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Coastal Areas: A Standalone Solar Wind Diesel Hybrid Energy System

Rehaman
Department of Electrical and Electronics Engineering, SRM University, Chennai
Corresponding Author: rehamaneee@gmail.com

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Abstract*: Access to power at all times has become essential for a nation's sustained development in the modern era. One of the main obstacles to Bangladesh's economic growth is the power crisis. Bangladesh does not have a reserve for fossil fuels. In Bangladesh's coastal regions, the abundance of renewable energy sources, such as wind and sun, offers prospects for hybrid energy systems based on renewable energy. Energy production using a hybrid system lowers generation costs and contributes to energy cost parity. Once more, a hybrid energy system with independent renewable energy will lower grid load demand and be environmentally benign. This study suggested an affordable standalone solar-wind-diesel hybrid power system architecture for a Bangladeshi coastal region. A hybrid power system simulation was conducted while taking into account various variables for a coastal area design. A thorough economic analysis and comparison with diesel- and solar-powered energy systems make it abundantly evident that the suggested hybrid power system is a financially sensible option for Bangladesh's coastal regions.*

Keywords*: Wind energy, solar energy, standalone energy systems, renewable energy, coastal areas, and hybrid energy systems*

I. Introduction

With a population of about 160 million, Bangladesh is a developing country with a 70% electricity availability rate. The need for power is rising significantly in developing nations like Bangladesh, whose economies are expanding quickly. Due to a number of factors, including population growth, the desire for higher living standards, and overall economic and industrial expansion, the current need for energy is rising daily. The demand for electricity is currently growing at a rate of around 10%, and this rate is predicted to increase in the years to come. Bangladesh now has a 9500MW power demand, whereas only 6000–7000MW of power is generated. The derated capacity is 7823 MW, whereas the installed capacity is 5793 MW. By 2017, demand is predicted to surpass 9,000 MW. Therefore, there is a lot of load shading in Bangladesh. Once more, a significant portion of Bangladesh's energy comes from fossil fuels, particularly gas. Eighty-four percent of energy generation is powered by natural gas. However, ten years would be taken off the current proved reserve. Coal continues to be a primary fuel for power generation worldwide. There are enough high-quality coal deposits in Bangladesh. However, coal mining is only getting started. There is still uncertainty around coal and gas exploration. The fact that fossil fuel-based power plants are not environmentally friendly is another significant problem.

In Bangladesh, alternative energy generation methods are urgently needed. Renewable energy, which is plentiful in nature, can help address the shortage of energy resources. Since renewable energy doesn't produce any pollutants or toxins that are bad for the environment, it is sometimes referred to as green or clean energy. In order to operate more sustainably and to take advantage of the limitless supply of renewable energy, a large portion of the world is currently switching to renewable energy sources for powering homes and businesses. In some parts of Bangladesh, renewable energy resources such as solar, wind, hydro, and tidal could be used to build power plants that rely on renewable energy. Bangladesh is located between latitudes 30°22' and 21°32' north and longitudes 99°02' and 29°14' east. The coastal region in the country's south has enormous potential for the establishment of solar and wind power. Located at latitudes 21°49' north and longitudes 90°7' east, Kuakata is a picturesque seaside beach in southern Bangladesh. Kuakata's total population is 174921. The beach's primary draw is its ability to provide views of both sunrise and sunset from certain spots. Sloping into the Bay of Bengal is this sandy beach.

The azure sky, vast expanse of ocean, surrounding evergreen forest, rows of coconut trees, boats of all types with their vibrant sails, and surfing waves are some of Kuakata's other attractions. Additionally, Kuakata serves as a refuge for winter migrating birds. As a result, Kuakata's natural beauty has made it a popular tourist destination. At a

height of 50 meters, the average yearly wind speed is 6.742 m/s, which is sufficient to capture wind energy, and the daily sun radiation is 4.651 kWh/m^2, which is appropriate for installing a solar energy system. The energy needs of this coastal region can be satisfied by implementing an off-grid hybrid energy system. Because the energy sources can work in harmony, hybrid energy systems that incorporate renewable energy sources enhance load factors and reduce maintenance and replacement costs. However, determining the right kind and scale of renewable energy system is crucial to building an efficient hybrid energy system. The feasibility of a hybrid system that incorporates renewable energy as a diesel generator substitute is being investigated. Wind-diesel hybrid power systems significantly lower greenhouse gas emissions, fuel usage costs, and the need for fuel storage. Several academics have conducted performance analyses of solar-wind-diesel hybrid systems. The optimization of solar-wind hybrid system sizing has been studied. The off-grid solar-wind-diesel hybrid power system design for Kuakata, Bangladesh, is presented in this study along with a discussion of the various components of a hybrid energy system. To validate the design, a thorough economic analysis of the suggested system is also conducted.

II. Research Method

An ideal freestanding hybrid system design is put forth in this paper for a Bangladeshi coastal region. Other coastal regions and certain isolated parts of Bangladesh can use this system design. In order to plan a hybrid energy system, energy resources are first examined to determine which ones are best. A hybrid energy system is then created employing the most appropriate energy resources. The simulation program HOMER (Hybrid Optimization Model for Electric Renewables) is used to plan the best sizes for the various system components. Energy balance computations are carried out by HOMER for every possible system configuration. The system cost calculations are examined and take into consideration expenses like fuel, capital, replacement, operation, and maintenance. The purpose of this economic analysis is to ascertain whether the suggested system is feasible. To verify the feasibility of the suggested system, comparisons with diesel-based and solar photovoltaic (PV)-based energy systems are examined.

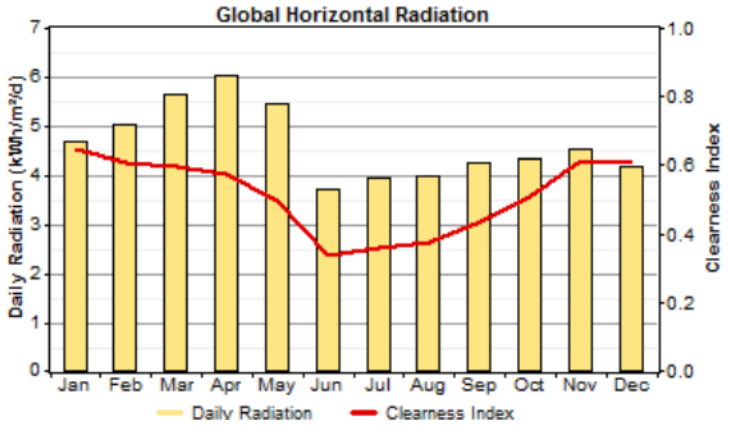

Fig 1: Radiation and cleanliness based on daily basis

along with a discussion of the various components of a hybrid energy system. To validate the design, a thorough economic analysis of the suggested system is also conducted.

III. Conclusion

An Electricity has become a vital necessity in modern society. Bangladesh's extreme electricity shortage is now endangering the country's economic growth. Alternative energy sources like wind and solar PV may be viable options in coastal regions where grid extension or connection is impractical. Even if there are already technologies for renewable energy systems, only one of them is able to supply the full load and is also less profitable. A standalone solar-wind-diesel hybrid energy system may be an affordable option for Bangladesh's coastal areas, which have an abundance of renewable energy sources. Additionally, it will lessen grid strain. Additionally, this hybrid system lowers petrol emissions and contributes to a reduction in environmental pollutants.

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