

REST Journal on Emerging trends in Modelling and Manufacturing

Vol: 11(2), June 2025

REST Publisher; ISSN: 2455-4537 (Online)

Website: <https://restpublisher.com/journals/jemm/>

DOI: <https://doi.org/10.46632/jemm/11/2/6>



Mathematically Modeling of Photovoltaic Generator

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Abstract: The study of Photovoltaic generator is used 1 kW PV. The solar radiation data of the School of energy Environmental studies from D.A.V.V Indore are analyzed for output of the solar radiation (renewable energy). The sun irradiance was through the year 2024 Jan. to Dec. period, to be considered for the output power of photovoltaic generator calculations from the Jan to Dec 2024.

Keywords: Hybrid system; Wind speed; Photovoltaic; solar radiation.

1. MATHEMATICALLY MODELING OF PHOTOVOLTAIC GENERATOR

A Photovoltaic system converts sunlight irradiation into electrical energy. The tool responsible for this conversion is Photovoltaic cells, silicon is the most common material used in the manufacturing Photovoltaic cells, **Diego B. et al. 2019.**

The output of PV generator (KWh) can be calculated based on the Eq. (1). This equation is used by many researchers related to mathematically modeling of Photovoltaic power generation (**Tao Ma. 2019, Muhammad Shahzad Javed 2019, Makbul A.M. Ramli 2016**)

Power output of the PV array is expressed as

$$P_{PV}(t) = P_R \cdot f_R \cdot (G_T(t) / G_S) \tag{1}$$

Where P_R is PV module rated power (kW) output, f_R is loss factor or derating factor (%) of PV module due to dirt, shadow and temperature etc., derating factor (f_R) of 80% is employed in this study G_T is hourly global solar radiation on PV module surface (KW/m^2) G_S is standard incident radiation ($1000W/m^2$).

TABLE 1. Monthly average solar radiation Jan. to Dec. 2024 by Solar electricity handbook 2019, Indore MP (India)

	Months	Solar Irradiation KWh/m ²
P1	Jan	4.46
P2	Feb	5.31
P3	Mar	6.13
P4	Apr	6.52
P5	May	6.72
P6	Jun	5.51
P7	Jul	4.24
P8	Aug	3.73
P9	Sep	4.65
P10	Oct	5.12
P11	Nov	4.64
P12	Dec	4.20

TABLE 2. Monthly average output power of Photovoltaic generator on different solar radiation Jan. to Dec. 2024 location of Indore MP (India)

	Months (2019)	Solar Irradiation kWh/m ² (2019)	Output power of Photovoltaic generator on different solar radiation(2024)
P1	Jan	4.46	0.78
P2	Feb	5.31	0.931
P3	Mar	6.13	1.07
P4	Apr	6.52	1.14
P5	May	6.72	1.17
P6	Jun	5.51	0.96
P7	Jul	4.24	0.74
P8	Aug	3.73	0.65
P9	Sep	4.65	0.81
P10	Oct	5.12	0.89
P11	Nov	4.64	0.81
P12	Dec	4.20	0.73

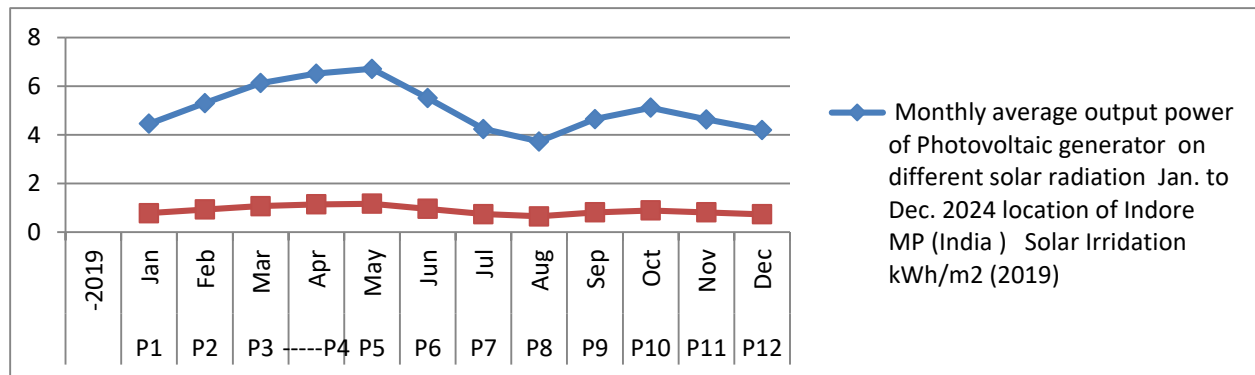


FIGURE 1. Monthly average output power of Photovoltaic generator on different solar radiation Jan. to Dec. 2024 location of Indore MP (India)

2. CONCLUSION

Photovoltaic system is a suitable solution for clean energy production. In this paper, a new Photovoltaic system has been proposed and implemented. The photovoltaic system of power generation was developed by using mathematical modeling. Analyzing the solar radiation data location of the school of Energy Environmental studies from D.A.V.V Indore for calculating output power of the photovoltaic generator. The solar radiation is 6.72 kWh/m² for particular location and maximum output of photovoltaic Generator is 1.17 Output of photovoltaic generator system is dependent on different parameters like solar radiation, PV module, loss factor of PV module due to dust. It is concluded that by changing some parameters, output of Photovoltaic generation system can be changed.

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