Chapter 1
Solar Hybrid Power System for Marine Diesel Engine: UMT Vessel Experience

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ABSTRACT

Like all modes of transportation that use fossil fuels, ships produce carbon dioxide emissions that significantly contribute to global climate change and ocean acidification. Additionally, ships release other pollutants that also contribute to the problem and exacerbate climate change. Considering the large volume of ships on the high seas, ship emissions pose a significant threat to human health. The ocean is exposed to vast amounts of sunrays and has a great potential to be explored by the maritime sector and green power industry. Solar energy hybrid assisted power to support auxiliary power for the instruments on board the vessel is explored in a UMT vessel. The vessel that is used in this case study is Discovery XI, which is a 16.50 meter diving boat owned by University Malaysia Terengganu. The study explores the feasibility of using solar energy as a supporting power for marine vessel auxiliaries. The reduction of fuel usage after installing the solar PV system on the boat is determined, as well as an economic analysis. The power requirement for the vessel's electrical system is estimated. The fuel and money saved is also estimated for comparison purposes of the vessel using the solar PV system and the vessel without the PV system. Economic analyses are performed, the Annual Average Cost (AAC) between a vessel using solar PV system and a vessel without solar PV system is estimated, and the period of the return of investment for the vessel with solar PV system is also estimated. The use of a photovoltaic solar system to assist the boat power requirement will benefit the environment through Green House Gas (GHG) reduction, and the use of solar as a supporting alternative energy could cut the cost of boat operation through fuel savings.

DOI: 10.4018/978-1-4666-4317-8.ch001

INTRODUCTION

The current oil price is a global concern. The rise in oil prices has exacerbated global imbalances. Most fleet today use diesel engine to drive and power up the ships. When the diesel fuel burns inside the engine, it produces a complex mixture of thousands of gases and fine particles that contain more than 40 toxic air contaminants. To tackle these issues, an effort in finding the alternative energy is essential. A lot of studies have been carried out in order to find alternative energy to replace the fossil fuel with other renewable energy resources. In the maritime sector, solar energy is a great potential to be explored and it is the right impetus for the maritime sector towards green power industry. Solar energy promises to reduce usage of fossil fuels with consequent economic and environmental benefits. Solar energy can be extracted through the use of concentrator cells system and thermo photovoltaic systems. Photovoltaic is a system that directly converts sunlight into Direct Current (DC) and can be fed into any DC power load system.

Being dependent on fossil fuels and gas increases the market prices and fluctuates the global economy. Like all modes of transportation that use fossil fuels, ships produce carbon dioxide emissions that significantly contribute to global climate change and ocean acidification. Although shipping may be a more efficient mode of transport than planes or trucks, it is indisputably a major source of carbon dioxide and other greenhouse gas releases into the planetary system.

This study focuses on the potential use of solar energy as a supporting power for the marine vessel auxiliaries system, towards reduction of fuel usage on board ships. The study compares the diesel fuel used by the generator of the vessel before and after use of the solar PV panels by carrying out solar PV panel experiment and numerical analysis and to determine the investment return by carrying out economic analysis.

The study is divided into two parts. The first part is fieldwork where solar experiments are conducted on board of Discovery IX. She is navigated around Kuala Terengganu River mouth and around Kuala Terengganu coast for two days. The second part is laboratory analysis where the collected data is analysed.

METHODOLOGY

The methodology is divided into three parts. The first part is data collection by fieldwork, the second is Numerical modelling for power requirement and the third is economic analysis.

Data Collection and Field

This fieldwork involved a solar experimental setup on board of Discovery IX. The solar PV panels were deployed from 9.00 a.m. until 5.00 p.m. and the experiments ran for two days. The experiments were broken into three parts. The first experiment was to find the power output from the solar panels with the equivalence solar radiation intensity without the disturbance of load from the boat electrical system. The second experiment was to find the fuel consumption of the generator and experiment three was to find the capabilities of the solar panels to support the boat electrical load.

Secondary data collected from the diving boat, Discovery IX were the plans and electrical distribution drawing and data on auxiliary power consumption. Data on solar radiation intensity was collected from the Renewable Energy Research Center, data on the specification of solar panel and other data and facts required including the current market price of the fuel and solar panels was obtained from the Internet.