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A rising role for decentralized solar minigrids in integrated rural electrification planning? Large-scale, least-cost customer-wise design of grid and off-grid supply systems in Uganda

A. González García; P. Ciller Cutillas; S.J. Lee; R. Palacios Hielscher; F. Cuadra García; J.I. Pérez Arriaga

Abstract-

Increasing Uganda’s low electrification rate is one of the country’s major challenges. Power service is essential to achieve socioeconomic development and poverty reduction, especially in rural areas. This paper shows the advantages of using an integrated (grid and off-grid) electrification model with high geospatial, temporal, and customer-class granularity as the Reference Electrification Model (REM). In universal electrification strategies, REM will help better ascertain the role of minigrids, jointly with grid extension, solar kits, and stand-alone systems. REM has been applied to the Southern Service Territory (SST) to determine the least-cost mix of electrification modes—grid extension, off-grid minigrids, and standalone systems—that satisfies the hourly demand requirements of each customer—residential, commercial, or industrial—considering its individual location. REM incorporates the existing grid layout, the hourly solar local profile, and the catalogs of actual components for network and generation designs. The paper shows that minigrids can provide grid-like service at a significantly lower cost in many circumstances and to a considerable extent. Therefore, minigrid strategies should play a more important role in electrification planning, both transitorily and on a permanent basis, particularly when the central grid suffers from frequent and prolonged blackouts.

Index Terms- universal access, rural electrification, grid extension, minigrids, standalone systems, geospatial electrification planning, power systems design, electrification strategies, Reference Electrification Model (REM).

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