The 4th ICMSc 2022

FMIPA UNMUL

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CERTIFICATE
OF ACHIEVEMENT

The 4th International Conference on Mathematics and Sciences (ICMSc) 2022
proudly presents this certificate to

Dr. RAHMAWATI MUNIR, S.Si., M.Si

as a

PRESENTER

in the conference that was held in Science Learning Center,
Faculty of Mathematics and Natural Sciences, Mulawarman University,
Samarinda - East Borneo, Indonesia. October 10th - 11th 2022.

Theme :
"The roles of tropical science in new capital nation planning"

Faculty of Mathematics and Natural Sciences
Mulawarman University

Dr. Eng. Idris Mandang, M.Si
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ICMSC 2022

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Improved PV/T System Performances with Air Collector: Thermodynamics and Photonic Analysis

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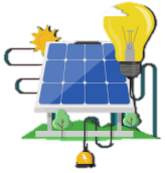
Outline

❖Introduction



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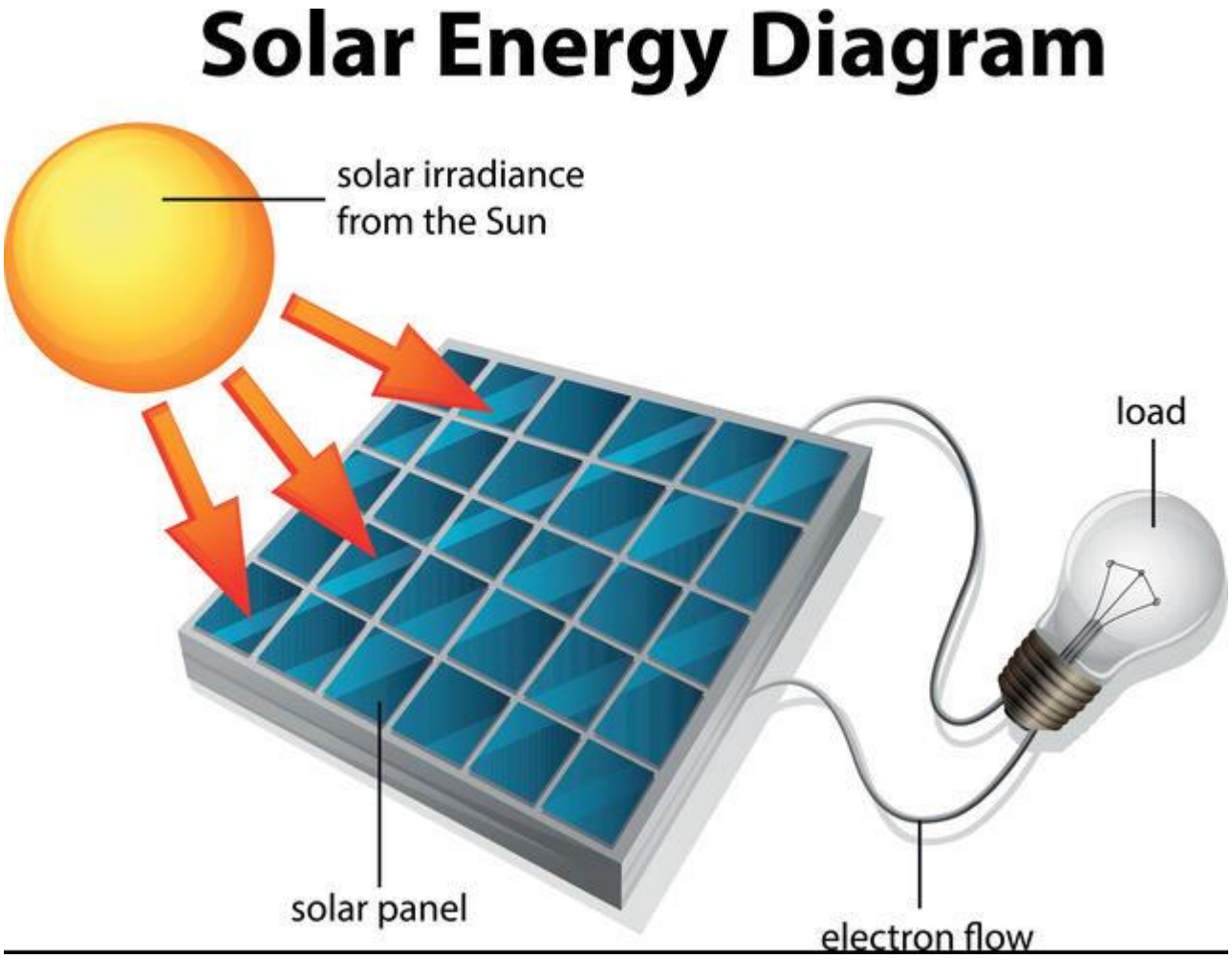
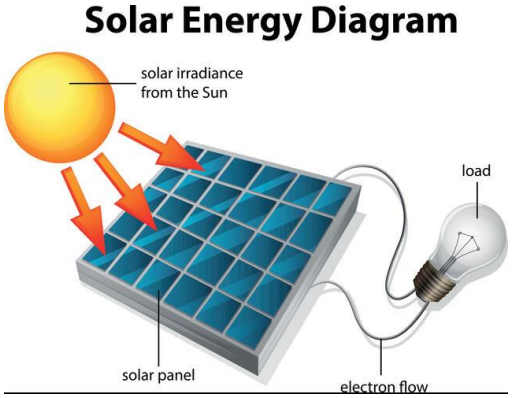
❖Introduction



Source of Image: Alamy Stock Vector

❖Introduction



The major applications of solar energy can be classified as thermal system which converts solar energy into thermal energy and photovoltaic (PV) system which converts solar energy into electricity

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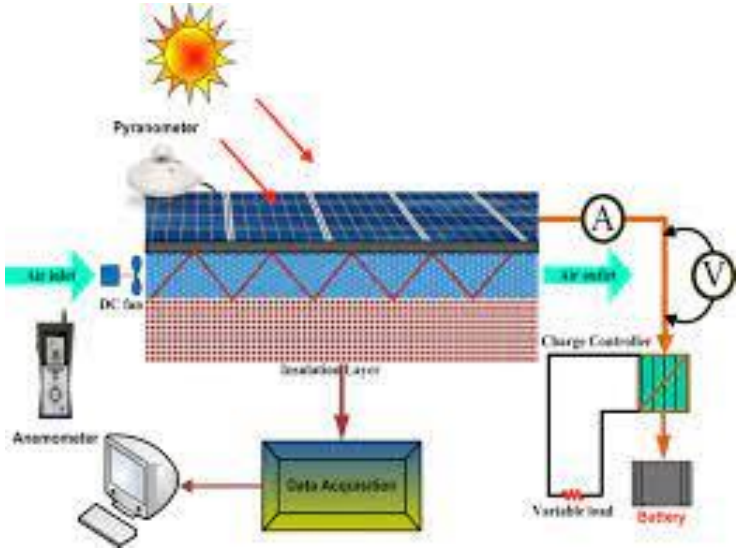
In the solar thermal system, external electrical energy is required to circulate the working fluid through the system.



Diwania, S. et al, 2020

❖Introduction

The aim of this research is to development of thermodynamics analysis of PV/T system using exergy analysis and photonic exergy (useful chemical potential) from the sun to evaluated and compared with exergy from the solar exergy using thermodynamics approach.

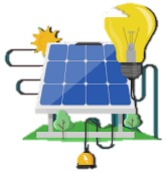
❖Materials and Methods

Fig 1 The experimental set up of PV/T system with air collector

Experimental Method

(standard test conditions) used in module are as follow:

- Type : Monocrystallin
- Open Circuit Voltage(V_{OC}) : 21.6V
- Short Circuit Current(I_{SC}) : 2.98A
- Number of cells(Pcs) : 36 PCS
- Area of PV module: 0,451 m^2
- Cell Efficiency (%) : 14.5%



❖Materials and Methods

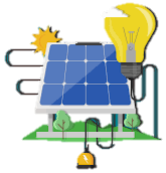
Thermodynamics Analysis

For PV system:

$$\eta_{energy} = \frac{\dot{E}n_{out}}{\dot{E}n_{in}} = \frac{V_m I_m + \left[h_{ca} A\left(T_{cell} - T_{amb}\right)\right]}{GA} \quad \ldots(1)$$

$$\psi_{exergy,PV} = \frac{\dot{E}x_{out}}{\dot{E}x_{in}} = \frac{\dot{E}x_{out}}{\dot{E}x_{solar}}$$

$$= \frac{V_m I_m - \left(1 - \frac{T_{amb}}{T_{cell}}\right)\left[h_{ca} A\left(T_{cell} - T_{amb}\right)\right]}{\left(1 - \frac{T_{amb}}{T_{sun}}\right)GA} \quad \ldots(2)$$

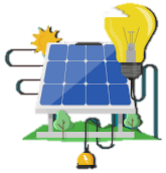


❖Materials and Methods

Thermodynamics Analysis

For PV/T system:

$$\psi_{exergy,PV/T} = \frac{V_m I_m + \left(1 - \frac{T_{amb}}{T_{cell}}\right)\left[h_{ca} A\left(T_{cell} - T_{amb}\right)\right]}{\left(1 - \frac{T_{amb}}{T_{sun}}\right) GA} \quad \ldots(3)$$



❖Materials and Methods

Photonic Method

The exergy of PV system can be calculated if the chemical potential is known by multiplying it with the solar cell power conversion efficiency

$$\dot{E}x_{Chemical} = \eta_{pc}\dot{E}n_{Chemical} \qquad \ldots(4)$$

Where η_{pc} is calculated using solar intensity, short circuit current, and the area of PV surface and can be given

$$\eta_{pc} = \frac{I_{SC}V_{OC}}{GA} \qquad \ldots(5)$$

❖Results and Discussion

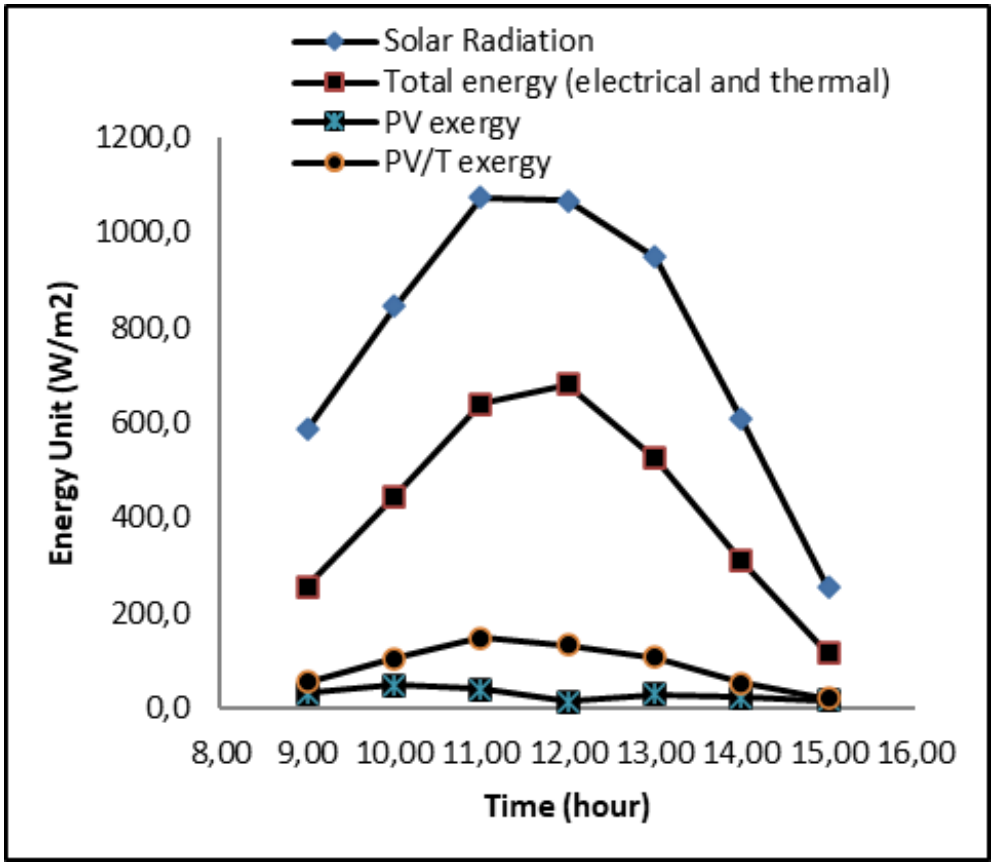


Fig. 2 Hourly variation of total solar radiation, energy and exergy of PV and PV/T systems with time of the day for September, 10th 2022 for Samarinda City East Kalimantan.

❖Results and Discussion

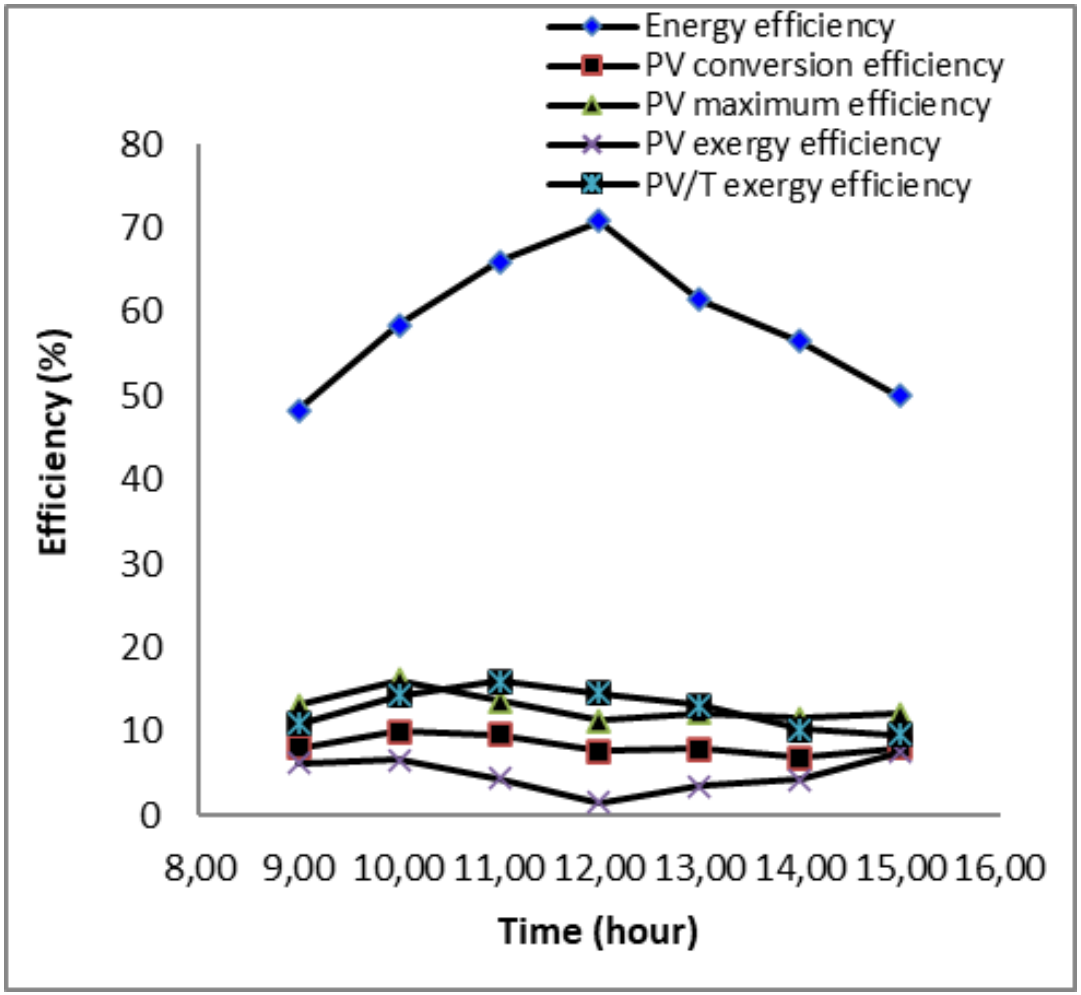


Fig. 3 Hourly variation of energy and exergy efficiencies of PV and PV/T systems with time of the day for September, 10th 2022 for Samarinda, City East Kalimantan.

❖Results and Discussion

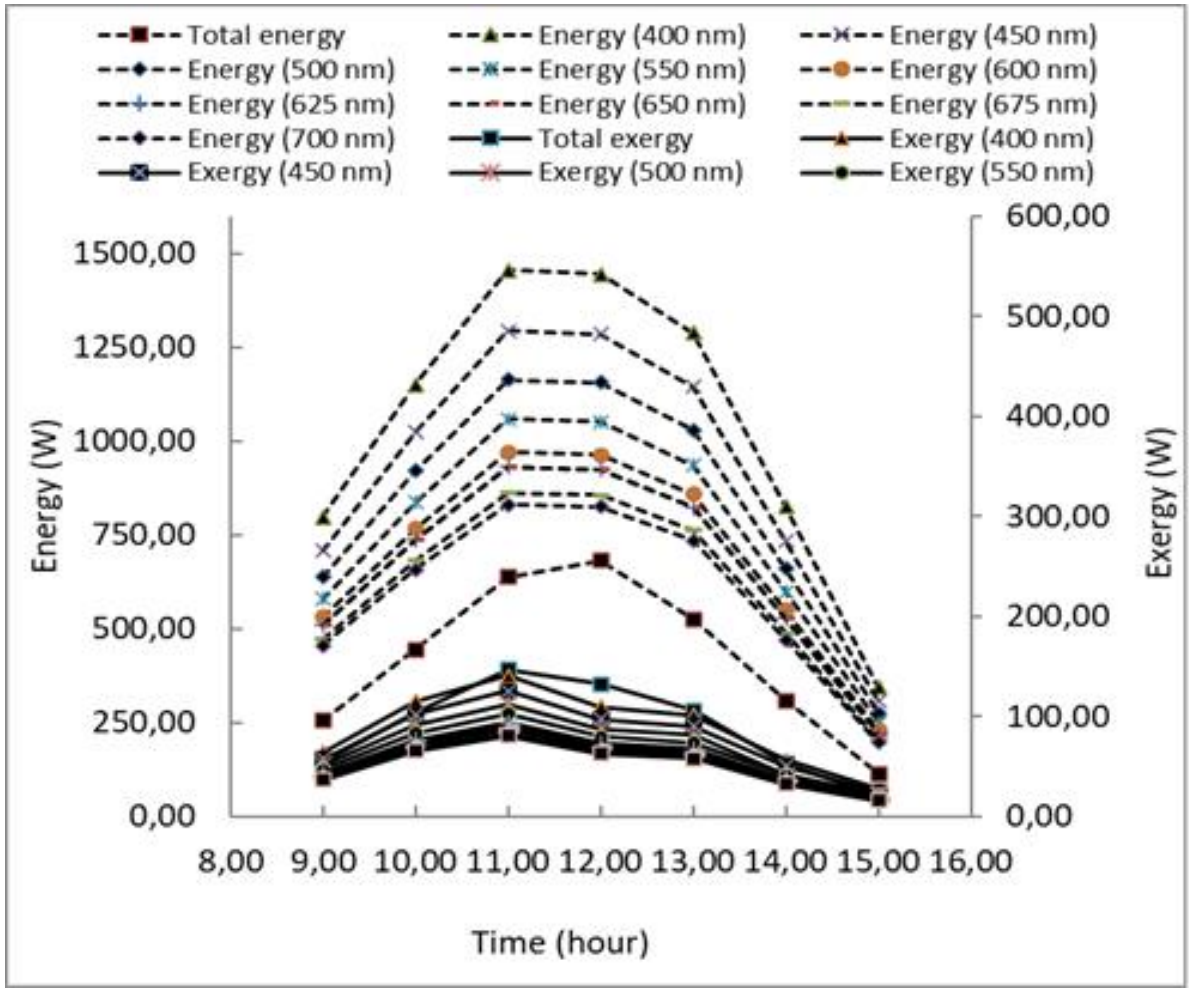


Fig. 4 Hourly variation of photonic and total solar energy for different wavelengths for September, 10th 2022 for Samarinda East Kalimantan.

❖Results and Discussion

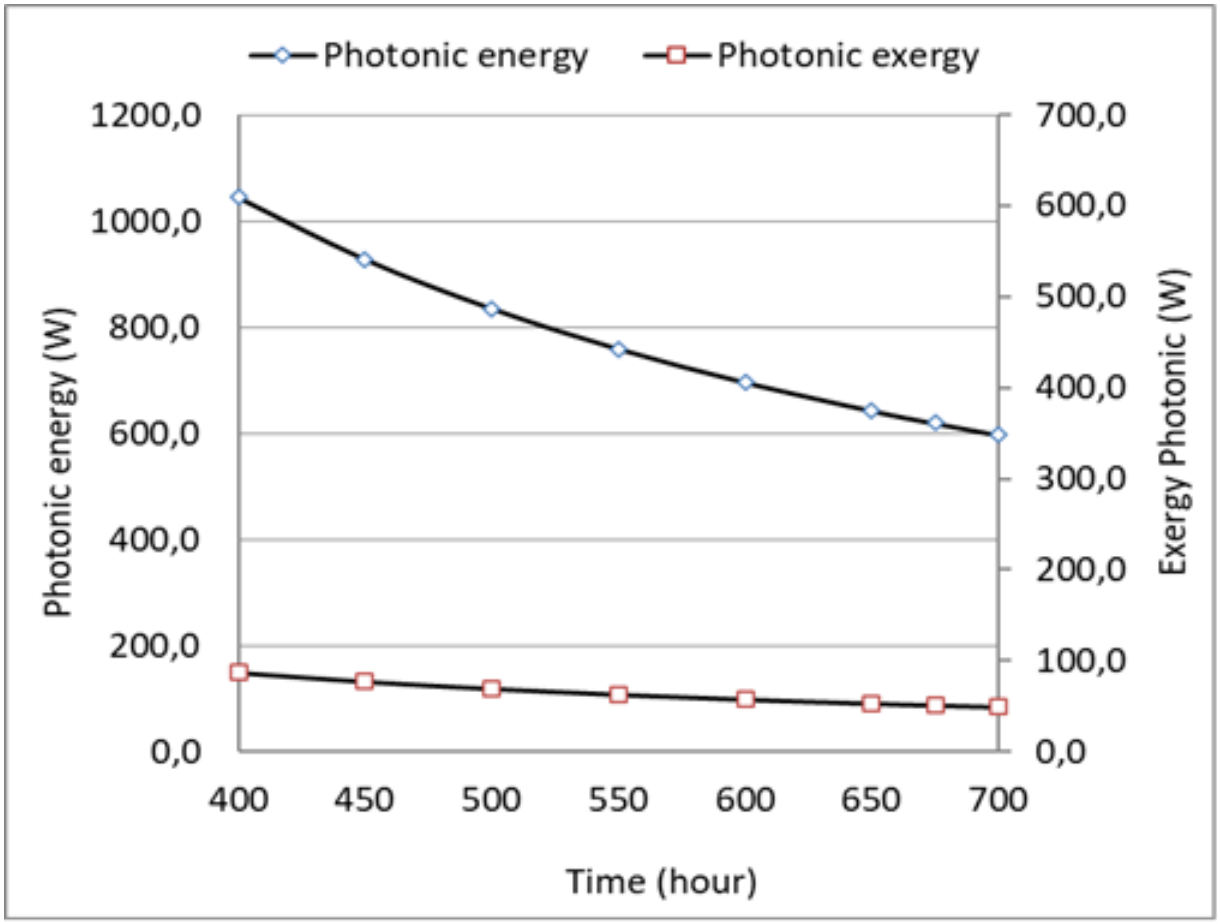


Fig. 5 Effect of Wavelengths of visible spectrum on photonic energy and exergy

❖Conclusion

- The analysis of PV/T system with integrated solar collector using thermodynamics (thermal) and photonic methods have been carried out to some actual data sets as obtained through experiments in Samarinda City, East Kalimantan.

- Energy efficiency of PV system is higher than exergy efficiency and exergy efficiency of PV/T system is higher than that of a PV system according to useful thermal energy in addition to electrical energy where as for the PV system it is considered as a heat loss to ambient.

- Photonic energy and exergy analysis using various wavelength of the visible spectrum for performances of PV system have been carried out and show that the photonic energy and exergy are higher for lower wavelengths of visible spectrum.

Thank You