Applied Mechanics and Materials Vol. 793 (2015) pp 323-327
© (2015) Trans Tech Publications, Switzerland
doi:10.4028/www.scientific.net/AMM.793.323

Submitted: 2015-02-02
Accepted: 2015-06-16

Potential of Solar Radiation and Ambient Temperature as an Alternative Energy in Perlis

Y.M.Irwan[1,a], A.R.Amelia[1,b] , M.Irwanto[1], Fareq.M[1], W.Z.Leow[1] , N.Gomesh[1]

[1]Centre of Engineering for Renewable Energy,

School of Electrical System Engineering,

University Malaysia Perlis (UniMAP), Malaysia.

[a] irwanyusoff@unimap.edu.my, [b]amelia_razak87@yahoo.com

Keywords: Solar radiation; ambient temperature; photovoltaic (PV)

Abstract. As a renewable energy and clean energy source, solar power has great development potential. This paper presents the potential of solar radiation and ambient temperature characteristics can be used as alternative energy. All data collected using Davis Vantage Pro2 Weather Station at Centre of Engineering for Renewable Energy (CERE) in Kangar, Perlis. All data consist of daily and monthly average was analyzed. The result shows the average solar radiation and ambient temperature is high in the middle of the year 2013 which is from April to September. These results provide useful information for the design of solar energy system in order to plan the productive system.

Introduction

Photovoltaic system is usually designed on the basis of standard meteorological data, such as solar radiation, temperature, wind speed and relative humidity. Basically, the overall performance of solar cell depends on the surrounding temperature (ºC) and solar radiation (Wh/m^2). The impact of solar radiation and temperature on the performance of compensating crystalline silicon solar cells was investigated [1]. A PV system technology characteristic provided at standard test condition (STC) with a rating of 25 ºC, 1000 W/m^2, and wind speed less than 1 m/s [2-3]. The PV module operating temperature has an important role in modifying the power output and system efficiency. Increasing the temperature of the PV cell by 1 ºC decreases the power of the PV module by 0.5% to 0.6% [4]. When placed in the sun, the surface attains a temperature proportional to the amount radiant energy falling on it. Solar radiation is the main resources for solar energy system. It is necessary to have solar radiation data in order to design, planning and performance monitoring of solar energy systems [5]. The amount of solar radiation incidence on a point on the Earth's surface depends on several factors such as altitude, latitude, sunshine duration and air temperature. Table 1 shows the intensity of solar radiation. This paper reviews the potential of solar radiation and ambient temperature in Perlis, Malaysia in order to have a productive PV system.

Table 1 Intensity of solar radiation

Quantity	Definition	Symbol	Unit
Solar irradiance	The intensity of solar power at a point observation	G	Wm^{-2}
Solar radiation	The intensity of solar energy at a point observation	H	Whm^{-2}

Review of potential solar radiation and ambient temperature in Malaysia

Malaysia is positioned on the South China Sea and lies between 3.164° in North latitude and 101.7° in East longitude. It has an experience the warm and humid climate because of lies entirely in the equatorial zone. The climate is governed by the regime of the northeast monsoon, which start from November to March and the southwest monsoon originates from the desert of Australia blow between May to mid-September. The ambient temperature varies from 24 °C to 33 °C as shown in Figure 1. Average temperature remains uniformly high over the peninsular throughout the year which is

between 25.6 °C and 27.8 °C [6]. Malaysia comprises the Peninsular and Sabah and Sarawak on the island Kalimantan (Borneo). Global solar radiation has been measured in the few areas in the peninsula cities [7-8]. The average solar radiation is about 4.5 kWh/m^2 per day and 400-600 MJ/m^2 per month [9-10]. On the average, Malaysia only receives about 6 hours of sunshine per day because the clouds cover cuts off a substantial amount of sunshine and thus solar radiation [11]. Figure 2 shows the potential of solar radiation in selected cities in Malaysia [12]. In Peninsular Malaysia, the Klang Valley (Kuala Lumpur, Petaling Jaya) has the lowest solar radiation value, whereas around Bayan Lepas (Penang) have the highest values measured [13]. But most of solar technology was installed around Kuala Lumpur and Selangor [14]. Penang as the best resources, solar energy not in use advantageously. The Figure 2 explored Sabah is the best spot to produce electricity from sunlight. In terms of the amount of sunlight captured, Kota Kinabalu which is the capital of state Sabah measured highest average month value of 6.01 kWh/m^2/day in April.

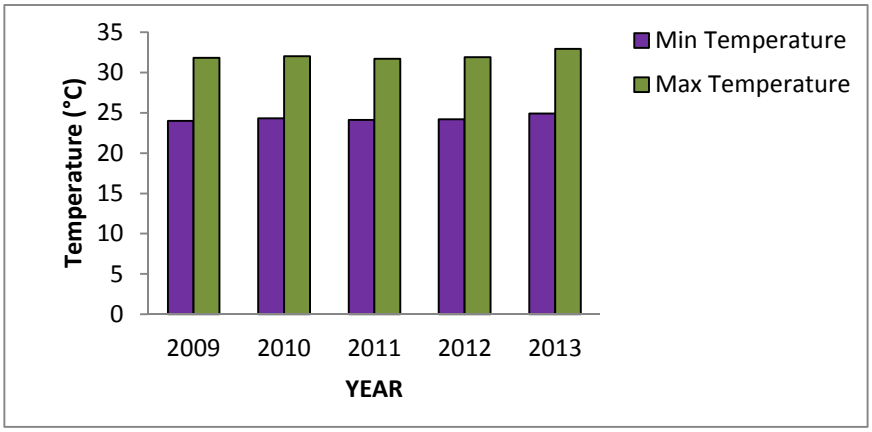

Fig. 1 Mean of maximum and minimum temperature through five years in Malaysia [15].

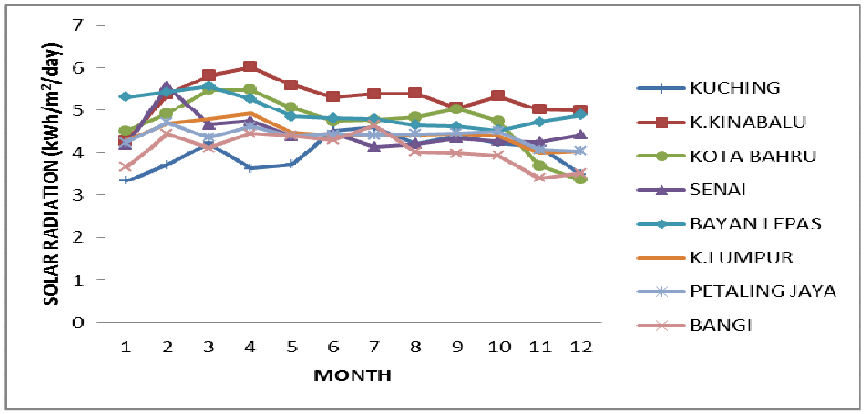

Fig.2 The average monthly of solar radiation in selected countries in Malaysia.

Potential of solar radiation and ambient temperature in Perlis, Malaysia.

a. Geographical of Perlis, Malaysia

Perlis is the smallest state in Malaysia, lies on the northern part of the west coast of Peninsular Malaysia. The state bounded by Thailand in the north, on the east and south with Kedah and its western coastline borders the Straits of Malacca. Perlis has an area of 821 km^2 and total population of 227, 025 as of 2010. All data were collected at Centre of Engineering for Renewable Energy (CERE) in Kangar, Perlis. Kangar is a state capital of Perlis.

b. Methodology

In order to develop a reliable solar system, the characteristics of solar radiation and air temperature for the whole year 2013 was investigated. The characteristics can be evaluated from the daily and monthly average data recorded. All data were collected and recorded in every minute of the day using Davis Vantage Pro2 Weather Station console. The console displays and records records weather data, provides graph and alarm functions, and interfaces to a computer using WeatherLink® software.

c. Potential of solar radiation in Perlis

Solar radiation is potential energy source for power generation emitted by the sun in the form of electromagnetic waves. Most of the average annual daily solar radiation recorded (Figure 3) is greater than 3 kWh/m^2 indicates that the sky is very clear with high solar intensity and very good for PV application. The highest average monthly solar radiation recorded in April at 5.64 kWh/m^2 as shown in Figure 4. The measured value shows Perlis has great potential for solar technology comparable with India as the best solar resources in the world. India has the average solar radiation, stands at a robust 4-7 kWh/m^2/day [16].

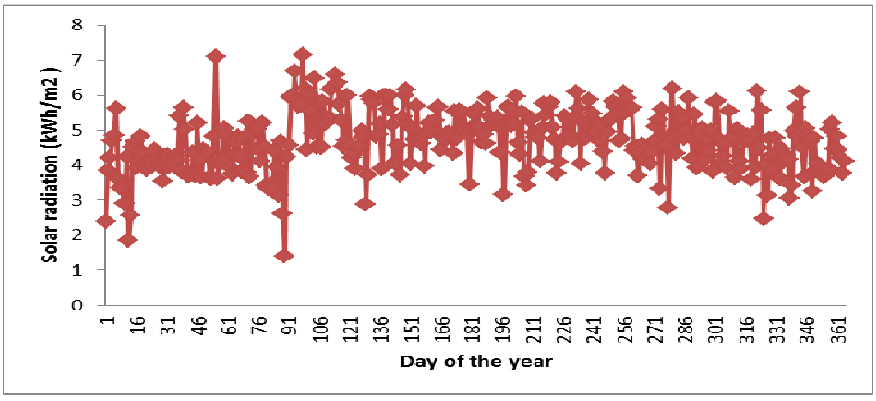

Fig.3 The average annual daily of solar radiation.

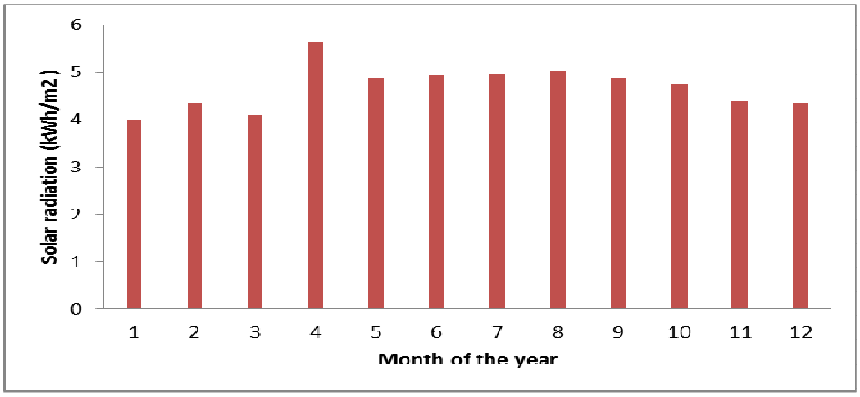

Fig.4 The average monthly of solar radiation.

d. Potential of ambient temperature in Perlis

Perlis's climate is tropical monsoon because it's located near to Thailand, with temperature ranging from 25 °C to 32 °C. Perlis known as the hottest state in Malaysia with highest temperature recorded in 1998 at 40.1 °C. Figure 5 shows Perlis experienced in average high temperature in 2013 with average daily temperature is above 25 °C. The highest temperature recorded in April at 30.1 °C as shown in Figure 6. One of the reasons for such high temperatures is that the sun is vertically overhead the equatorial region from mid-February to mid-April. The results show Perlis experienced dry weather from April to September. Generally, during this period Malaysia is experiencing Southeast

Monsoon. The lowest temperature recorded between November and January because of Northeast monsoon, which brings heavy rainfall.

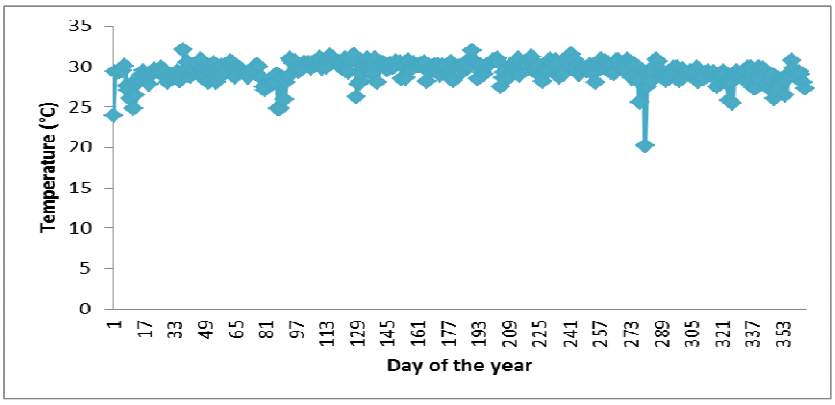

Fig.5 The average daily of ambient temperature.

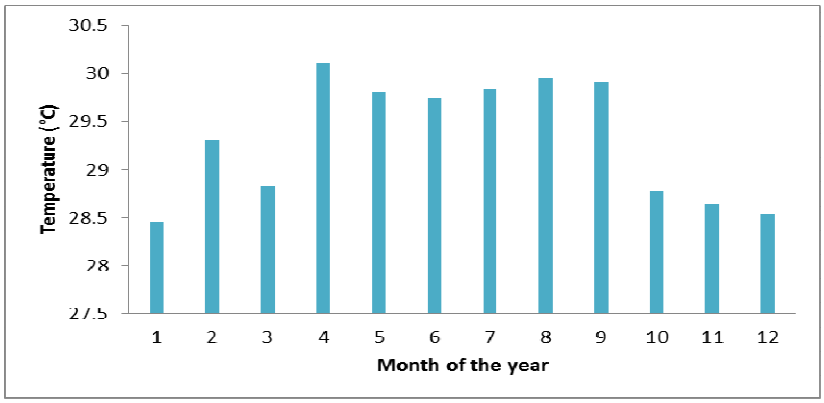

Fig.6 The average monthly of ambient temperature.

Conclusion

From the overall of the observation and discussion, this paper conclude that Perlis is very potential to develop a reliable PV system as alternative energy. The average solar radiation in a day and month above 3 kWh/m^2 described Perlis has big potential in development of solar technology. The average temperature explored Perlis is in hot sunny climates. The provided results very useful in predict the output of PV system.

Acknowledgement

The authors thank the Centre of Engineering for Renewable Energy (CERE) in Kangar, Perlis for providing all data used in this study.

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