Utilization Photovoltaic Plan for Energy Conservation and Decrease CO2 in Universiti Teknologi Malaysia

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Abstract

The fossil fuels combustion for electricity production releases greenhouse gasses (GHG) into the environment Currently, electricity price is raising rapidly, therefore cost saving and pollution preventing carry out by increase energy efficiency. This research investigate energy consumption pattern and co2 emission rate in Universiti Teknologi Malaysia (UTM). In order to reduce Carbon Footprint and its impact on the environment in UTM solar power energy is used.

Keywords: Renewable energy, Sustainability, Global warming, Carbon dioxide emission.

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1. Introduction

Carbon dioxide (CO2) is the most important anthropogenic GHG, and the global increases in CO2 concentration are due primarily to fossil fuel use and land use change [1]. According to the International Energy Outlook 2006, world CO2 emissions from the consumption of fossil fuels are expected to grow at an average rate of 2.1% per year from 2003 to 2030. The world CO2 emission from the consumption of fossil fuels is predicted to increase from about 25,000 billion metric tons in 2003, to more than 40,000 billion metric tons by 2030 [2]. Indirect emissions associated with the consumption of purchased electricity are a required element of any organization's accounting and reporting under the GHG Protocol Corporate Standard. Because purchased electricity is a major source of GHG emissions for companies, it presents a significant reduction opportunity.

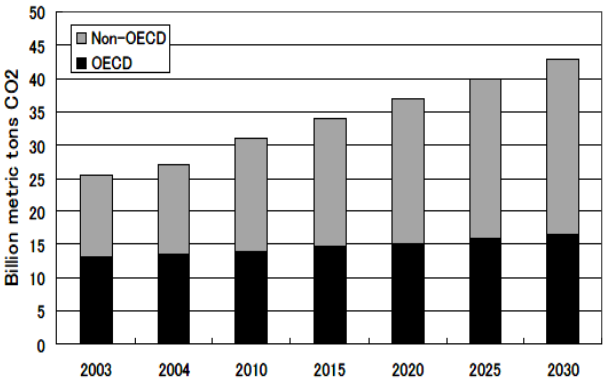

Fig 1. World energy-related CO2 emissions by region, 2003-2030.

Table 1 shows, CO2 emissions of Malaysia in comparison with the world [3]. Due to rapid economic growth and industrialization, CO2 emission of Malaysia is relatively high compared to the world average. In term of per capita emission, it is 6.51 metric tons for Malaysia, much higher than the world average in 4.44 metric tons.

Table 1: CO2 emissions of the world and Malaysia, 2010 .

Country	Population , million	CO_2 emissions, million metric tons	CO2/capita metric tons
World	6,825	30,326	4.44
Malaysia	28.40	185.00	6.51

Malaysia's electricity demand is expected to reach 18,947 MW in 2020 and 23,092 MW in 2030 which is 35% increment from 14,007 MW in 2008.[4] These non-renewable fuels are gradually depleting and contribute huge amount of GHG. The implementation of various policies and programs by the government of Malaysia has increased the awareness of the importance of the role of renewable energy in a sustainable energy system [5]. Fossil fuel technologies (coal, oil, gas) have the largest carbon emission, because they burn these fuels during operation. PV, are often referred to as 'low carbon' or 'carbon neutral' because they do not emit CO2 during their operation. It is expressed as grams of CO2 equivalent per kilowatt hour of generation (gCO2eq/kWh) [6]. The past records of Malaysia climate show similar trend that has been encountered globally as found in the Intergovernmental Panel on Climate Change (IPCC) assessments [7]. The country's temperature had increased 0.18 0C per decade for over 40 years since 1951.

Solar energy or Photovoltaic (PV) electricity generation is a form of green and renewable energy (RE) which is clean, non-depleting and does not emit any GHG since it generates energy directly from the sun by means of PV effect [8].PV is the conversion of sunlight into electricity via the use of solar cell installed in a solar panel. PV cells produce electricity when sunlight excited electrons in the cells.

Malaysia's current focus is on developing effective policies on renewable energy (RE) in order to reduce dependency on fossil fuel and contribute towards mitigating the effects of climate change [9]. In 8th Malaysia Plan (8MP – 2001–2005), the fifth-fuel strategy was introduced to promote the use of RE as well as to address rising global concern on climate change. A year after the introduction of the Fifth Fuel Policy, the Small Renewable Energy Power (SREP) program was launched in May 2001. A target of 350 MW of electricity generation from RE such as biomass, biogas, municipal waste, solar and mini-hydro as alternatives to fossil fuel was set but has so far not been achieved [10]. Malaysia is positioned on the South China Sea and lies between 1° and 7° in North latitude and 100° and 120° in East longitude. Malaysia is entirely equatorial, which is characterized by the annual Southwest (April–October) and Northwest (October–February) monsoons. The ambient temperature remains uniformly high throughout the year between 27 °C and 33 °C, with an annual average daily solar irradiations for Malaysia were from 4.21 kWh/m2 to 5.56 kWh/m2 and average daily sunshine duration of about 12 h [11]. The highest solar radiation was estimated at 6.8 kWh/m2 in August and November while the lowest was 0.61 kWh/m2 in December [12].

The monthly solar radiation in Malaysia is approximately around 400–600 MJ/m2. Fig.2 shows the annual average of solar radiation (MJ/m2/day) in Malaysia [13].

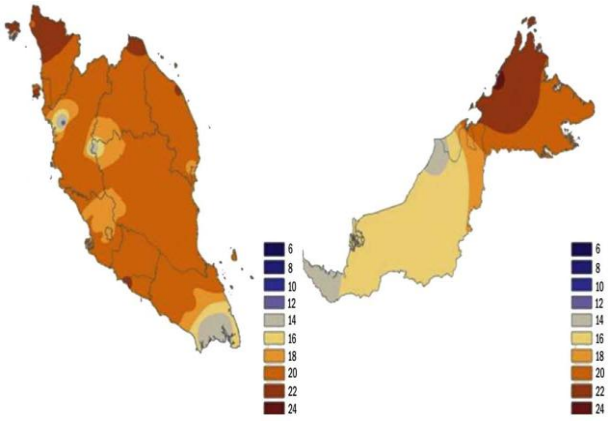

Fig2. the annual average of solar radiation (MJ/m2/day) in Malaysia.

The abundance of solar radiation in Malaysia makes it highly potential for solar power generation [14]. Table 2 is a summary of yearly average solar radiation in various towns in this country [15].

Table2. Solar radiation in Malaysia (average value throughout the year).

Irradiance	Yearly (kWh/m^2)
Kuching	1470
Bandar Baru Bangi	1487
Kuala Lumpur	1571
Petaling Jaya	1571
Seremban	1572
Kuantan	1601
Johor Bahru	1625
Senai	1629
Kota Baru	1705
Kuala Terengganu	1714
Ipoh	1739
Taiping	1768
George Town	1785
Bayan Lepas	1809
Kota Kinabalu	1900

3. Methodology

The efficiently reducing energy-related CO2 emissions are to quantify how much an individual or organization emits through various activities. Moreover, indirect sources, GHG emissions are extracted from the electricity consumed based on utility bills. Activity data relate to the activity that produces an emission into the atmosphere in the average years, based on 2010,2011 and 2011 data for UTM main campus in Johor Baharu. The calculation of carbon emission per capita is achieved by total carbon emission to total number of student and staff. The activity data have been collected to measure GHG emissions using this method is the quantity of purchasing electricity. Electricity consumption is generally measured in kilowatt hours (kWh) [17] because carbon emission is calculated from electricity generation; this study adopts the baseline emission factor calculated by Malaysia Green Tech Cooperation, formerly known as Malaysia Energy Centre (PTM). Satellite images have been finded as an alternative and accurate method for predicting average annual daily solar radiation of a specific location. These images can be use to predict the efficiency and sizing of various solar energy systems such as solar photovoltaic applications. The data from satellite images are used and compared with the actual readings from solar instruments. The results are then used to estimate solar intensity for other places where solar instrument is not available. Malaysia lies entirely in the equatorial region. The tropical environment has been characterized by heavy rainfall, constantly high temperature and relative humidity [5].

4. Result and Discussion

The study identified UTM's carbon emission Rate because the electricity Average electricity consumption in the years 2010, 2011 and 2012 of per month Which is shown in Table 3. Figure 3 portrays compare UTM's electricity usage (kWh) in the years 2010,2011 and 2012 and Figure 4 shows compare the carbon emission rate in the years 2010,2011 and 2012.

Resource	Electricity consumption (kwh)	carbon emission
Average Monthly Use in 2010	6,000,649 kWh	4,032 MTCO2
Average Monthly Use in 2011	5,982,371 kWh	4,020 MTCO2
Average Monthly Use in 2012	5,912,268 kWh	3,973 MTCO2

Table3. Average monthly use of electricity (kWh) and carbon emission.

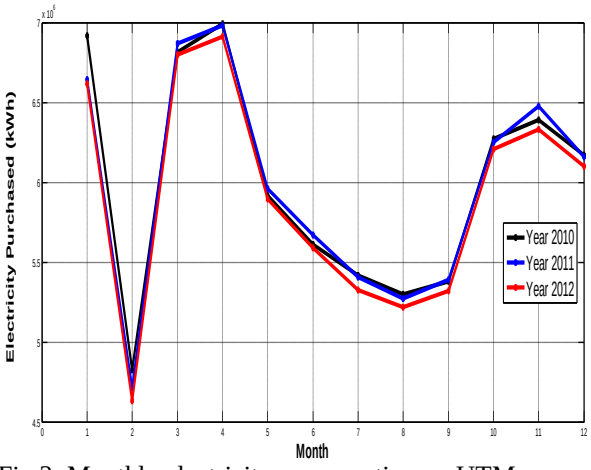

Fig 3: Monthly electricity consumption on UTM.

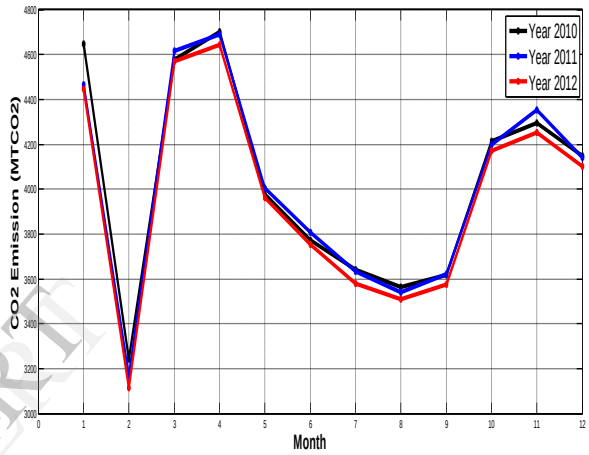

Fig 4. UTM's carbon emissions from electricity purchased in years 2010,2011 and 2012.

Figure 5 shows the graph for the Maximum, minimum and average value of the monthly average daily solar irradiation for Johor-Malaysia from Satellite images. This plotted graph, shows that there are three months where the maximum average daily solar radiation is almost as high as 7.0 kWh/m2.

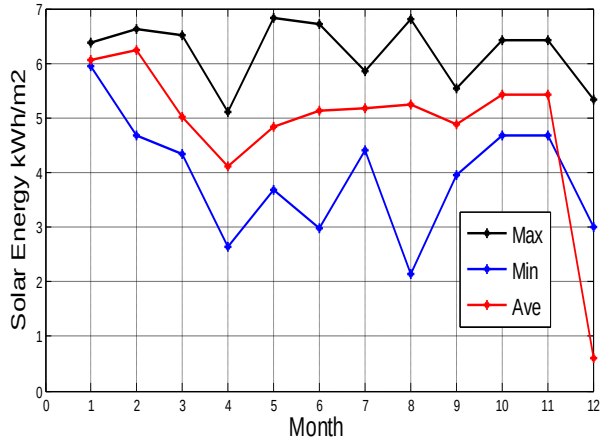

Fig 5. Maximum, minimum and average value of the monthly average daily solar irradiation.

5. Conclusions

Malaysia has been dynamic in its energy planning so far by aligning its national energy policies towards global trends. The CO2 emission rate at UTM University comes mainly from the consumption of electricity. In order to reduce the environmental impact at UTM University, the CO2 emission a very important starting point. There are many strategies, can conserve energy and reduce CO2 emissions. With PV, the sun can be used to reduce the need for GHG causing fuels whenever it shines. The amount of power generate by a solar system depends upon the amount of sun light to which it is exposed. On the other hand, environmental benefits would be reduction in air pollution and GHG emissions. This will improve air quality, increase of public health.

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