

## Techno Economic Analysis for Solar PV and Hydro Power for Kafue Gorge Power Station

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**Abstract :** This research study work was done to evaluate and propose an optimum measure to enhance the uptake of clean energy technologies such as solar photovoltaics, the study also aims at enhancing the country's energy mix from the overdependence on hydro power which is susceptible to droughts and climate change challenges. The country in the years 2015 - 2016 and 2018 - 2019 had received rainfall below average due to climate change and a shift in the weather pattern; this resulted in prolonged power outages and load shedding for more than 10 hours per day. ZESCO Limited, the utility company that owns infrastructure in the generation, transmission, and distribution of electricity (state-owned), is seeking alternative sources of energy in order to reduce the over-dependence on hydropower stations. One of the alternative sources of energy is Solar Energy from the sun. However, solar power is intermittent in nature and to smoothen the load curve, investment in robust energy storage facilities is of great importance to enhance security and reliability of electricity supply in the country. The methodology of the study looked at the historical performance of the Kafue gorge upper power station and utilised the hourly generation figures as input data for generation modelling in Homer software. The average yearly demand was derived from the available data on the system SCADA. The two dams were modelled as natural battery with the absolute state of charging and discharging determined by the available water resource and the peak electricity demand. The software Homer Energy System is used to simulate the scheme incorporating a pumped storage facility and Solar photovoltaic systems. The pumped hydro scheme works like a natural battery for the conservation of water, with the only losses being evaporation and water leakages from the dams and the turbines. To address the problem of intermittency on the solar resource and the non-availability of water for hydropower generation, the study concluded that utilising the existing Hydro power stations, Kafue Gorge upper and Kafue Gorge Lower to work conjunctively with Solar energy will reduce power deficits and increase the security of supply for the country. An optimum capacity of 350MW of solar PV can be integrated while operating Kafue Gorge power station in both generating and pumping mode to enable efficient utilisation of water at Kafue Gorge upper Dam and Kafue Gorge Lower dam.

**Keywords :** hydropower, solar power systems, energy storage, photovoltaics, solar irradiation, pumped hydro storage system, supervisory control and data acquisition, Homer energy

**Conference Title :** ICPEEE 2022 : International Conference on Power, Energy and Electrical Engineering

**Conference Location :** Jerusalem, Israel

**Conference Dates :** November 29-30, 2022