Modelling of an expandable, reconfigurable, renewable DC microgrid for off-grid communities - DTU Orbit (16/12/2018)

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This paper proposes a DC microgrid system, comprising multiple locally available renewable energy sources in an off-grid rural community, based on a commissioned field study carried out in a rural, off-grid village in Nepal, which has solar and wind resource available. Using estimated solar data for the site's location, wind data measured locally, household and population data collected over the course of several months and typical measured domestic demand profiles, DC microgrid system models have been constructed using HOMER and Simulink software to represent the DC system proposed.
This work is innovative in using a range of on-site data collected and measured locally in a commissioned field study carried out over several months to quantify current local resources and loads and estimating future ones based on the local population's current economic and domestic activities, and intended ones. This data is used in determining both the optimal size of the generation and storage elements through HOMER based on long term system behaviour, and to model shorter term system response to changes in generation and load using Simulink, ensuring system stability and grid voltage is maintained. Further novel aspects of this study are that power flow is controlled using adaptive DC droop control on each individual energy source to enable optimal power sharing with minimum power dissipation across distribution lines, and the droop control has been further adapted to the case of storage which can act as a source or a load.

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