ABSTRACT

Rwanda is a country with many hills, thus expansion of electricity is expensive. Hence no wonder that at the present, the major energy resource used in Rwanda is fuel wood biomass where the current national electrification is estimated to be 23% mostly concentrated in towns. So, most of rural villages are not electrified. The aim of this study is to investigate the feasibility of renewable energy technologies, technically and economically; focusing on two renewable resources (solar and wind) to come up with hybrid system to electrify Kinyana village in Kayonza District as this district has been found to have the strongest Wind in Rwanda and then all the collected data were analyzed using HOMER software tools.

The wind data was collected from the installed weather stations in different parts of Rwanda while the solar data were provided internally from the HOMER software and RET Screen. These data are the following: The maximum wind speed at 40 m of height is found at wind mast of Kayonza District and the horizontal solar radiation of 5.13kWh/m²/day was also measured in Eastern province. This is also proven by a solar power plant in this region that is already connected on national grid. The selected village has a typical daily load of 265.14 kWh/day, with an estimated maximum load of 29.2 kW that has been observed during the evening hours from 18:00 hrs to 21:00hrs.

With the simulation in HOMER; Hybrid System (Solar-Wind-diesel generator) composed of 40 kW PV panels, 4 wind turbines with 10 kW rated capacity each; 15 kW diesel generator; 40 batteries of 1, 156 Ah each and the inverter of 20 kW has been selected for this village. This system was chosen due to its low cost of energy which is $0.339 compared to the remaining ones. With 20 years of lifetime considered for this project; it is showed that the required initial capital investment for this project is $ 268,000. Then, the Net Present Cost (NPC) needed for this project is $ 850,480 with a total O&M cost of $ 21,376for the whole system. This has mainly increased by O & M of the diesel generator, batteries and wind turbine. The obtained results show that the system can satisfy the demand at a LeEvilized Cost of Energy (LCOE) of 0.339 $/kWh with renewable fraction of 56% as found in simulated results.

Keywords: Renewable Energy, Rural Electrification, Solar and Wind Energy, Hybrid System, HOMER Simulation and Feasibility Analysis.