

# OPTIMAL ELECTRIFICATION PATHWAYS IN SUB-SAHARAN AFRICA (SSA)

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## ABSTRACT

Access to reliable, sustainable, and affordable electricity services is essential for quality of life and economic development. However, about half of the population in Sub-Saharan Africa live without access to electricity. Due to its rapid population growth and accelerated urbanization, Africa is a key driver of growth in global energy demand. However, to meet the United Nations Sustainable Development Goal 7, which aims to achieve 100% electricity access by 2030, the region is faced with a dual challenge: to provide access to the 600 million people currently without access while reaching the millions born every year in areas without access to electricity. A variety of local or national studies have been undertaken in recent years to provide feasible electrification solutions.

This paper first investigates the historical evolution and the current situation of electricity supply and demand to reveal links between electrification and socio-economic factors, as well as energy resources exploration. Next, utilizing an open-source Spatial Electrification Tool (OnSSET), this paper seeks the least cost electrification options for SSA countries, including grid-connection, mini-grid and stand-alone systems, and analyzed the sensitivity of the results relative to the projected population, energy targets, grid generation costs, diesel prices, and solar costs, etc. The results show that in urban areas with the majority of population and close to transmission lines, grid extension is the least cost option, while stand-alone or mini-grids are more economical in rural areas with lower population density and electricity demand. For a certain level of access, the population connected to the grid will be ~ 90% in Senegal by 2030, but investments for grid connection will only account for 70% of total investments for electrification. Considering a scenario with emission costs and renewable subsidies, where grid generation cost is higher and solar cost lower, more spots around the grid will alter into mini-grid solar or stand-alone solar option instead of grid extension.

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