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Optimal design and Levelized Cost of Electricity of 100% solar power microgrids in Africa: robustness and sensitivity to meteorological and economical drivers

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To accelerate the rate of electrification in remote places of sub-Saharan Africa and to be coherent with the COP21 Paris agreement, different studies propose the development of autonomous solar microgrid which have a moderate levelized cost of electricity (LCOE) while ensuring a good quality of service. This LCOE directly depends on the storage and PV oversizing needs required locally. In the present work, using high resolution satellite irradiance data for 20 years period and considering load curves for a panel of productive/domestic uses configurations, we show that the optimal design required locally (storage capacity/oversizing level of PV panel fleet) first depends on the temporal pattern of the demand and are typically lower when the demand is based on productive uses rather than domestic. It next depends on the level of the temporal resource/demand adequacy which typically varies in space according to the local climate features.

The costs of batteries, solar panels and the discount rates, obviously significantly determine the LCOE to be achieved with a given microgrid. These economical drivers could also influence the optimal storage/PV oversizing configuration. We further explore the sensitivity of the optimal design to such drivers. This sensitivity could have obviously important implications for all operational and institutional actors involved in the development of such systems in this area. We explore how this sensitivity varies in space and where the optimal design obtained with chosen values of those economical drivers can be considered as robust.