

5 Conclusion

The present research studied optimization of hybrid renewable energy systems (HRES), where WT and PV functioned as generation systems and battery banks for storage. A computer program was used to simulate dynamic behavior of these components. By this program, the different combinations of these components were taken into consideration, so that the system with the minimum costs and the acceptable reliability would be selected as the best combination for HRES. The simulation and optimization were carried out for Tarfaya, Essaouira, Zagora and Midelt, and it was shown that among different systems, the hybrid ones are more economical for an off-grid usage, and among the regions Tarfaya has the best COE equal to 0.026 \$/KWh, Essaouira are the next regions. According to the results, hybrid systems are made of combinations of WT and PV systems in which the batteries are employed to store surplus energy mostly for night time. In the non-hybrid systems, especially in PV systems, the capacity of battery bank heavily increases and O&M costs of battery banks in remote area will be a serious problem. Among the non-hybrid systems, due to the appropriate potential and relatively regular nature of the wind, less capacity is required for both WT modules and battery banks, compared to photovoltaic. As a result, WT systems are more economical than PV systems in the studied regions of Morocco except Zagora. Nevertheless, the PVs can be used as a complementary system, covering the weaknesses of WT systems, reducing costs of the produced energy.

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