

Priority-based market clearing model for off-grid P2P energy trading

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ABSTRACT

Standalone solar PV power system is being used as an option for electrification in remote areas around the world providing basic electricity needs. However, the approach suffers from power mismatch and energy efficiency issues. This paper proposes market-clearing model peer-to-peer energy trading (P2PET) based on multiple standalone solar power system design specification in rural Sarawak, Malaysia. The proposed system combined multiple standalone solar PV system within the community through P2PET trading concept. P2PET creates the platform for energy transaction between each system and even support business such as a workshop to operate high-power electrical appliances. As energy generation is constrained in an off-grid system, the proposed market-clearing model prioritizes the energy trading between the seller and business buyer who bring more benefit to the community. Subsequently, participants in energy trading have a selection of strategies to maximize personal benefits such as profit earning or energy sufficiency. Simulation studies are applied to verify the performance of the proposed model which increases energy efficiency, improves the local economy, and maximizes the community's welfare from electrification.

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1. INTRODUCTION

Based on the report of the International Energy Agency (IEA), 993 million people around the world are still unable to access electricity which 73% of them are live in rural areas [1]. Financial and geography issues have restricted the potential of rural electrification with grid propagation for these countries [2]. A large investment is essential for grid extension to reach the rural area which is considered an uneconomical option as low energy demand from a particular area [3]. To accomplish full electrification globally, renewable energy sources is the cheapest way to achieve especially in rural area [1], [4]. The renewable energy system is an outstanding solution for remote areas with low power demand areas due to the scalability of input power sources. The maturity of the PV technologies and continuing decrease in the cost of solar PV over the years led to the usage of the grid and off-grid electricity increasing [5], [6].

For rural electrification of a remote area in Sarawak, the diesel generator is the common solution although it is costly and has difficulty with fuel transportation. The utilization of local energy resources such as solar, wind, and hydro bring significant benefits such as energy cost saving and greener energy [7]. In Sarawak, several rural electrification schemes utilizing renewable energy as primary sources have been introduces such as Sarawak Alternative Rural Electrification Scheme (SARES), standalone solar hydro hybrid station, Sarawak Energy's CSR Project [8], [9]. Those electrification schemes is aiming to supply electricity