Burkina faso energy storage research and development

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The assessment also examines existing enabling frameworks for renewable energy deployment, as well as an overview of the renewable energy financing landscape, including international, regional and national financial instruments and programmes to promote renewable energy investments.

Key recommendations in the report include the reinforcement of institutional frameworks; development and updating of an integrated resource plan with investment plans for grid capacity and electricity storage; development of business models for rural electrification; strengthening of financing capacities, and insurance and tax ecosystems; operationalisation of rooftop solar and net metering; regulation of the solar home systems market; supporting local industries and entrepreneurship; assessment of bioenergy potential; and review of hydropower potential.

This study investigated three scenarios based on the existing microgrid"s characteristics: conventional standalone diesel generators, PV/diesel without battery storage and PV/diesel with a battery storage system which are the main technologies used for off-grid rural electrification in Burkina Faso. The levelized cost of electricity (LCOE) was used to assess the economic performance of each scenario, and the calculations were made using the HOMER software.

It was found that the best among the scenarios considered is the PV/diesel/battery configuration which has the lowest LCOE of US$ 0.524/kWh. The battery storage system for the optimal configuration has a capacity of 182 kWh with about 8 h of autonomy.

It can be inferred from this study that a storage unit is necessary for an optimal management of a PV/diesel microgrid. Indeed, the storage unit significantly reduces the operating and maintenance costs associated with running diesel generators, as well as the excess electricity. The storage system also allows for a greater reduction in CO2 emissions compared to systems without storage.

Access to reliable electricity is essential for the socio-economic development of any country. In sub-Saharan Africa, the electricity access rate is very low, which negatively impacts the region"s economic growth and living standards [1].

Renewable energy sources have been identified as the most suitable alternative to fossil fuel sources for power generation in most developing countries. They are abundant in nature and environmentally friendly compared to fossil fuel sources [4, 5]. They can help reduce fuel costs and challenges due to technical and economic constraints associated with grid expansion systems [6].

PV/diesel hybrid systems without battery storage units, based on the flexy energy concept, have been

developed and implemented for electricity generation in off-grid areas, especially in Burkina Faso and Mali [9, 10]. As shown in previous studies cited below, battery storage was excluded in the flexy energy concept to reduce the replacement cost in the system and the environmental concerns associated with batteries at the end of their lifetime.

Azoumah et al. [9] performed a simulation of three power-generating scenarios, namely diesel generators only, a PV/battery system, and a PV/diesel without battery system. From their analysis, they reported that the PV/diesel without battery system scenario was the most optimal system among the three considered in terms of LCOE and CO2 emissions. They concluded that PV/diesel hybrid systems based on the flexy energy concept could be a better alternative in rural and peri-urban areas if their design management is improved.

Yamegueu et al. [11] carried out experimental work on a PV/diesel system without a battery storage system. The study assessed the behavior of the PV/diesel hybrid system for different ranges of load profiles, representing different nominal power levels of the diesel generator, namely 40%, 62%, 82%, and 105%. It was found that the contribution of the PV array affects the output performance of the diesel generator because the generator was operating at a lower-rated capacity, which results in high fuel consumption and consequently to a high electricity production cost.

However, eliminating batteries from the PV/diesel system has its drawbacks, such as the excess electricity produced by the system is not put into any productive use, stability problems, extended operating hours, high operation and maintenance (O& M) costs, and a short lifetime for diesel generators.

The paper is arranged into five sections. Following this introduction, the study methodology is presented, followed by results and discussion sections. The conclusion wraps up the paper.