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A Thorough Investigation on Hybrid Application of Biomass Gasifier and PV Resources to meet Energy Needs for a Northern Rural off-grid Region of Bangladesh: A Potential Solution to Replicate in Rural off-grid Areas or not?

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Abstract: Rural electrification is a critical global challenge specifically in developing countries and Bangladesh is no exception. Most of the people live in the rural areas of the country and having no access to grid electricity hindering the development of these areas and the overall progress of the country’s economy severely. In this regard, renewable energy based hybrid mini-grid can be a viable solution to ensure access to electricity for all. This paper presents a case study of supplying electricity through hybrid mini-grid to the rural unelectrified areas of the northern region of Bangladesh, and provides an analysis of its business creation, operation and related challenges. The study involves modelling of three alternative configurations for electricity generation with the different combination of solar energy, biomass generator, diesel generator and battery storage resources. Hybrid Optimization Model for Electric Renewable (HOMER) software is used to carry out the techno-economic analysis and identify the optimal off-grid system configuration. The analysis exposed that the per unit cost of electricity from the optimum off-grid supply configuration is much higher than the regulated tariff for grid connected residential consumers and cannot reach grid parity even with the full capital subsidy. However, the cost of off-grid supply is economical than the diesel-only supply option or the cost of owning a solar home system. The analysis further considered different electricity selling tariff to obtain a practical and reasonable payback period to make the proposed hybrid mini-grid system economically worthwhile. From the emission analysis, it is found that the proposed hybrid system would produce 75% lower CO₂ than the existing methods of fulfilling energy needs in the study area.

Keywords: Bangladesh; Hybrid mini-grid; Rural electrification; Solar Photovoltaic; Biomass; Electricity access

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