Yaounde energy storage for renewable energy

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Mathematical modelling of solar PV, PHES, and ultra-capacitor systems and their optimal dimensioning using multi-objective optimization algorithms as potential replacements for HFO and LFO thermal power plants connected to Cameroon"s southern interconnected grid were conducted. On this basis, the ultra-capacitors were specifically sized to serve as the fast-response energy storage system required during the transition period necessary for the start-up of the PHES system.

The impact of the geographical location of the solar PV field on the total annualized cost was investigated in order to inform decision-makers about the best areas for PV installation in Cameroon"s southern region.

Figure 3 depicts monthly solar radiation data for localities with thermal power plants in southern Cameroon. The data in question were derived from52. This figure reveals that solar PV has a strong potential in all geographical zones of Cameroon.

Figure 3 shows the minimum monthly solar radiation for Limbe, Douala, Bamenda, Yaound?, and Bafoussam as 102.10 kWh/m2, 112.29 kWh/m2, 113.83 kWh/m2, 132.74 kWh/m2, and 133.32 kWh/m2, respectively. Limbe, Douala, Bamenda, Yaound?, and Bafoussam have maximum monthly solar radiation measurements of 184.98 kWh/m2, 185.81 kWh/m2, 203.03 kWh/m2, 192.30 kWh/m2, and 205.62 kWh/m2, respectively. As a result, Bafoussam has the best insolation conditions for solar system installation when compared to Bamenda, Yaound?, Douala, and Limbe.

The proposed renewable energy system consists of a PV field, a PHES power plant, and an ultra-capacitor battery system functioning as a fast-response storage system. The layout proposed for the integration of renewable energy resources with the PHES and ultra-capacity energy storage system is illustrated in Fig. 4.

A comprehensive understanding of the mathematical and economic models pertaining to renewable energy production sources and storage systems is imperative for the efficient sizing of each constituent component.

In the literature, several mathematical models are used to calculate the power supplied by photovoltaic solar panels. The mathematical model utilized in this work has been used in several previous studies, including55,56. The model incorporates hourly irradiation and temperature data, as well as the surface area and efficiency of solar PV panels. It is determined by Eq. (1)57,58.

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