Optimization of Hybrid Renewable Energy in Malaysia Remote Rural Area Using HOMER Software

Siti Sufiah Abd Wahid
Faculty of Electrical Engineering
Universiti Teknologi MARA
(UiTM)
Masai, Johor, Malaysia

Yanuar Z. Arief
Dept. of Electrical and Electronic Eng.
Faculty of Engineering
Universiti Malaysia Sarawak
(UNIMAS)
Kota Samarahan,, Sarawak, Malaysia
ayzulardiansyah@unimas.my

Naemah Mubarakah
Dept. of Electrical Engineering
Faculty of Engineering
Universitas Sumatra Utara
(USU)
Medan, North Sumatra, Indonesia

Abstract*—Renewable energy resources can be seen as an alternative energy to capture the remote rural electrification's problems. Installing and operating a renewable energy generation is not difficult but it requires cautious step as to make sure maximum use of energy can improve the electrification rate. In this work, the evaluation of potential of solar, wind and biomass energy for three locations in Malaysia's rural remote area including Pontian, Kerteh and Teluk Intan was performed using HOMER software. The results revealed that with the same rating and operating hours of biomass generator, all locations have high empty fruit bunch (EFB) biomass potential and is able to fulfill the load demand with equal annual electricity production of 601,979 kWh/year and a low cost of electricity (COE) of $0.342/kWh. Meanwhile, Pontian generates the highest annual solar electricity generation of 543,509 kWh/year due to the large size of 400 kW PV panel of the system. However, the COE produced is expensive. On the other hand, with the highest solar irradiation received in Kerteh, the PV stand-alone system requires lower size of 350 kW PV panel but at the same time is able to fulfill the demand with the lowest COE of $0.442/kWh among other locations. Finally, wind potential is not feasible in Malaysia due to low average wind speed recorded. However, the largest amount of wind output power of 16,625 kWh/year was generated in Kerteh which recorded as the highest wind speed and, in the end, produced the cheapest COE of $0.474/kWh compared to other locations.

Keywords*—HOMER, renewable energy resources, remote rural area, PV system, biomass, wind energy, net present cost, initial capital, operating cost.

I. INTRODUCTION

Electricity energy has been one of backbones for supporting socio-economic development to a modernize country as growing financial in industries and development in the standards of living is the reason of rising in energy consumption. Fossil fuels energy such as coal and natural gas of conventional energy contribute to greenhouse impact and start to appreciate natural resources in order to help electrification in some inaccessible rural areas. Based on the current rising trend of fuel prices in the world market, Malaysia government perceived the potential of renewable energy as an alternative option to make sure the sustainability of energy resources [1].

The renewable energy resources is an alternative energy to capture the remote rural electrification's problems since the off-grid hybrid renewable energy focusing in rural area is to reduce the poverty rate. The combination of two or more hybrid renewable energy eventually give advantages in supporting the shortcoming of electrical energy and give strength to unpredictable renewable energy resources [2]. However, a major problem with this kind of application is to find the optimum hybrid energy that can satisfy customers' demand with minimum cost. This problem can be overcome by doing a deep research on the potential of renewable energy system.

The main objective of this work is to simulate a hybrid renewable energy sources which consist of photo voltaic (PV) system, wind turbine, and biomass generator at Malaysia rural remote area in term of technical and economic aspects. This work also compares the cost for hybrid renewable energy sources with stand-alone biomass and PV for electricity source.

II. METHOD

A. HOMER software

HOMER stands for Hybrid Optimization of Multiple Electric Renewables is a software developed by the National Renewable Energy Laboratory (NREL), US to design and evaluate technically and financially the options for off-grid and on-grid power systems for remote, stand-alone and distributed generation applications. HOMER calculates the mathematical data and generates results of feasible configurations sorted by net present cost (NPC) to compares various design configurations on the basis of operational and economic rates. The possible system configurations can be evaluated from HOMER's optimization and sensitivity analysis. In total, there are three principle tasks modelled by HOMER which include the simulation, optimization and sensitivity analysis.

Fig. 1 shows the HOMER simulation concept in hybrid renewable energy sources simulation. Three cores of capability of HOMER software which consists of simulation, optimization and sensitive analysis. The result simulates all potential combinations of components depending on the different scenarios. HOMER filter and optimize the best configuration and then it displays a list of configurations sorted according to lifecycle cost.