Comparative Analysis of Hydropower and Thermal-fired Plants in Zimbabwe’s National Grid

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Abstract

Zimbabwe's national power generation sector heavily depends on two primary sources: hydropower and coal-fired thermal power stations. The country, with a total installed capacity of approximately 1,700 MW against a demand of 5,000 MW, faces persistent power shortages, leading to imports and frequent blackouts. These two sources present distinct operational characteristics, environmental implications, and resilience to climate and economic pressures. This paper presents a comparative analysis of hydropower and thermal-fired plants in Zimbabwe’s national grid, focusing on their current status, challenges, and future prospects. The study evaluates generation capacity, reliability, cost structure, environmental impact, and long-term sustainability under climate variability. The research will use data from the Zimbabwe Power Company, Zambezi River Authority, policy documents, and relevant government ministries to assess the performance of the power stations. The methodology involves techno-economic and environmental performance assessments. The key indicators to be examined include average annual generation output, operational efficiency, carbon emissions, fuel availability, vulnerability to climate change, and maintenance downtime. Expected results include a clearer understanding of the relative strengths and weaknesses of hydropower and thermal power in Zimbabwe's energy system, including their suitability for long-term sustainability and climate resilience. The study also anticipates identifying policy and investment pathways that support a more diversified, reliable, and low-carbon electricity mix. The water–energy–climate nexus approach will serve as the analytical framework to understand the research's interdependencies, trade-offs, and policy gaps. Finally, this paper aims to contribute to ongoing national and regional discussions on energy security and infrastructure modernization in line with sustainable development goals.