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An investigation into integration of renewable energy resource for electricity generation for rural areas in Sarawak State Malaysia

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The difficulties faced in the extension of conventional grid electricity to remote locations elicit increased application of renewable energy (RE) sources in such locations. In locations that are in close proximity to rivers or streams, micro-hydro hybrid RE systems (HRES) are employed. Similarly, hybrid photovoltaic (PV) /battery configurations exist. Unfortunately, micro-hydro turbines require a minimum height/head and expensive civil works during installation. Hydrokinetic turbines (HKTs) eliminate the height/head requirement and greatly reduce necessary civil work by generating electricity using the kinetic energy of water flow in a river or stream. This study used HOMER software to simulate and obtain the optimal size and configuration of a hybrid PV/HKT/Battery storage system for Kampung Asum in Sarawak, Malaysia. Techno-economic comparison of the system is done with a PV/Battery and a standalone diesel generator (DG) system thereafter. The levelized cost of energy (LCOE) and the total net present cost (NPC) are the primary indices used for comparison purposes. The optimal configuration from simulations has 79.9 kWp of PV, two 4.5 kW HKTs and 132 kWh of battery storage. Also, economic results obtained indicate that the LCOE of 2.1 RM/kWh and NPC of RM 1,225,000 for the PV-HKT-battery configuration bested those for the PV-battery and standalone DG systems by 165 % and 27 % respectively. This optimal configuration is more environmentally friendly and highlights the role of the HKT in reducing battery usage and wear in addi

Topics

inkjet- and flexitrail-printing of silicon

An Investigation into Integration of Renewable Energy Resource for Electricity Generation for Rural Areas in Sarawak State Malaysia

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Abstract. The difficulties faced in the extension of conventional grid electricity to remote locations elicit increased application of renewable energy (RE) sources in such locations. In locations that are in close proximity to rivers or streams, micro-hydro hybrid RE systems (HRES) are employed. Similarly, hybrid photovoltaic (PV) /battery configurations exist. Unfortunately, micro-hydro turbines require a minimum height/head and expensive civil works during installation. Hydrokinetic turbines (HKTs) eliminate the height/head requirement and greatly reduce necessary civil work by generating electricity using the kinetic energy of water flow in a river or stream. This study used HOMER software to simulate and obtain the optimal size and configuration of a hybrid PV/HKT/Battery storage system for Kampung Asum in Sarawak, Malaysia. Techno-economic comparison of the system is done with a PV/Battery and a standalone diesel generator (DG) system thereafter. The levelized cost of energy (LCOE) and the total net present cost (NPC) are the primary indices used for comparison purposes. The optimal configuration from simulations has 79.9 kWp of PV, two 4.5 kW HKTs and 132 kWh of battery storage. Also, economic results obtained indicate that the LCOE of 2.1 RM/kWh and NPC of RM 1,225,000 for the PV-HKT-battery configuration bested those for the PV-battery and standalone DG systems by 165 % and 27 % respectively. This optimal configuration is more environmentally friendly and highlights the role of the HKT in reducing battery usage and wear in addition to achieving lower LCOE and NPC values.

INTRODUCTION

Energy generation and management specialists in recent times have concentrated on the application of renewable energy sources (RES) in different locations due to a myriad of reasons. A primary issue arises from environmentalists who have posited that there are severe effect on the present and future by the pollution and degradation caused by the use of fossil fuels in power generation. A second issue is the predicted depletion of the conventional oil reserves in several decades. The study suggested that the world's oil reserves will be exhausted in 35 years. Other fossil fuels like coal and natural gas are projected to last 107 years and 37 years respectively [1].

The state of Sarawak represents East Malaysia. This part of Malaysia is yet to achieve the one hundred percent coverage by the electrical grid as proposed by the One Malaysia plan of 2015 [2]. The absence of grid electricity in Sarawak, Malaysia is predominant in rural villages. The major challenge faced in extending grid electrification is the absence of access to these remote villages. This is further compounded by the sparse distribution of the villages and low population as related to cost. Some villages make use of diesel generators for temporary provision of electricity.