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Comparative Performance Evaluation of Fixed, Single-Axis, and Dual-Axis Solar Tracking Systems

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Abstract

The study analyzes and compares the efficiency of fixed, single-axis and dual-axis solar tracking systems with data from Jordan's climate. Solar tracking was implemented using a field programmable Gate Array (FPGA) kit from Altera, as shown to significantly improve the amount of energy a system generates. The single-axis tracking system produced an extra 51.4 Wh each day for a total of 702.02 Wh, against the fixed system's 582.95 Wh. The highest amount of energy produced was seen at 70 W for the fixed system, 75 W for single-axis and 80 W for dual-axis. Results also indicated that dust can reduce daily energy output by about 40%, while humidity causes declines of up to 12%. Although the dual-axis system functions better, its reaction to changes in the weather requires the system to be widely cleaned and maintained. The results reveal that solar tracking improves photovoltaic performance more when paired with good environmental management.