Tanzania microgrid operation

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We organize the rest of the paper as follows. Section 2 presents a background of mini-grid development, regulation, financing, and operation in Tanzania. In Sect. 3, we describe both the methodology and the study area chosen for this paper. Section 4 discusses the results from our LCOE model vis-?-vis the current tariff structure in Tanzania. Section 5 concludes with some policy recommendations.

Mini-grid Projects in Tanzania.

Despite the above regulatory interventions, there is still uncertainty among private developers about the fate of their investments in the arrival of the national grid. Up to date, there is no clear regulatory directive in that regard. However, the regulator envisages the following possible options. Firstly, the mini-grid operator can continue its operations as a small power producer and sell excess electricity to TANESCO. Secondly, in the event where the mini-grid operator is unable to compete with the national utility, the operator has the option to decommission its generation asset and buy electricity from TANESCO as a small power distributor. Lastly, the operator has the option to decommission its generation assets and sell-off its distribution assets to TANESCO.

Electricity regulators in SSA face the choice of applying the uniform national tariff or the cost-reflective tariffs for mini-grid systems operators.

The uniform national tariff is a fixed regulated rate that the regulator charges all customers irrespective of whether they are served by the national grid or by mini-grid systems. The idea behind this tariff scheme is to ensure equality and fairness across all consumer types. Mostly, utility regulators fix the electricity tariff for commercial mini-grid operators at the same rate as the state-owned utility service, which the government often subsides below the cost of supply (Reber et al., 2018). Usually, the main drivers of the tariff scheme are political and social considerations. Mini-grid systems operators struggle to be competitive under the national uniform tariff scheme as their production costs are often significantly higher than the uniform national tariffs.

Under the cost-reflective tariff scheme, the regulator deregulates the electricity rates, and operators are allowed to charge rates that will enable them to recover the power supply costs and earn favourable returns on their investments. With the cost-reflective tariff scheme, economic considerations are the main determinants of the electricity rates underpinned by "willing buyer - willing seller agreements". Therefore, it is perceived as a more effective scheme for attracting private mini-grid developers and encouraging efficient electricity supply (Economic Consulting Associates Viewpoint Mini-Grids: Are Cost-Reflective Tariffs Necessary? What Are the Options? Economic Drivers of Tariff Policy, 2017). However, it does not consider the consumer ability to pay for power.

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This section describes the methodology adopted by this study. We provide an overview of the selected community for the study, followed by the explanations on the LCOE and modeling approach. Later, we describe the data used for this project.

Satellite image of Mafinga Town.

The Iringa region is considered to have one of the highest solar energy resources in Tanzania, as presented in Fig. 3 (ESMAP, 2015). The Global Horizontal Irradiance (GHI) of the region located at latitude 7.67 south and longitude 35.75 east is estimated at 6.24 kWh/m2 (ESMAP, 2015). We use the HOMER software, linked to NASA"s Surface Meteorology and Solar Energy (SSE) dataset, to estimate the region"s average daily radiations. The SSE has proved to be an accurate and reliable source for providing solar and meteorological data for regions with sparse or no surface measurement data (Pavlovi et al., 2013). Additionally, the SSE data set is explicitly formatted to support PV power system designs.

Photovoltaic Power Potential of Tanzania.

The graph in Fig. 4 illustrates the average daily variations in the solar resource data for the Iringa region downloaded from NASA"s SSE dataset.