Photovoltaic versus Micro-Hydropower for Rural Non-Grid Connected Areas of Equatorial Sarawak

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***Abstract*—There is currently a large expansion in photovoltaic installation worldwide especially in the temperate regions of the world which have tended to influence electrical power decisions in developing countries at the equator. This research clearly justifies hydropower over photovoltaic electricity generation in non-grid connected regions of equatorial Sarawak, Malaysia. A case study was made of photovoltaic installations versus micro-hydropower installation in these regions. There are problems of micro-hydroelectricity especially during dry seasons but this work justifies allocating more resources in improving micro-hydroelectricity research such that eventually it will produce enough electricity even with the low water flow rate of the dry seasons. This research can be done locally compared to photovoltaics whose research tends to be mostly imported into Malaysia. Some comparisons are made to grid connected hydroelectric dams to depict capabilities of this technology given sufficient research allocations.**

***Index Terms*—Solar; PV; Micro-Hydro; Rural Electrification; Equatorial Regions.**

I. INTRODUCTION

Currently a high amount of finance is diverted for photovoltaic (PV) installations in non-grid connected regions of equatorial Sarawak, while this is not an optimum source of electric power for an equatorial region. The aim of this study is show this and to help divert some of this finance to micro-hydroelectricity (MHEP).

For this research, a case study was made of a solar power installation in Kuching and one in Bario, Sarawak. A case study was also made on the MHEP project in Bario, Sarawak.

In the electrification of rural non-grid connected regions of equatorial Sarawak, Malaysia, there are only two competing sources of green electric power generation, PV and MHEP. Wind turbines have been tried without success even in windy mountainous areas. Historically, the English sailors used to worry about the equator and called it "doldrums" because there is very little wind there to move their sailing ships [1]. In recent years, many PV projects are being implemented in Sarawak and the rest of Malaysia despite the many major disadvantages in implementing such technologies here. The drive to install PV is prompted by emulation of activities of the temperate countries where most of the educated elite of the world are located. Two example evidences of such copying of designs from temperate countries, without considering the local climatic conditions are as follows. The Main Switch Board (MSB) of the engineering building of Universiti Malaysia Sarawak (UNIMAS) is located in the underground level; flooding of this room is common because Sarawak has a 390% [2,11] more rain than temperate countries where designs are generally done. Another example is a train station in equatorial Malaysia (Kuala Lumpur Railway Station) which is built to withstand almost two meter of snow [3].

II. DATA AND OBSERVATIONS

The heavy rains result in the five factors listed in the next five paragraphs below which indicate that tapping solar power is not conducive to equatorial Sarawak.

Figure 1: Above is view of clouds over Sarawak from ground level on a typical morning. On right is a picture of clouds taken from a plane which depicts the vertical height of clouds

The temperature during day time when the PV is functioning in Sarawak averages around 30^{o}C but it can reach up to 36^{o}C [4]. Such a high temperature reduces PV voltage and thereby its energy production efficiency. PV is excited by certain frequencies of light and not the infrared portion (heat) of EM spectrum.

Fungus grows rapidly in equatorial countries. This fungus actually consumes minerals on the glass panel, eventually leaving them slightly opaque to the required frequency of light from the sun [5].

Most common batteries operate at temperatures below 25^{o}C [6] and will reach the end of their life span much faster above this temperature.

Sudden cloud cover is the next problem. Even if batteries are not used and solar panels are grid-connected (or as in a non-grid connected village depending on multiple power sources), a sudden cloud cover can remove a dangerous amount of power from the grid. Such a sudden cloud cover was experienced in Hawaii in the early part of 2015 which