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Application of Ground Source Heat Pump Technology for Cooling in Sub-Saharan African Countries' Buildings

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Abstract : The increased demand for home cooling systems in Sub-Saharan African countries is driven by rapid population growth and rising temperatures due to climate change in the continent. Regular cooling systems, which depend heavily on electricity, contribute to high energy costs. Sub-Saharan Africa already has weak energy infrastructure, and heavy increased greenhouse gas emissions. Ground source heat pumps (GSHPs) technology present a good solution for sustainable and efficient cooling in Sub-Saharan African countries' homes. By using underground temperatures, ground source heat pump technology (GSHP) systems can provide cooling solutions that could significantly reduce energy consumption and emissions and could also offer environmental and economic benefits and alternative technology by transferring heat between a building and the ground. This new technology offers several advantages over regular air conditioning systems, including cost reduction, higher energy efficiency, and a lower environmental impact. Furthermore, ground source heat pump aligns with the transition toward sustainable energy, and this can play an important role in supporting Sub-Saharan Africa's countries' efforts to achieve net-zero emissions targets, at the same time by addressing the growing demand for cooling in commercial, residential, and industrial buildings. Notwithstanding these advantages, the adoption of ground-source heat pumps in Sub-Saharan Africa faces significant challenges. A lack of technical skills personal, limited public awareness, high upfront costs installation, insufficient policy support, and significant barriers to the implementation of GSHP. Additionally, the climatic conditions and the diverse geophysical across sub-Saharan African countries require localised research for ground source heat pumps. This paper investigates the prospects of the use of GSHP systems for cooling in Sub-Saharan African countries and examines the economic, technical, and environmental feasibility. The paper highlights the potential energy savings and the achievable emissions reductions with the GSHP adoption, and this is supported by the case studies from Cameroon that demonstrate the successful of the technology. The research emphasises the need for capacity-building initiatives to develop local expertise in the design, installation, and maintenance of GSHP systems. Training programs and partnerships with national and international organisations can bridge knowledge gaps and ensure that local stakeholders are equipped to implement and manage these systems effectively in Sub-Saharan African countries. Moreover, public awareness campaigns and demonstration projects are vital to showcasing the benefits of GSHP technology and fostering acceptance among consumers and businesses. Collaboration among governments, private sector actors, researchers, and development partners is critical to overcoming these challenges and unlocking the full potential of GSHP technology. The ground source heat pumps offer a transformative opportunity to address the increasing demand for cooling in Sub-Saharan Africa while advancing the region's energy efficiency and sustainability goals. Ground source heat pump (GSHP) technology can become a key component of the region's cooling infrastructure. Their adoption not only supports the transition to low-carbon energy systems but also enhances resilience to the impacts of climate change, contributing to improved living standards and sustainable development in Sub-Saharan African countries.

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