Microgrid economics kinshasa

Microgrid economics kinshasa

This paper reviews practical challenges for microgrid electrification projects in low- and middle-income economies, proposing a Social-Technical-Economic-Political (STEP) framework. With our STEP framework, we review recent Artificial Intelligence (AI) methods capable of accelerating microgrid adoption in developing economies.

Many authors have employed novel AI methods in microgrid applications including to support energy management systems, fault detection, generation sizing, and load forecasting. Despite these research initiatives, limited works have investigated the specific challenges for developing economies. That is, high-income countries often have high-quality power, reliable wireless communication infrastructure, and greater access to equipment and technical skills. Accordingly, there are numerous opportunities for the adaptation of AI methods to meet the constraints of developing economies.

In this paper, we provide a comprehensive review of the electrification challenges in developing economies alongside an assessment of novel AI approaches for microgrid applications. We also identify emerging opportunities for AI research in the context of developing economies and our proposed STEP framework.

Affordable and high-quality electricity is essential for the advancement of modern economies. Developing economies, especially those with large rural populations, face significant challenges in achieving sustainable economic and social development due to inadequate electricity access [1]. According to the International Energy Agency, around 775 million people worldwide lack access to electricity, while 75 million more may lose access due to energy affordability [2]. Africa accounts for nearly 600 million of those without electricity, with the majority of the remaining population residing in regions of Asia.

This paper aims to holistically examine AI solutions and their integration within emerging economies, bridging the gap between academic scholarship and real-world contexts. To our knowledge, this paper represents the first such type of review with the analysis of AI applications in microgrids with a specific focus on the limitations inherent in low- and middle-income countries. The chief objectives of this review are

To provide insights into the social, technical, economic, and political (STEP) rural electrification challenges unique to developing economies,

To review the application of AI in the context of microgrids in developing economies, and

To propose future research directions and potential AI advancements in microgrids located in low- and middle-income countries.

Access to electricity in African countries as a percentage of the total population [19]

Access to electricity has been associated with numerous developmental and welfare benefits, such as increased economic opportunities, better quality of life, improved health, and greater educational attainment [20,21,22]. Renewable energy electrification in regions without electricity can yield additional social benefits. Electrification could introduce awareness and opportunities for refrigeration, proper lighting, and electrical based clean cooking, which can all improve the quality of life [23,24,25].

Mapping the challenges for electrification in developing economies: interplay of social, technical, economic, and political elements

In efforts to improve both reliability and electricity access, microgrids are often suggested as an innovative and cost-effective solution [29]. A microgrid is a localized grouping of electricity generators and electrical loads capable of operating independently of the centralized grid. Depending upon the connection with the main grid structure, microgrids can take on two forms--grid-connected or islanded (standalone) [30].