Abstract:
Sustainable energy resources are essential to meet the world's growing population and extending energy demands. Among the potential solutions, incorporating renewable energy sources into hybrid energy systems holds a lot of opportunities.
This paper presents a design and economic analysis for an off-grid microgrid intending to power agricultural loads. Solar resources and PV-inverter system were modeled using pvlib-python, while the remainder of the microgrid, including the battery energy storage system (BESS) and biogas-based generator (BGG), was modeled and simulated using a custom dispatch method. The same system was modeled in Homer as well, and the outcomes of the designed microgrid were compared. When compared to Homer, the proposed approach reduced life cycle cost (LCC), and levelized cost of energy (LCOE) by 25%, and 20%, and emissions by 85%. In terms of generation, the proposed strategy reduced PV production by 20%, BGG output by 85%, and unmet load and surplus energy by 14% and 65%, respectively. The study additionally addressed an in-depth approach to modeling PV using various data sources and the associated modules and functionalities.

Keywords:
Solar PV, Microgrid, Biogas, Energy planning, performance modeling