Innovative: International Multi-disciplinary Journal of Applied Technology
(ISSN 2995-486X) VOLUME 02 ISSUE 11, 2024

Study & Technical Analysis of on Grid Solar Power Plant in Different Regions in India

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Abstract:

One unusual energy source is solar power. Since ancient times, people have utilized a range of technologies to capture solar energy. Solar radiation and secondary solar-powered resources such as biomass, hydroelectricity, wind, and wave power provide most of the non-conventional energy currently available on Earth. Only a small percentage of the available solar energy is utilized. Solar-powered electricity generation requires heat engines and photovoltaic systems. Human ingenuity is the only thing limiting the uses of solar energy. The most common way to harvest solar energy is with photovoltaic panels, which convert photon energy from the sun into electrical energy. Solar technologies are typically divided into two categories based on their intended use.

Keywords: Grid connected solar plant, PV plant, Roof top solar plant, Solar energy, solar plant installation, solar system.

Introduction:-

India's need for electricity is growing at a startling rate every day. Coal, liquid fuels, gaseous fuels, and other energy-generating resources are scarce. The best course of action is to use renewable energy resources because the supply of these resources is steadily declining while demand is rising. The sun is the best alternative for producing energy, based on the climate in India. Eco-friendly and pure energy is produced by the sun. Earth receives some of the solar energy. This component is known as solar irradiance. 1360 W/m2 is the intensity of this solar energy [1].

A solitary photovoltaic cell produces a negligible amount of power as an output. Consequently, we connect a large number of PV cells on a plate to increase the output power fraction. The name of that plate is PV module. These PV modules are connected in series or parallel, depending on the power demand, to increase output power, or to increase voltage and current [2]. The Indian government has launched the "Jawahar Lal Nehru National Solar Mission (JNNSM)" as a solar mission. Increasing the use of renewable energy resources is the aim of this program. This mission has a cost-effective target of producing 20,000 MW of solar power [3].

Depending on their storage systems, solar plants are classified into two types.

a) The entire system in an off-grid solar plant is disconnected from the local grid. For the purpose of using solar power during cloudy days or at night, we must use local batteries. Because batteries in the storage system need to be changed on a regular basis for optimal efficiency, off-grid solar plants are more expensive [4].

PVSyst required Input:

The design of a photovoltaic system is totally depend upon location because every location receives different amount of solar radiation. It happens due to the position of that particular location with respect to sun. This difference of position is observed in the form of unique set of parameters like latitude, longitude andaltitude of a location [7,8].

Table 3 Meteorological and System Data

Parameter	Location: JSPM Wagholi
Latitude Longitude Tilt Angle Azumith Angle Albedo PV system size PV module Inverter Battery	18.58°N 74.00°E 18° 0° 0.2 1KW SS330P36C Microtech1734 VA, 230V Amron quanta 42Ah,12V

Load Forecasting:

Table 4 Load Forecasting

Equipment	Numbers	Power Rating per equipment	Daily Usage	Energy Consumption
Computer	3	120W	4hr/day	1440Whr/day
Lamp	5	16W per lamp	8hr/day	640Whr/day
Domestic use	1	511w per app.	5.5hr/day	2811Whr/day
Stand by consumer	-	-	24hr/day	24whr/day
Total				**4915Whr/day**

A detailed report consisting of various graphs and tables obtained using PVSyst software is presented in this section. One inverter of l734 VA and 3 modules of 330 Wp each are required for this system. The output power is obtained after applying all necessary efficiency corrections. System simulation results are shown in Table 5.

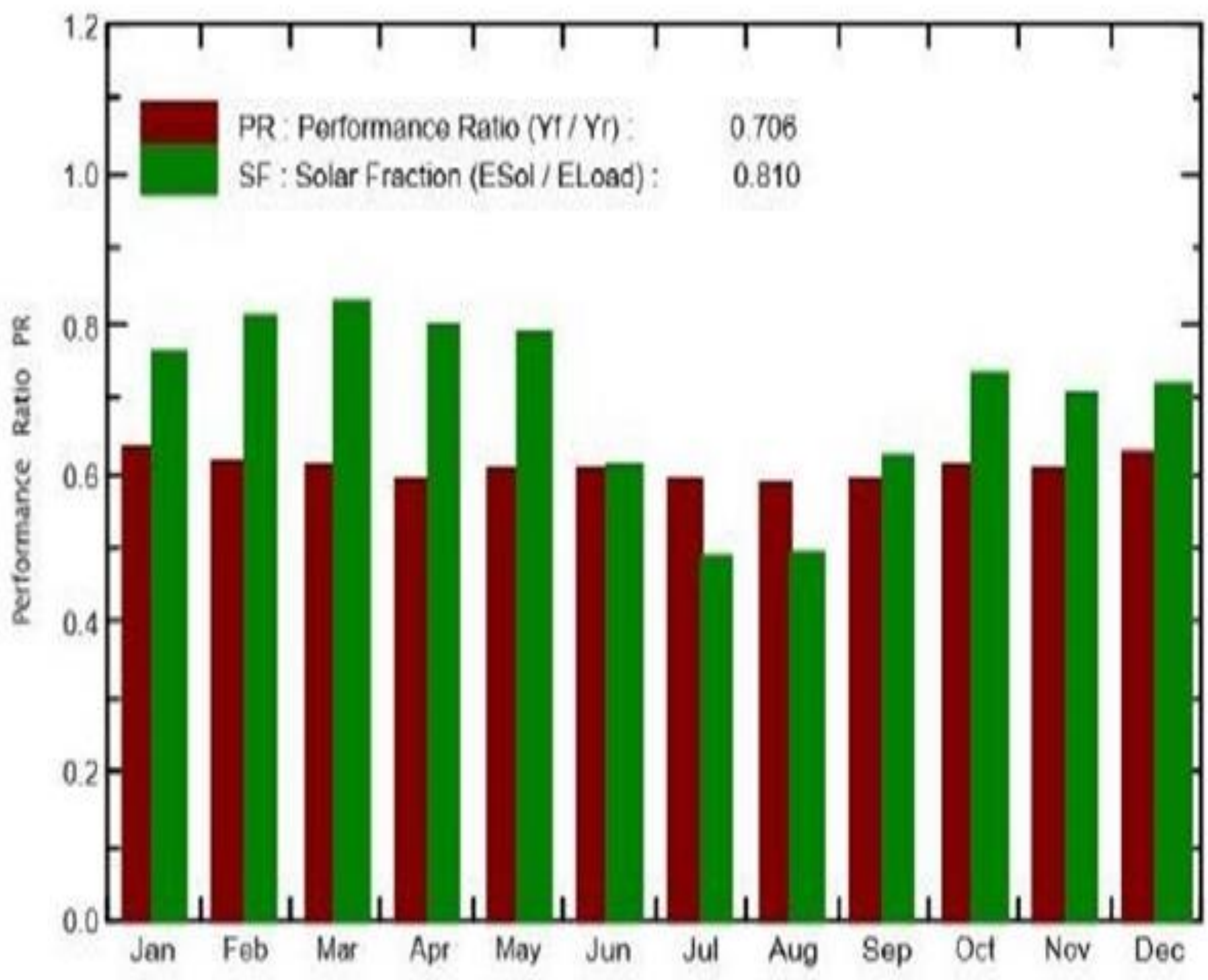
The global horizontal radiation data taken as input to the software are measured data obtained from pyranometers installed at Pune. Yearly total incident global horizontal radiation of 2052.2 kWh/m^2

is given as input to the system. Where Glob Hor- Horizontal global irradiation, Glob Eff- Effective Global, E Avail- Available Solar Energy, E Unused -Unused energy (full battery) loss, E Miss-Missing energy, E User- Energy supplied to the user, E Load- Energy need of the user (Load) and Sol Frac- Solar fraction (E Used / ELoad)

Performance ratio (PR)

Performance ratio (PR) is used to evaluate the performance of the PV plant. Performance ratio of the system is the ratio of energy output of the system and radiation incident on the given area. It is presented in fig c. It is around 0.7 for most of the months in a year which is satisfactory for a system as small as this. The solar fraction is near about 0.8.

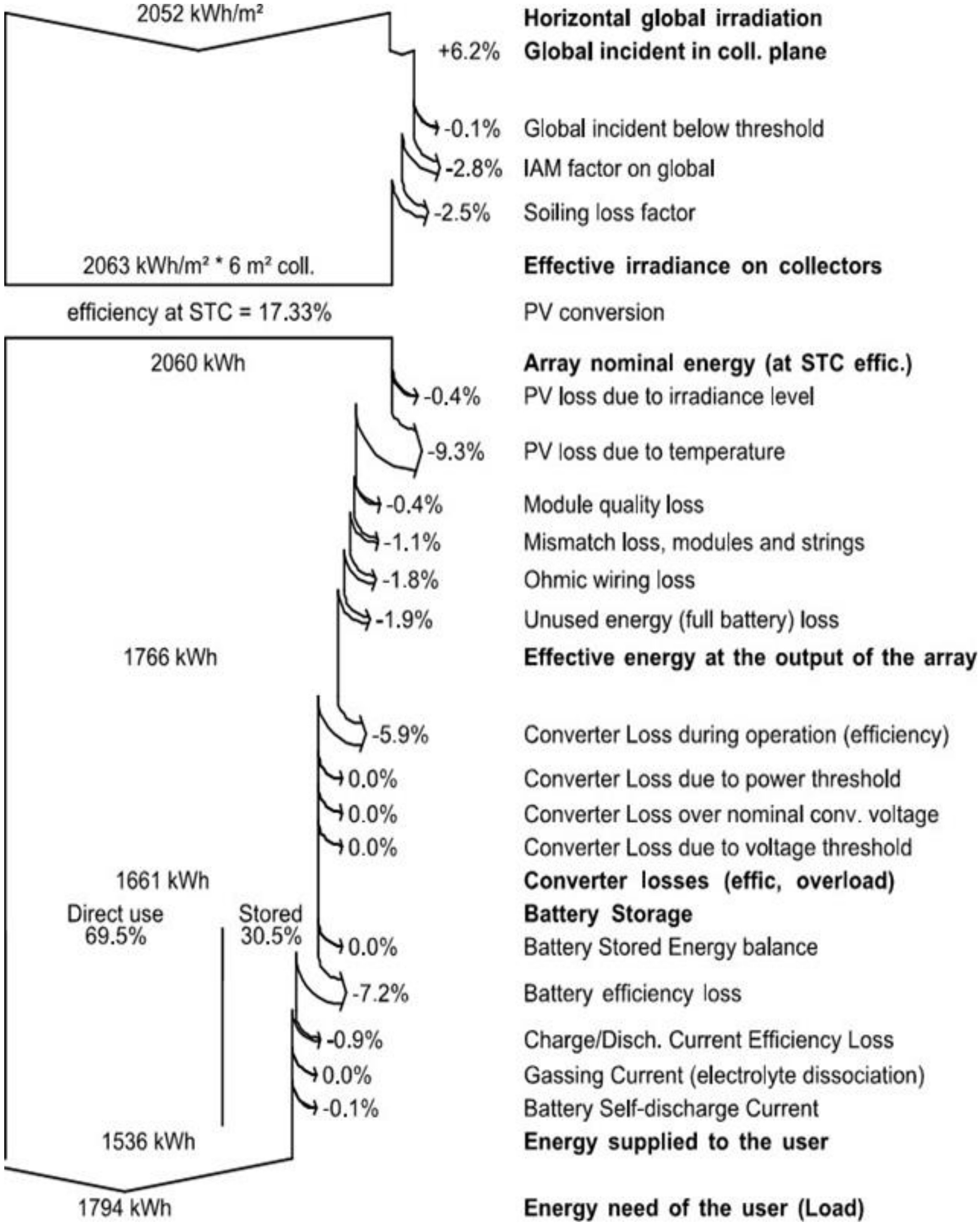
Fig 4 : Performance ratio chart



Loss diagram

Loss diagram shows all the losses that occur in the system step by step. At the output 1453 kWh of energy is obtained from the system. A number of losses occur in photovoltaic module and array. Wiring loss, module quality loss and module mismatch this losses are mainly depend upon temperature.

Fig.5 Loss Diagram



Result and Discussion :

Here we will discuss the result with four different cases.

CASE 1: EAST ZONE (LUCKNOW)

	Temp Loss kWh	Ohm Loss kWh	I Array Ah	U Array V	IL Oper kWh	Syst_ON Hour	E Out Inv kWh	EUseful kWh	PR ratio
Jan	527	79.4	14672.8	272.2	154.9	0	9324	9324	0.884
Feb	1090	116.9	18272.1	288.0	175.4	0	11239	11239	0.857
Mar	2130	177.3	24934.5	292.3	218.8	0	14768	14768	0.822
April	2378	164.0	23952.4	300.8	207.6	0	13831	13831	0.801
May	2378	154.3	23888.7	318.4	215.7	0	13685	13685	0.795
Jun	1788	114.8	19691.8	333.5	198.6	0	11439	11439	0.806
July	1275	86.8	16680.5	328.9	180.4	0	9883	9883	0.820
Aug	1381	97.4	17861.1	315.0	181.3	0	10611	10611	0.822
Sept	1446	107.7	17682.7	301.9	176.7	0	10454	10454	0.818
Oct	1539	118.6	18836.1	281.0	184.6	0	11154	11154	0.825
Nov	889	84.3	15614.0	265.8	153.3	0	9602	9602	0.858
Dec	633	81.7	15363.0	267.2	155.6	0	9684	9684	0.880
Year	17507	1383.2	227449.6	297.1	2202.9	0	135674	135674	0.829

The customized table is as shown below including many variable factors of this on grid 100KW power plant.

Case 2 : WEST ZONE (JAIPUR)

	Temp Loss kWh	Ohm Loss kWh	I Array Ah	UArray V	IL_Oper kWh	Syst_ON Hour	EOut Inv kWh	EUseful kWh	PR ratio
Jan	1162	144.9	170.1	33704.8	187.3	13312	13312	13312	0.871
Feb	1688	173.9	182.5	37252.5	195.6	14324	14324	14324	0.848
Mar	2562	211.4	180.4	43166.9	217.3	15990	15990	15990	0.814
April	2831	198.7	201.6	42555.8	224.9	15448	15448	15448	0.797
May	2763	170.5	201.3	40256.4	209.6	14518	14518	14518	0.789
Jun	2193	138.0	206.3	35914.1	193.0	13200	13200	13200	0.804
July	1580	109.2	210.7	30977.4	185.2	11653	11653	11653	0.822
Aug	1579	117.4	205.8	31543.9	189.6	11903	11903	11903	0.825
Sept	1999	149.0	189.8	34874.8	192.3	12952	12952	12952	0.815
Oct	2198	167.6	174.6	37323.0	195.3	13831	13831	13831	0.815
Nov	1522	139.9	167.9	33502.1	175.7	12868	12868	12868	0.846
Dec	1250	140.7	167.5	33457.2	184.7	13121	13121	13121	0.865
Year	23326	1861.2	188.2	434528.8	2350.6	163119	163119	163119	0.824

CASE 3 : NORTH ZONE (DELHI)

	Temp Loss kWh	Ohm Loss kWh	I Array Ah	U Array V	IL_Oper kWh	Syst_ON Hour	EOut Inv kWh	EUseful kWh	PR ratio
Jan	537	85.1	28577.3	146.8	164.6	0	9926	9926	0.890
Feb	1110	125.3	35182.4	155.4	179.7	0	11813	11813	0.862
Mar	1997	176.6	46105.6	155.7	217.7	0	14966	14966	0.832
April	2429	173.2	45936.6	171.3	223.9	0	14457	14457	0.806
May	2547	163.4	45294.6	174.3	221.4	0	14091	14091	0.795
Jun	2092	132.6	40700.9	177.4	202.0	0	12841	12841	0.805
July	1609	108.7	35988.8	179.7	193.7	0	11556	11556	0.819
Aug	1697	120.1	36875.5	174.2	196.4	0	11804	11804	0.817
Sept	1819	134.7	39090.6	165.1	199.5	0	12527	12527	0.820
Oct	1654	128.9	37376.3	152.8	191.7	0	12065	12065	0.828
Nov	914	90.8	30128.4	144.5	157.7	0	10130	10130	0.862
Dec	665	88.3	29418.7	143.7	163.5	0	10116	10116	0.882
Year	19071	1527.7	450675.5	161.8	2311.6	0	146294	146294	0.831

CASE 4 : SOUTH ZONE (BHOPAL)

	Temp Loss kWh	Ohm Loss kWh	I Array Ah	U Array V	IL_Oper kWh	Syst_ON Hour	EOut Inv kWh	EUseful kWh	PR Ratio
Jan	1162	144.9	170.1	33704.8	187.3	13312	13312	13312	0.871
Feb	1688	173.9	182.5	37252.5	195.6	14324	14324	14324	0.848
Mar	2562	211.4	180.4	43166.9	217.3	15990	15990	15990	0.814
April	2831	198.7	201.6	42555.8	224.9	15448	15448	15448	0.797
May	2763	170.5	201.3	40256.4	209.6	14518	14518	14518	0.789
Jun	2193	138.0	206.3	35914.1	193.0	13200	13200	13200	0.804
July	1580	109.2	210.7	30977.4	185.2	11653	11653	11653	0.822
Aug	1579	117.4	205.8	31543.9	189.6	11903	11903	11903	0.825
Sept	1999	149.0	189.8	34874.8	192.3	12952	12952	12952	0.815
Oct	2198	167.6	174.6	37323.0	195.3	13831	13831	13831	0.815
Nov	1522	139.9	167.9	33502.1	175.7	12868	12868	12868	0.846
Dec	1250	140.7	167.5	33457.2	184.7	13121	13121	13121	0.865
Year	23326	1861.2	188.2	434528.8	2350.6	163119	163119	163119	0.824

Conclusion :

From the entire results of these four different zones and locations , on comparison we found that the Performance ratio of the west zone I.e. Jaipur is best and is 83.1 % among all of the other zones.

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