

## Assessing the Contribution of Informal Buildings to Energy Inefficiency in Kenya: A Case of Mukuru Slums

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**Abstract :** Buildings, as they are designed and used, may contribute to serious environmental problems because of excessive consumption of energy and other natural resources. Buildings in the informal settlements particularly, due to their unplanned physical structure and design, have significantly contributed the global energy problematic scenario typified by high-level inefficiencies. Energy used in buildings in Africa is estimated to be the highest of the total national electricity consumption. Over the last decade, assessments of energy consumption and efficiency/inefficiency has focused on formal and modern buildings. This study seeks to go off the beaten path, by focusing on energy use in informal settlements. Operationally, it sought to establish the contribution of informal buildings in the overall energy consumption in the city and the country at large. This study was carried out in Mukuru kwa Reuben informal settlement where there is distinct manifestation of different settlement morphologies within a small locality. The research narrowed down to three villages (Mombasa, Kosovo and Railway villages) within the settlement, that were representative of the different slum housing typologies. Due to the unpredictability nature and informality in slums, this study takes a multi-methodology approach. Detailed energy audits and measurements are carried out to predict total building consumption, and document building design and envelope, typology, materials and occupancy levels. Moreover, the study uses semi-structured interviews and to access energy supply, cost, access and consumption patterns. Observations and photographs are also used to shed more light on these parameters. The study reveals the high energy inefficiencies in slum buildings mainly related to sub-standard equipment and appliances, building design and settlement layout, poor access and utilization/consumption patterns of energy. The impacts of this inefficiency are high economic burden to the poor, high levels of pollution, lack of thermal comfort and emissions to the environment. The study highlights a set of urban planning and building design principles that can be used to retrofit slums into more energy efficient settlements. The study explores principles of responsive settlement layouts/plans and appropriate building designs that use the beneficial elements of nature to achieve natural lighting, natural ventilation, and solar control to create thermally comfortable, energy efficient, and environmentally responsive buildings/settlements. As energy efficiency in informal settlements is a relatively less explored area of efficiency, it requires further research and policy recommendations, for which this paper will set a background.

**Keywords :** energy efficiency, informal settlements, renewable energy, settlement layout

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