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ENERGY SUSTAINABILITY STUDY OF A RURAL ICT TELECENTER AT THE BARIO HIGHLAND

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ABSTRACT

The eBario project has won the eAsia Award and the Mondialogo Engineering Award in 2004 and 2005 respectively for its successful implementation of an Information and Telecommunications Technology Center (ICT) and solar renewable energy-incentive rural community project at the Bario Highland of Sarawak, East Malaysia, Borneo (<http://www.unimas.my/ebario/>). Although solar photovoltaic (PV) energy has been opted for power generation at the ICT Telecenter for the past five years, there is still a need to investigate the cost-effectiveness of the current energy setup as well as to conduct sustainability study taking into account factors such as system efficiency, weather, costs of fuel, operating costs, as well as to explore the feasibility of implementing alternative energy resources for the rural ICT Telecenter. Recent theoretical study conducted has shown that renewable combined power systems are more sustainable in terms of supplying electricity to the ICT Telecenter, and in a more cost-effective way compared to a standalone PV system which is subject to the cloud and the recent dense haze problems. For that purpose, two combined power systems are being put into consideration namely PV-Hydro and PV-Hydro-Fuel Cell, where the total simulated annualized cost for these two system configurations are US\$10,847 and US\$76,010 respectively as far as the present location is concerned. The PV-Hydro-Fuel Cell produces electrical energy at the amount of 3,577 kWh/yr while the annual energy consumption is 3,203 kWh/yr. On the other hand, PV-Hydro produces 3,789 kWh/yr of electricity annually load which consumes energy at 3,209 kWh/yr. Results thus obtained has shown that the PV-

Hydro scheme is expected to have advantages over the existing PV standalone system. Firstly, it is more cost-effective. Secondly, it provides the best outcomes for the local indigenous community and the natural highland environments both for now and the future. Thirdly, it also able to relate the continuity of both economic and social aspects of the local society as a whole. As the combined PV-Hydro system had been chosen, plus for completeness purposes, the present paper also discussed the custom design and construction of a small water-wheel breast-shot hydro-generator, suited to the local location and existing water energy resources. Energy saving design calculations and Sankey diagram showing the energy flows for the new combined system are also given herein. Finally, the energy system performance equations and the performance curves introduced in this study provide a new simple method of evaluating renewable energy systems.

Keywords: Highland energy resources, Solar energy, Fuel cell, Hydro-power, Rural electrification, ICT telecenter

1. INTRODUCTION

The highland of Bario is situated in the remote area of Sarawak, East Malaysia. It is located about 400 km to the south east of Miri town as shown in Fig. 1. The highland is situated in the middle of the mountainous region of Borneo and near the border of Sarawak and Kalimantan. The highland also stands about 1000 feet above sea level and surrounded by dense jungle and vegetation, Fig. 2. As such, it is isolated from other