ANALYSE THE STUDY OF OPTIMIZATION OF HYBRID ENERGY RENEWABLE SYSTEM

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ABSTRACT

Off-grid services can be provided by renewable energy technologies in underserved areas without the need for extensive and expensive grid infrastructure upgrades. Consequently, relying on a stand-alone system The use of renewable energy is now widely accepted as the norm. This study provides a comprehensive analysis of hybrid renewable energy power generation systems from the perspective of energy sustainability. This article summarises studies pertaining to the design, sizing, optimization, storage, and management of renewable energy systems.
Keywords: Relevant phrases include hybrid energy systems, reliability, cost, unit optimization, storage, and energy management.

1.INTRODUCTION

When compared to single-source systems, hybrid energy systems have many advantages since they use many methods of energy generation, storage, and consumption. [1] One could argue that variety is the spice of life, so why restrict ourselves to using only one energy source or type of energy storage when there are so many others from which to choose? Hybrid energy systems, which can be modified to meet the needs of a wide range of consumers, are an excellent choice in such circumstances due to their high efficiency and low cost. In a traditional, self-contained REPS, the energy storage system (ESS) has a limited service life due to the intermittent nature of renewable energy generation. When the peak power consumption is unpredictable, some systems' ESSs are larger to handle the load [2]. In terms of longevity, usability, and overall cost-effectiveness, a hybrid energy storage system (HESS) is the superior alternative. In this paper, we take a look at the framework and frequent problems of standalone REPS with ESS. [3] Passive, semi-active, and active HESS architectures for use in stand-alone REPS This work introduces decision matrices to evaluate the technical and economic properties of

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energy storage technologies according to the needs of standalone REPS, as there are many such technologies now on the market.

Therefore, the idea of producing hydrogen via nuclear power, which is indeed a solution to reduce carbon emissions, is motivated by the need for a reliable backup system for renewable energy-generating stations that are not connected to a national power grid and can produce energy during off-peak and store it for use during on-peak periods. Nuclear waste storage costs, along with related challenges like proliferation and security of fissionable weapon-grade waste coming out of the reactor core as a byproduct of the end-of-burnup residue of the fuel used in them, or any air- or land-based manufactured event, are all part of the price to be paid. [5]

Hon. Hannah E. Murdock and Mr. André (2019). Today, electricity is essential to daily life and crucial to the orderly operation of any society. It can be produced by a wide range of resources, including renewable and nonrenewable ones. According to a recent analysis of the status of renewable energy around the world, this sector has been increasingly responsible for providing the world's electrical needs. In 2018, the power sector saw an increase of 18 GW in renewable energy installation.[6]

Use of Hybrid Power Plants to Generate Renewable Energy

In modern society, energy infrastructures are more important. Depending on the circumstances, we may talk about your refrigerator, air conditioner, power generator, etc. We all use energy and power, yet surprisingly few people are worried about reducing their impact on the environment. [7] We attempt to make it work financially, but I think there's more to it than that, especially when we factor in our moral obligations. The world's supply of fossil fuels is dwindling quickly, and at the same time, many issues have arisen as a result of the pollution caused by burning these fuels. Therefore, it is crucial that we pay extra attention to energy savings at the moment. In these situations, it is crucial to design energy systems optimally, a difficult task that requires taking into account a wide range of technological, economic, and ecological factors. Modeling such energy systems is typically a challenging undertaking. In the meantime, there are a large number of design variables to think about. This places a heavy burden on optimization, making it critical to abandon traditional approaches. [8]

Methods of Storing Energy

Energy storage has long been acknowledged as essential for the efficient and coordinated functioning of utility grids due to its many benefits. Distributed renewable generation technologies can't be successfully integrated without energy storage. Storage can prevent costly grid upgrades or downtime caused by abrupt demand or the tripping off of any source connected to the nationwide grid system, and

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it can also shift demand during peaks by storing off-peak energy and regulating the grid's frequency.[9]

Azad, Abdus Samad (2020) It is likely that over the next few decades, global energy use, and especially electricity usage, will rise dramatically. The rising standard of living in the world's poorest nations is essential to making this goal a reality. When compared to other forms of renewable energy, hydropower's level of technological expertise in power generation is very high. The paper focuses on the metaheuristic approach to hydropower optimization that has been the subject of recent studies and developments. Emerging initiatives to promote the optimization of hydropower are the topic of this article. Many recent research projects have focused on expanding the operating policies of hydraulic structures in order to achieve unprecedented degrees of adaptability; this article gives a thorough examination of these efforts. Furthermore, the study based on reservoir operation and scheduling of flow and energy output discusses cutting-edge methods for hydroelectric power generation.[10]

2.MATERIALS AND METHOD

To effectively bring electricity to rural areas, it is necessary to have a clearly defined and standardised framework for power generation using hybrid systems. Here's what has to be done: Accurate load forecasting of outlying communities allows for a reliable assessment of demand. Interviews with grain pradhans, teachers, locals, labourers, etc. can also help with load assessment. When conducting a load survey, it is possible to take into account the following factors: the need for street lighting; the number of homes, schools, hospitals, and other commercial establishments; the number of small-scale industries; and the need for other services.

The potential of wind, MHP, solar, biomass, and biogas, along with other renewable energy sources, can be calculated using existing meteorological data to form the basis of a resource assessment.

Issues/Restrictions:

Considerations for the economy and the environment, as well as the number of people employed, are included in the annual demand for electricity, the reliability of the power supply, the net present cost, and the cost of doing business.

Hybrid renewable energy system meets demand . One way to accomplish this is to combine renewable energy with more traditional forms of power.

Here are some examples of hybrid renewable system configurations:

Two types of hybrid renewable energy systems (HRES) include solar photovoltaic (PV), wind (W), and fuel cell (FC) systems.

The Hybrid Reverse Energy System (HRES) uses wind and battery power.

Biomass, wind, and diesel-powered HRES generators

Photovoltaic, Wind, Biomass, and Fuel Cell High-Reliability Energy Sources

After settling on a certain setup for the system, optimization is next carried out using an appropriate optimization method. Power reliability and system life-cycle cost evaluation are required to choose an optimal combination for a hybrid system to fulfil the load demand.

Analysis of Power Reliability

When developing a hybrid system, ensuring the power supply is reliable is a crucial step. The load must be met in the most efficient and cost-effective manner possible by the hybrid energy system. Different strategies are employed to determine the hybrid system's dependability. System Performance Level (SPL), Loss of Load Hours (LLH), Loss of Power Supply Probability (LPSP), and LOLH LPSP measures how likely it is that the hybrid system will fail to provide enough power to meet the load demand. The likelihood of overloading the system's power supply, or LOLP, is the rate at which system demand rises above available power. [11] In other words, the SPL is the chance that the load won't be met.

Expenditure dissection for the whole system

There are a number of economic metrics that may be applied to the cost of the system, including the net present cost, the levelized cost of energy, and the life-cycle cost. [12]To calculate the net present cost, add up the prices of all the parts of the system at the outset plus the prices of any replacement parts that will be needed during the project's lifetime plus the price of regular upkeep. In most cases, the lifespan of a PV system is defined as the lifetime of its modules. The Levelized Cost of Energy (LCOE) is defined as the total annualised cost of the system divided by the annual electricity delivered by the system.[13]

3.RESULTS

Table 1. Characteristics of each of the energy storage

Attributes	Efficiency	Maturity of technology	Cost	Energy density	Power density
CAES	70%	Mature	High	High	High
PHS	75 %	Mature	High initial cost	Depends on the size of reservoir	Depends on the height distance between

					reservoirs
Hydrogen	60%	Early stages of mature	High	Depends on hydrogen reservoir	Depends on speed on reaction
Fly wheel	90%	Mature	Low	Low	High
Super capacitor	95%	Immature	High	Low	High
SMES	95%	Immature	High	Low	High
Battery	85%	Mature	Low	High	High

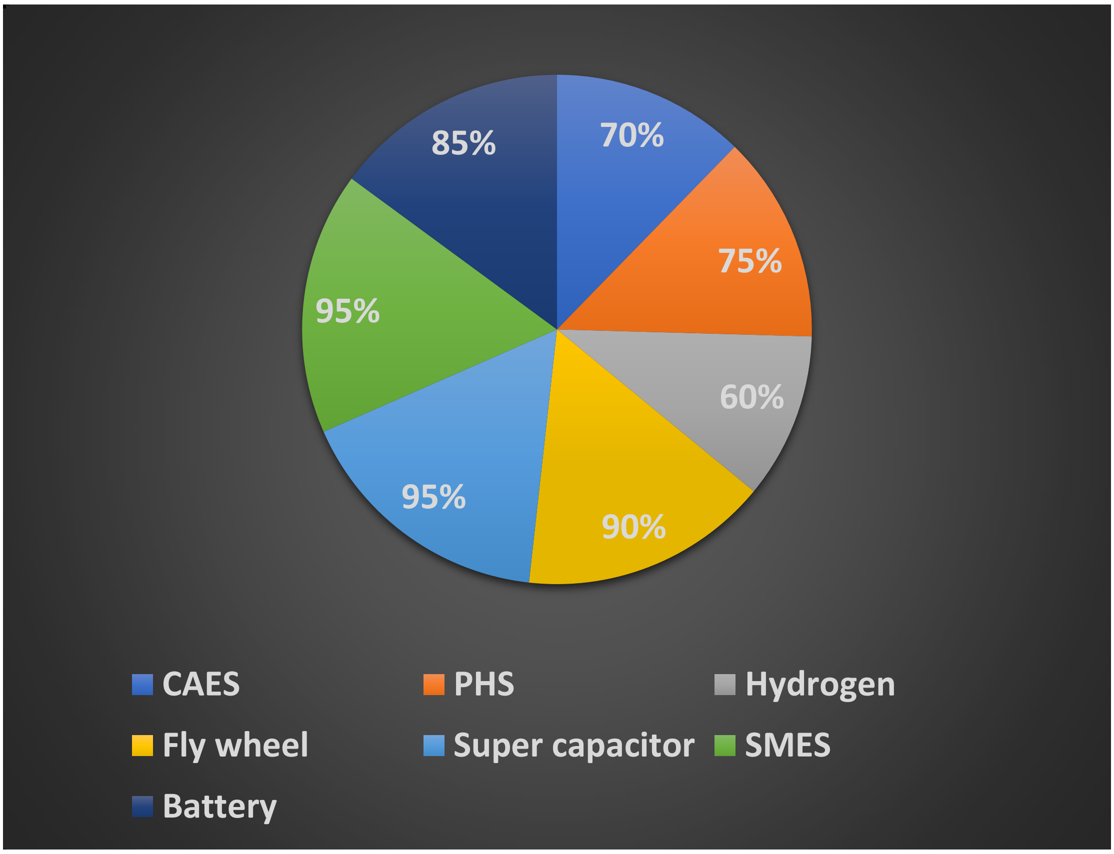

Fig 1. Characteristics of each of the energy storage

SMES is the cutting-edge technology with the maximum efficiency, but it comes at a significant price because it requires the use of superconductive wiring in the coil. Applications where sufficient technical support is unavailable should not utilise hydrogen storage or super capacitors.

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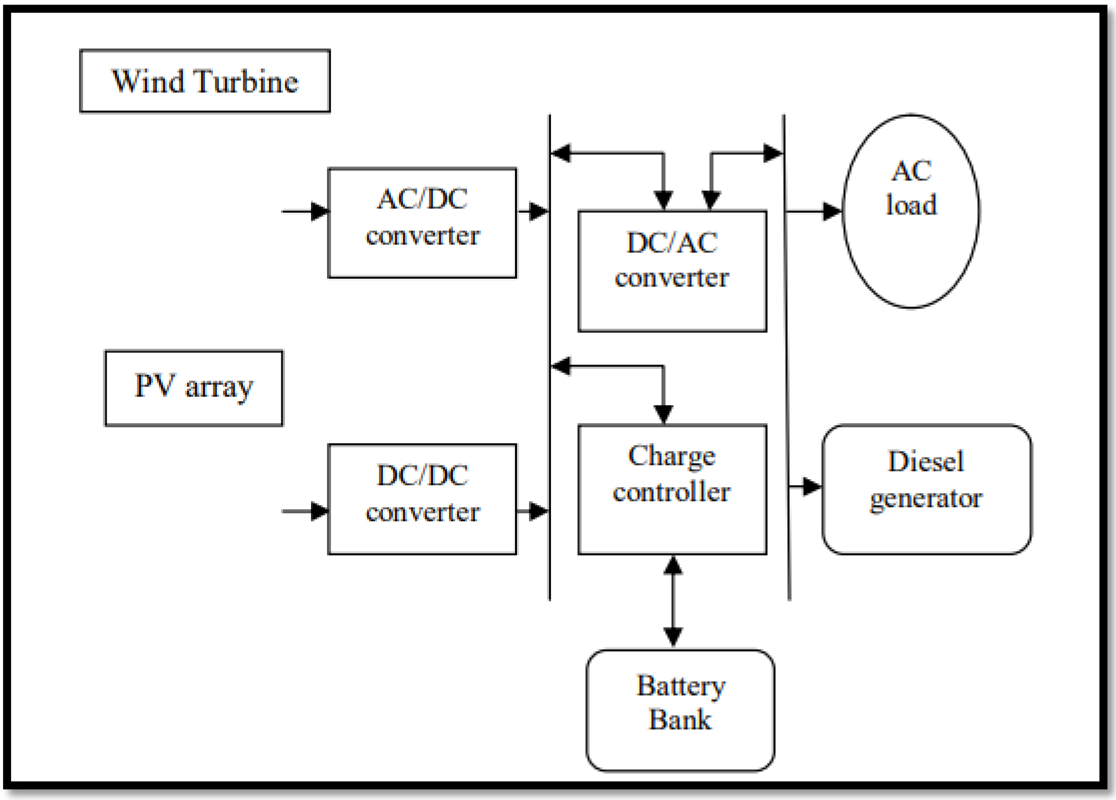

Fig 2. PV/wind/battery/diesel generator HRES

A Hybrid Renewable Energy System (HRES) combines multiple renewable energy sources with a conventional source (such a diesel or gasoline generator) and storage to meet local demand.

4.DISCUSSIONS

Sizing hybrid renewable energy and alternative energy (RE/AE) systems has been extensively examined because of its importance. It's a way to minimise overall system costs without sacrificing reliability, as stated in , when figuring out how big certain parts of a hybrid system should be. Undersizing can result in a failed power supply or inadequate power being delivered to the load, [14]while oversizing the system components would increase the system cost. Designers must locate a workable optimization method for choosing the best possible system configuration. [15] The hybrid system can be optimised in a number of ways, including through the use of graphical building methods, a probabilistic approach, an iterative technique, AI-based methodologies, and multi-objective design. The study and development of renewable technology have advanced greatly. Still, there are several limitations to their usefulness and effectiveness. [12]

5.CONCLUSIONS

Despite the intermittent nature of renewable energy sources like wind and solar,

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hybridization between two or more sources with complementary characteristics has emerged as a key strategy for enhancing reliability and reducing the cost of renewable energy output. Incorporating proper energy storage technology has also been demonstrated to be crucial in transforming erratic intermittent energy sources into more consistent, dispatchable forms. However, the hybrid power system's design, control, and optimization are not simple tasks. For a hybrid system to be cost- and reliability-effective, component sizing must be optimised. To sum up, the presented literature has provided an overview of the trends, directions, and prospective inclination of study into the optimal size of hybrid renewable energy systems. It has been proven that in distant parts of the world, renewable energy generation that does not rely on the grid or conventional fossil fuels is a viable option for providing electricity.

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