عنوان مقاله:

Optimizing Parameters for Hybrid Power Supply in Autonomous Solar Street Lighting Systems

محل انتشار:

مجله انرژی تجدیدپذیر و محیط زیست, دوره 11, شماره 3 (سال: 1403)

تعداد صفحات اصل مقاله: 13

نویسندگان:

Ihor Shchur - Department of Electric Mechatronics and Computerized Electromechanical Systems, Institute of Power Engineering and Control Systems, Lviv Polytechnic National University, ۱۲ Bandera str., Lviv, ۷۹۰۱۳, Ukraine.

Ihor Bilyakovskyy - Department of Electric Mechatronics and Computerized Electromechanical Systems, Institute of Power Engineering and Control Systems, Lviv Polytechnic National University, ۱۲ Bandera str., Lviv, ۷۹۰۱۳, Ukraine.

Mykhailo Khai - Department of Electric Mechatronics and Computerized Electromechanical Systems, Institute of Power Engineering and Control Systems, Lviv Polytechnic National University, ۱۲ Bandera str., Lviv, ۷۹۰۱۳, Ukraine.

خلاصه مقاله:

Autonomous photovoltaic (PV) street lighting systems, most suitable for use in areas distant from power grids, have traditionally been constructed according to the modular principle, with each lighting point equipped with its own PV panel (PVP) and battery. Analysis indicates that such implementation with distributed generation and storage of electrical energy faces challenges in matching installed PVP power and battery capacity with seasonal changes in insolation and daily lighting duration, particularly in middle and northern latitudes. To address this inconsistency, this work proposes a hybrid configuration for autonomous street lighting systems, concentrating generation and storage of electrical energy in one designated location. Apart from facilitating equipment maintenance, this configuration allows for a reduction in installed PVP power and battery capacity. It also addresses electricity shortages during winter days by incorporating an additional energy source, such as a gasoline electricity–generating set. This paper examines the viability of such a solution using park lighting as an example, within the climatic conditions of the Western region of Ukraine. Optimization of the parameters of the main constituent elements of the proposed autonomous park lighting system, with concentrated generation and storage of electrical energy, was carried out to minimize annual costs. For the optimal configuration, costs were found to be ۴۷% lower compared to traditional autonomous systems with distributed generation and storage of electrical energy.

کلمات کلیدی:

Autonomous street lighting system Photovoltaic system Battery Gasoline electricity, generating set Distributed and concentrated structures Optimization