

Standalone solar power generation with dynamic error-driven PI-based energy management system for rural electrification in Malaysia

ABSTRACT

This paper presents a standalone solar power generation with energy storage management developed for an Eco-tourism centre in Sabah. The site is isolated and located far away from the power grid, and hence, it motivates the development of an onsite solar power generation for sustainable and efficient power usage. A perturbed and observed maximum power point tracker is deployed to ensure the solar system always generates the maximum power with solar irradiance. It is integrated with energy storage to preserve the continuity of power supply to the tourists, which is controlled by the energy management system. The power flow of the entire system is managed by regulating the charging and discharging process of the battery. The performance of the proposed system is verified using MATLAB Simulink with the load demand and solar irradiance profile collected from the site. The results show that the proposed system can balance power generation and utilization by alleviating the mismatch between solar power and the load demand for all the case studies. Besides, the EMS prolongs the battery lifespan by preventing it from over-charging and over-discharging, regulating its state of charge within the maximum and minimum state of charge at 10% and 90%, respectively. With the system's deployment, approximately 0.89 tonnes of carbon dioxide can be reduced annually. A preliminary economic analysis shows that the payback period is 12 years which guarantees the secure investment for the onsite green energy generation system.