Economics and reliability analysis of stand-alone electric power generation system from renewable sources

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Abstract

Because many remote areas are not connected to the electricity grid, it is critical to provide electricity from renewable and environmentally friendly sources. Due to the high cost of the battery bank in the stand-alone photovoltaics (PV)/Battery (BT) solution, electricity is costly and unaffordable. In the conventional arrangement of a stand-alone solution, the battery is used to transmit all of the daily energy to the inverter, making the storage system costly. The energy can flow straight to the inverter without going through the battery, resulting in less expensive and smaller-sized batteries in the new power flow configuration utilized PV system is sized according to the load requirements. In Siwa Oasis, Egypt, the proposed systems design and cost analysis were carried out for three different types of loads. The findings show that the proposed power evaluation approach still significantly lowers total costs due to its ability to reduce PV generating and energy storage capacity based on the load type. The daily load pattern gives the maximum cost savings of 81.4%, whereas the evening load type incurs no cost savings.

In this research work, the effect of the load distribution on the optimum supply configuration is studied where different generation sources are used. The generation sources are PV (with various tracking technologies), wind turbine (WT), Diesel generator (DG), and storage systems (BT) in many configurations are applied to three different load patterns with the same consumption energy and two optimization techniques – cuckoo search (CS) and white shark (WS) – are used and compared to optimize the system sizing.

The sources configuration used in this thesis is PV, WT, PV/WT, PV/BT, WT/BT, PV/WT/BT, PV/WT/BT/DG, for different PV system configurations (fixed, horizontal tracking, vertical tracking, and dual tracking). The load patterns used in this study are a daily load, an all-day distributed load, and a nightly load