Abstract

Stand-alone renewable energy plants are usually unable to generate stable electrical power because of resource intermittency. Consequently, grid operators find it difficult to plan power supply. Employing electrical storage, thermal energy storage, and hybridization in stand-alone plants could provide some solutions. However, electrical and thermal storage have limitations at megawatt scales with major ones being not cost-effective and the increased solar field. Hybridization of multiple sources of renewable energy is a promising way to address intermittency issues.

This paper presents thermodynamic modeling for sizing a steam Rankine cycle based solar–biomass hybrid power plant. Solar system uses parabolic trough technology, and biomass system uses fluidized bed combustion technology to generate steam for power generation. The biomass system plays a significant role in the hybrid operation during the solar intermittency periods. Also, the boiler in a stand-alone mode can generate power post sunshine hours to meet the power demand. Further, the paper presents a case study to emphasize parameters such as solar field area requirements, biomass requirements, system efficiency, intermittency aspects, capacity utilization factor, capex, and levelized cost of electricity for various scales of hybrid systems. The results suggest that hybridization could be a possible sustainable solution.