

# Solar Power Analysis Based Temperature

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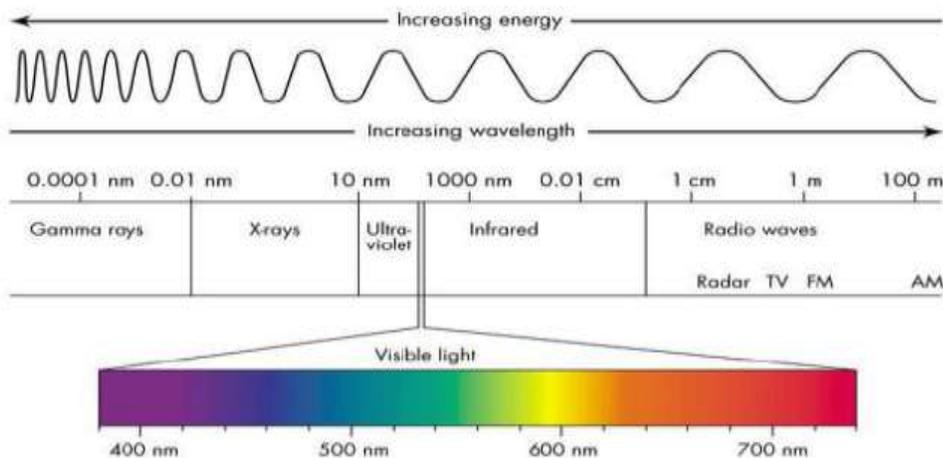
## ABSTRACT

The recent decades have seen the increase in solar power demand for reliable and clean sources electricity. The generation of solar power is based on the sun rays intensity on the solar panel and the wavelength. The challenge in solar power plant is to maximize the wavelength of the rays from the sun and minimize the temperature effect on the Panel. This paper analysis the solar panel based on temperature effect. Thus solar power plant efficiency increased by the wavelength and minimizes the temperature.

**Keywords:** efficiency, solar power, , tracking, sun rays, intensity, solar panel.

## I. INTRODUCTION

Electrical energy from solar panels is derived by converting energy from the rays of the sun into electrical current in the solar cells. The challenge in solar cell is to maximize the wavelength the rays of the sun upon the solar panels and minimize the temperature effect on the solar panel. which in turn maximizes the output of electricity. Solar cell response is dependent upon the wavelength of sunlight and temperature effect on the panel. The conversion of solar light into electrical energy represents one of the most promising and challenging energetic technologies, being clean, silent in continuous development, and reliable, with very low maintenance costs and minimal ecological impact. The energy from is free, practically inexhaustible, and involves non polluting residues or greenhouse gases emissions.[3] The conversion principle of solar light into electricity, called PV conversion. The PV conversion is not very new, but the efficiency improvement of the equipment is still one of top priorities for many academic and/or industrial research groups all over the world[3]. Light is combination of different colors. The light which we can see is called visible light and has colors from purple to red as shown in Fig-1. These different colors of light have different wavelengths and energies. There is also a lot of light that our eyes can't see! Light that is lower in energy than visible light we call **Infrared** or **IR** light. Your task is to determine what colors of light from a lamp and from sunlight work in a solar cell[1].



**Fig-1: Light spectrum based on wavelength**

In this paper we are simulating the solar panel based on the different colors like Red, Blue and green to change the wavelength on the panel and observing the output of panel based on wavelength & temperature.

This paper is organized as follows. Section II outline the different factor for wavelength spectrum. Section III It will explain the effect of temperature on the solar panel. Section IV Result analysis based on wavelength and temperature. Finally V draws the conclusions.

## II. PHOTOVOLTAIC CELL MAKING USE OF LIGHT ENERGY

The silicon atoms in a photovoltaic cell absorb energy from light wavelengths that roughly correspond to the visible spectrum. The cell made up silicon, which is mixed with two different impurities that produce positive and negative charges. Light causes the charges to move the electrons and producing an electric current. Material containing different impurities charges for different the wavelengths. The photovoltaic cell does not convert complete light into electric charge, even if it's at the right wavelengths. Some of the energy becomes heat and some reflects off the cell's surface.

## III. SPECTRAL RESPONSE

Spectral response is the ratio of the current generated by the solar cell to the power incident on the solar cell. Spectral response curve is shown bellow. The ideal Spectral response limited at long wavelengths by the inability of the semiconductor to absorb photon with energies below the band gap. Any energy above the band gap energy is not utilized by the solar cell and instead goes to heating the solar cell. the inability to utilize the incident energy at high energies and the inability to absorb low energies of light represent a significant power los in solar cells consisting of a single p-n junction.

## IV. EFFECT OF TEMPERATURE ON PV PERFORMANCE

- Solar cells output change with temperature changes. The change in temperature will affect the power output from the cells.
- Increase in temperature will decrease the voltage.
- The current increase with temperature due to decrease in the band gap of si.
- The increased cell temperature results decrease in the open circuit voltage due to increase in reverse saturation current.
- Peak power decreases with increase in module temperature

While it is important to know the temperature of a solar PV panel to predict its power output, it is also important to know the PV panel material because the efficiencies of different materials have varied levels of dependence on temperature. Therefore, a PV system must be engineered not only according to the maximum, minimum and average environmental temperatures at each location, but also with an understanding of the materials used in the PV panel. The temperature dependence of a material is described with a temperature coefficient. For polycrystalline PV panels, if the temperature decreases by one degree Celsius, the voltage increases by 0.12 V so the temperature coefficient is 0.12 V/C[2]. The general equation for estimating the voltage of a given material at a given temperature is:

$$V_{OC,ambient} = \text{Temperture coefficient} \times (T_{STC} [^{\circ}C] - T_{ambient} [^{\circ}C]) + V \quad (1)$$

### a. PV Module Efficiency as a Function of Operating Temperature

The solar cell power conversion efficiency can be given as:

$$\eta_c = \frac{P_{max}}{P_{in}} = \frac{I_{max} \times V_{max}}{I(t) \times A_c} \quad (2)$$

Where  $I_{max}$  and  $V_{max}$  are the current and voltage for maximum power, corresponding to solar intensity ( $I_{(t)}$ ) and  $A_c$  is Area of solar cell (Tiwari and Dubey., 2010). The correlations expressing the PV cell temperature ( $T_c$ ) as a function of weather variables such as the ambient temperature ( $T_a$ ), solar radiation ( $I_{(t)}$ ), etc. will be discussed in this section. The effect of temperature on the electrical efficiency of a PV cell/module can be obtained by using the fundamental equations.[4] The basically effect leads to a relation in the form:

$$\eta_c = \eta_{T_{ref}} [1 - \beta_{ref} (T_c - T_{ref}) + \gamma \log_{10} I(t)] \quad (3)$$

In which  $\eta_{T_{ref}}$  is the modules electrical efficiency at the reference temperature,  $T_{ref}$ , and at solar radiation of 1000W/m<sup>2</sup>. The temperature coefficient,  $\beta_{ref}$ , and the solar radiation coefficient, are mainly material properties, having values of about 0.0045K and 0.12, respectively, for crystalline silicon modules[5] [4].

The quantities  $\eta_{T_{ref}}$  and  $\beta_{ref}$  are normally given by the PV manufacturer. However, they can be obtained from flash tests in which the module's electrical output is measured at two different temperatures for a given solar radiation flux[6][4]. The actual value of the temperature coefficient, in particular, depends not only on the PV material but on  $T_{ref}$  as well. It is given by the ratio:[4]

$$\beta_{ref} = \frac{1}{T_0 - T_{ref}} \quad (4)$$

In which  $T_0$  is the (high) temperature at which the PV module's electrical efficiency drops to zero[7][4]. For crystalline silicon solar cells this temperature is 270 °C [8][4].

For variations in ambient temperature and irradiance the cell temperature (in °C) can be estimated quite accurately with the

$$T_c = T_a + \frac{T_{NOCT} - 20}{0.8 \text{ kw/m}^2} \times I(t) \quad (5)$$

linear approximation[9][4]

If substitute equation (5) in equation (3) we will obtain important equation (6):[4]

$$\eta_c = \eta_{ref} [1 - \beta_{ref} \times [T_a - T_{ref} + (T_{NOCT} - 20) \times \frac{I(t)}{I(t)_{NOCT}}] + \gamma \log_{10} I(t)] \times 100$$

## V. SIMULATION RESULTS

### a. Temperature Effect on PV Panel

We are simulating two 12V panels on simulating machine with different temperature levels as shown in Table-1. By different temperature we are finding out the Voltage and current values of the Panel.

**Table-1: Temperature Vs voltage & current**

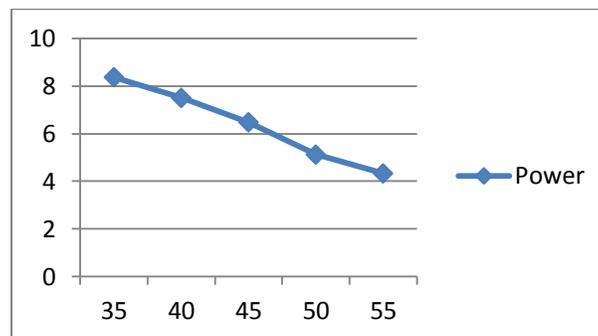
Temperature	Voltage	Current
35	15.5	0.54
40	15.0	0.50
45	13.8	0.47
50	12.2	0.42
55	11.4	0.38

Based on the Voltage and current on the different temperature calculate the Power of the Panels as shown in the Table-2.

**Table: 2- Temperature Vs Power**

Temperature	Power
35	8.37
40	7.50
45	6.48
50	5.12
55	4.33

Consider the different values of current on the x-axis and power on the y-axis and draw the graph as shown in Fig-2. From the graph, when the temperature is increasing the power is decreasing.



**Fig-2 Power Vs Temperature on PV panels**

### CONCLUSION

In solar systems maximum efficiency can be obtained if the sun rays wavelength is more and the temperature on the Panel surface is less. This is obtained by using the different color of light spectrum and we can minimize the panel surface by using some culling method like water circulating methods. From the results we can conclude that the efficiency of panels can improve if the wavelength of light is increasing and temperature on panel body is decreasing.

### ACKNOWLEDGEMENT

We are thankful to the management of Guru Nanak institutions for giving opportunity to enhance our research.

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