

**PERFORMANCE ANALYSIS OF AN INSTALLED
WIND, SOLAR, DIESEL AND BATTERY HYBRID
POWER SYSTEM**

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Degree of Master of Science

Department of Mechanical Engineering

University of Moratuwa

Sri Lanka

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
Master

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Prof. R. A. Attalage,
Deputy Vice Chancellor,
University of Moratuwa.

Performance Analysis of an Installed Wind-Solar-Diesel and Battery Hybrid Power System

ABSTRACT:

Hybrid power system is identified as most economical solution for providing electricity to communities currently isolated from the national grid and mostly main land. Recently, first Solar wind diesel Battery Hybrid commissioned in one of the northern Island of Sri Lanka called Eluvathivu, as a pilot power plant for demonstrating the maturity and feasibility of hybridization of different power sources. One of other objective of implementing this project was train CEB staff to prepare them for implementing similar projects on the other Islands. During this study performance analysis of this power system was carried out using HOMER pro software. It was identified that initial capital cost of the hybrid system is more than 10 times higher than diesel power system. However present worth value of the hybrid system will be \$ 1,152,154 and discounted payback will be less than 4 years. Sensitivity analysis was done using future load demand demonstrates that design configuration of hybrid power system can be sustained maximum average load up to 235kWh/day and when the hybrid system operates in higher load demands than design, overall efficiency of the system increases. Sensitivity analysis was done for possible expansion of the current system illustrates installed configuration is the optimum configuration to meet the site conditions. Performance of the hybrid system very much depends on wind speed of the Island. When the wind speed exceeds cut in speed of wind turbines, 1m/s of increment of wind speed will result more than 6% increment of renewable fraction of the system. 0.5 kWh/m²/day increment of solar scaled average increment will generate around 7000kWh/ year of additional electrical energy. However cost of energy and net present cost of the power system do not depend on the variation of solar radiation since almost all the additional energy generated due to increment of solar radiation is accounted as excess energy to the system. When analyzed using actual data of hybrid power system with output predicted by using HOMER Pro, it was observed that HOMER Pro under estimates total renewable energy generation and total unmet load of the hybrid system and overestimates generated energy by the diesel generator and total electricity consumption. Therefore estimated values of COE and NPC are over estimated.

Key Words; Eluvathivu Island, HOMER Pro, Hybrid Power System

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ABBREVIATIONS

HOMER	Hybrid Optimization of Multiple Electric Renewables
NREL	National Renewable Energy Laboratory
COE	Cost of Energy
NPC	Net Present Cost
STP	Standard Temperature and Pressure
ADB	Asian Development Bank
PV	Photo Voltaic
NCRE	Non-conventional Renewable Energy
CEB	Ceylon Electricity Board
DGM	Deputy General Manager