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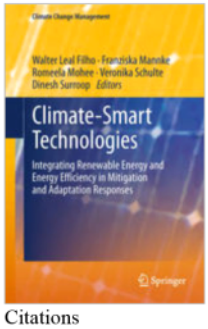
# Optimization of a Stand-Alone Renewable Energy System for a Small Load Requirement

## Abstract

Optimization of a stand-alone Renewable Energy (RE) system involves selecting the best RE resources and components, and sizing the system accordingly to get the most efficient and cost-effective solution. Design and optimization of an RE power system to serve the lighting in a University of the South Pacific car park was carried out using HOMER software and compared to manual calculations. Resource analysis showed that on average the site received 3.8 kWh $m^{-2}$ $day^{-1}$ of solar energy, with 1,387 full sun hours annually. Monthly average wind speed of 3.88 m $s^{-1}$ at 10 m above ground level extrapolated to 15 m (the hub height of the wind turbine) resulted in an average wind speed of 4 m $s^{-1}$, with power density of 70 $Wm^{-2}$. With this wind resource, a Whisper 100 wind turbine would be in operation for approximately 50 % of the time in the year. The complementary nature of solar and wind resources showed good potential for a solar-wind hybrid system. In this study three possible systems—a PV system, a wind power system, and a hybrid power system (PV-wind)—were analyzed. It was found that a hybrid system is the best and most cost-effective option, as it is able to provide reliable power whilst minimizing the need for battery storage compared to a single RE power system. The optimum system comprised 0.270 $kW_p$ PV combined with a 900 W Whisper wind turbine with total battery storage capacity of 440 Ah at 12 V. Manual calculations yielded results similar to the HOMER simulations.



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