy model. The output result of the software in form of befits in term of cost, reduction in green house gas (GHS) etc. This grid-connected PV system has reduction in GHG is 638\$to<sub>2</sub> total net present cost is 3110660\$ and benefit to cost ratio is 18 during the project life of system. This proposed system is more environments friendly and cost effective.

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