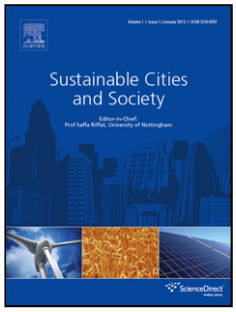

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LOW COST, HIGHLY RELIABLE RURAL ELECTRIFICATION THROUGH A COMBINATION OF GRID EXTENSION AND LOCAL RENEWABLE ENERGY GENERATION

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Highlights:

- Additional renewable energy and storage reduce the cost or rural electrification compared to pure grid extension
- The reliability of the central power grid and of the microgrid are introduced as important parameters
- Results on 20 test cases show that these parameters influence the choice of rural electrification strategy
- Local, renewable energy generation reduces drastically the grid losses: from 23.2% to 8.7% in the best scenario.

Abstract

Globally, 1.2 billion people have yet to be granted access to electricity. Another 2.4 billion receive an intermittent electrical supply due to undersized and unreliable rural power grids. However, existing rural electrification programs focus mostly on extending the central power grid, thus providing an intermittent supply and increasing the losses on the power grid. In the literature, extension of the central grid is unilaterally compared with a stand-alone microgrid solution. In the model for rural electrification presented in this paper, the extension of the central grid is supplemented with local renewable energy generation and storage. The "reliability of the central power grid", the "expected reliability of electrical supply in the village", and the "losses" are also introduced as important design parameters. The usefulness and relevance of the proposed model was illustrated through 20 test cases. For Kanjikuzhi, an Indian village, additional renewable energy can reduce the average cost of electricity by 26%, diminish power interruptions by 40% and decrease grid losses by 62.5%, compared to a simple extension of the central power grid.

Keywords: ; rural electrification; microgrid; renewable energy; grid extension; losses; reliability; design; energy shortage.