A Doorway to Greener Shipping Means Utilising Advanced Hybrid Power System

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Abstract:

This paper gives a review of the future for a cleaner planet shipping. This presents the design of hybrid solar wind turbine system for the power generation system by utilizing both solar and wind renewable energy to shipping industry. And its part to reduce global carbon dioxide emission by taking advantage of green and renewable energy and finding new and innovative ways to power vessels. The world is facing the challenge of continuously increasing energy consumption. At the same time, the energy resources are getting scarcer. The use of clean and renewable energies, such as solar energy for instance, is proposed as a method to improve the ship efficiency. Ships can get the benefits from solar energy due to the fact that most of their upper decks are always exposed to the Sun, especially in sunny water regions. Future solar cells may produce electricity in all weathers. Thus we will discuss here a cost-effective and high-efficiency graphene based conducting composite tailored all-weather solar cell that can be actuated with raindrops and sunlight. The optimization analysis is conducted for generating most feasible system configuration and determines the quantity of components in the hybrid energy system, in order to meet the load demand of machineries onboard and achieve the autonomy power supply with storing excess power generated in batteries storage for the sustainable energy storage. In this paper, we study the performance comparison of both solar and wind energy system also working together as a hybrid system. In addition, we will propose a major advancement in the hybrid system by incorporating the basic principle of a Semi-PMM (semi perpetual motion machine) to meet the energy demand and provide an efficient rotation at low wind pressure and discontinuous wind flow for a period of time.

Nomenclature:

PV = photovoltaic

WT = wind turbine

RES = renewable energy system

UPS = uninterruptable power supply

PWM = pulse width modulation

HAWT = horizontal aero wind turbine

PMM = perpetual motion machine

CB = carbon black

PTFE = poly tetra fluoro ethylene

1. Introduction:

Ships should be designed for the minimum power requirement and ship operation optimized for maximum efficiency. This concept meets these challenges and achieves 70% reduction in carbon dioxide emissions compared to a similar size vessel of today. An efficient powerplant concept with fuel cells brings fast energy savings while sales and solar power reduce emissions significantly the vessels cargo hoe is also used optimally for cargo storage. Ships should be designed for the minimum power requirement and ship operation optimized for maximum efficacy. This concept meets these challenges and achieves 70% reduction in carbon dioxide emissions compared to a similar size vessel of today these savings are achieved by reducing the ship's weight introducing a new loading concept an adding a modern propulsion system and an efficient powerplant concept with fuel cells brings fast energy savings while sales and solar power reduce emissions significantly the vessels cargo hoe is also used optimally for cargo storage.

Figure 1.

2. Renewable Energy.

. Island areas in maritime environments present the advantage of having several primary resources in their neighborhoods. Concerning the development and maturity of renewable energies over recent years, the main sources that can be used seem to be solar and wind energies, which

present a high technical level of maturity and the most interesting cost [1,2]. Furthermore, among the
marine energies available from the ocean, tidal and wave energies are currently two of the most advanced and promising technologies, with a better maturity level than other marine energies such as thermal and salinity gradient conversion energies [4]. Marine energies have the advantage of a good predictability and a high available energy level [1,2]. This part of the review aims to briefly present these four renewable energy sources in terms of the operating principle, main technologies existing today, and temporal resource characteristics. An overview of the main technologies currently existing is shown in Figure 2.

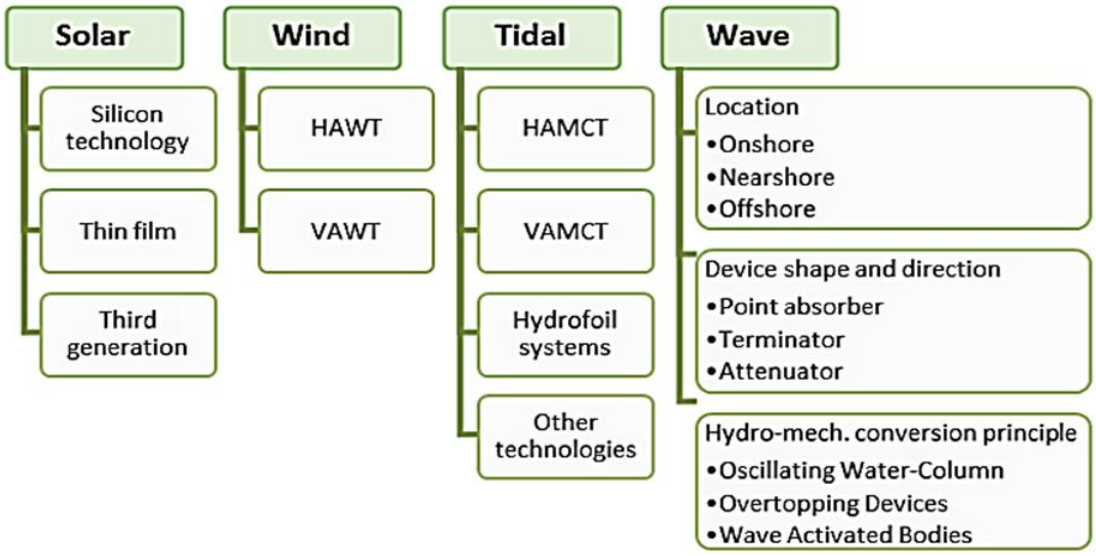


Figure 2. Solar, wind, tidal current, and wave energy converter technologies classification.

3. Hybrid System (Wind + Solar).

Hybrid solar PV and wind generation system become very attractive solution. Combining the two sources of solar and wind can provide better reliability and their hybrid system becomes more economical to run since the weakness of one system can be complemented by the strength of the other one. The integration of hybrid solar and wind power systems into the grid can further help in improving the overall economy and reliability of renewable power generation to supply its load. Ten years ago the concentrator cell was only ~30% efficient compared with more than 40% today with the potential to approach 50% in the coming years. Wind turbines (WTs) are classified into two types: horizontal-axis WT (HAWT) and vertical-axis WT (VAWT). The highest achievable extraction of power by a WT is 59% of the total theoretical wind power.

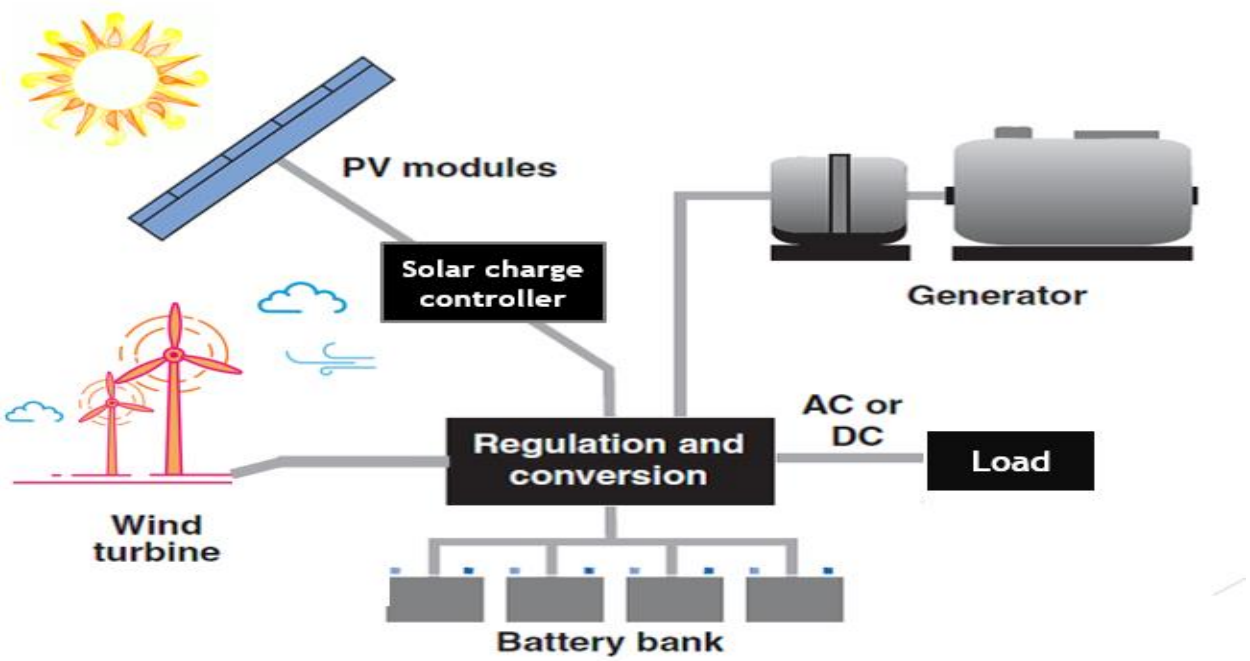


Figure 3. hybrid solar wind system

3.1.1 Optimization

A solar PV and wind systems can't provide a continuous supply due to the fact that those systems will generate electricity only during sunny and windy days. Hence, a combination of these two sources improves overall energy output especially if they are connected to grid. A proper optimization is required to ensure having optimal number and size of PV and WT. With the aim of maximizing the Net Present Value of a hybrid PV-wind systems connected to electrical grid. Clean PV panels could produce extra power, with 31% to 35% on the maximum solar intensity, compared to panels with dust.

4. Review of Hybrid System

Multisource systems that include marine energy are still scarce. As wind turbines now reach a high level of maturity, most of these projects consider offshore wind turbine use. Two categories of projects can be identified, according to the maturity level and the development status. Several projects have been tested under real sea conditions (meaning potentially severe environmental conditions) either at a reduced-scale or at full-scale (Section 3.1.1), whereas others have still not progressed beyond the concept step.

5. Development of the hybrid system

This design is proposed by Arttu-Matti immonen.The concept is to have round shape design which features flexible photovoltaic modules.With the virtue the design can accumulate solar power during daytime, also when wind gets stronger.This system produces electricity through the dynamos with each wings.The round shape eliminates the need to turn and adjusting according to the direction of sunshine.However, it can also harness wind energy as it's a VAWT (Vertical Air Wind Turbine).Also, it does not need the complicated head mechanism of the horizontal axis turbines.It leads to the effective power generation from low pressure winds.They are independent of wind direction and can be constructed in small size.The model efficiency can be increased by implementing certain modifications like ;

- All Weather Solar Cells
- VAWT attached to a Semi-PMM (Perpetual Motion Machine) through special shaft arrangement. Connected to the generator via flywheel system.

Tailored all-weather solar cell that can be actuated with raindrops and sunlight to produce electricity are dye-sensitized solar cell coated with a whisper-thin film of graphene based conducting composite.

As the rain drops spread quickly to periphery, forms EDL (electrical double layer) pseudo-capacitance at raindrop/graphene interface and dragging electron migration and charging at the front of the raindrops. This repeated charging/discharging processes yield persistent electric signals including current and voltage. Can be constructed by combining G-CB/PTFE conducting film.

(G-graphene, CB-carbon black, PTFE- polytetra-fluoroethylene)

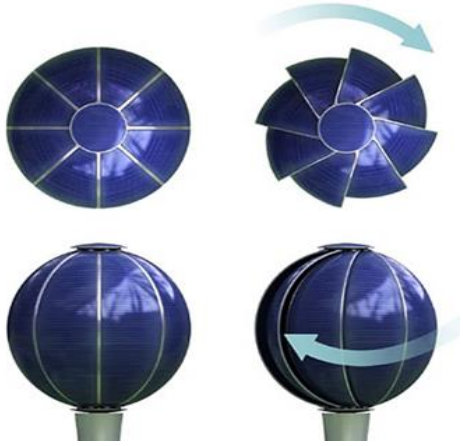
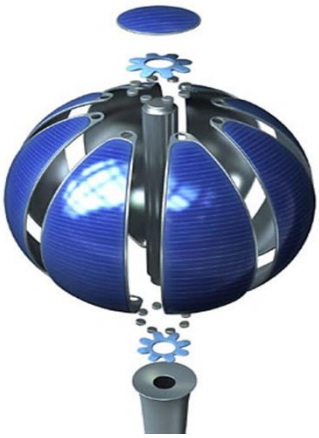


Figure 3. Aard system

6. Advantages of Hybrid System

Emissions free source of power!

- Clean source of power particularly useful when a ship is in port or near populated areas.
- Can be used as source of power for emergency lighting that may provide power longer than traditional back-up systems.

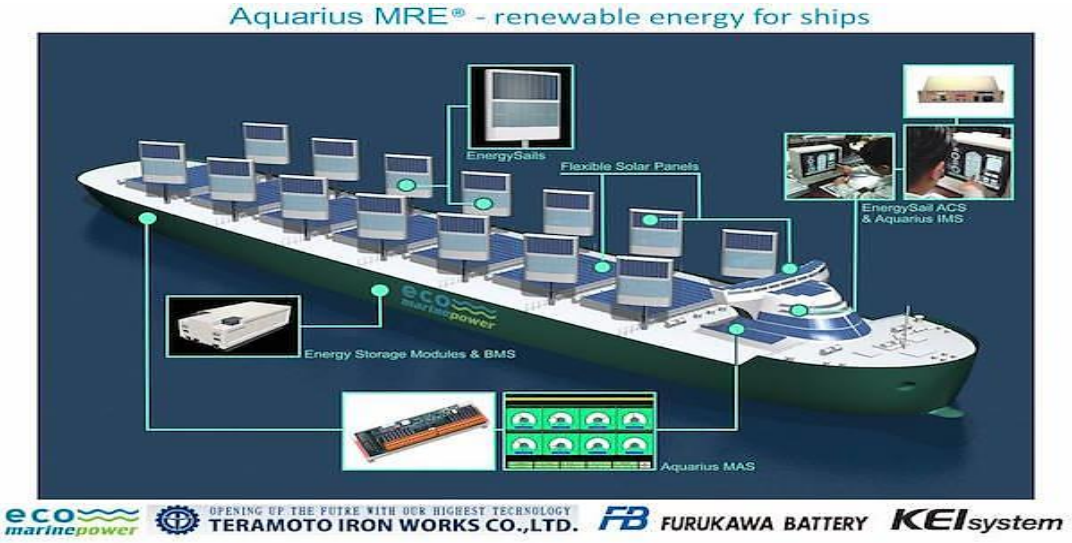


- The use of special lightweight & flexible solar panels allows for more solar to be installed on ships e.g. on awnings, angled surfaces, areas where access is needed.
- The solution meets Classification Society requirements and the basic configuration complies with ClassNK guidelines.
- When combined with efficient marine LED lights the effective output of the system can be increased by a factor of 3 or more.
- Suitable for retrofitting to existing ships or for inclusion into new shipbuilding projects.

- Does not need the complicated head mechanism of the horizontal axis turbines.
- The generator or other devices can be installed at the ground level, ease installation and maintenance.
- Utilization of round shaped or helical type can be implemented for effective power generation from low pressure winds.
- They are independent of wind direction and can be constructed in small size (Omnidirectional & Lighter weight towers).
- Due to smaller size, less centrifugal force stresses on blades.

7.Installation and Uses on board

Applications for the system include bulkers, oil tankers, survey ships, passenger ferries, cruise ships, Ro-Ro ships, car carriers & even unmanned surface vessels. Used to run electronic equipment such as alarms, lights, emergency lights, radio navigational aids, navigational lights, and other emergency loads on board the ship. The collected data are used to analyse the cost of the implemented power system and then compare it to the cost of the consumed fuel from the Gensets.



8. Conclusion:

Calculations show that the large available area of the commercial vessel allows it to have substantial PV installations and thereby meet a high percentage of energy generation through PV. Although wind turbines require further investigation based on backward drag force, initial calculations are based on existing HAWT turbines which provides significant amount of renewable energy. The additional weight of the installations is also within reasonable limits to encourage potential investments in this less ventured for area. With multiple energy sources such as diesel engine, fuel cells, solar and wind turbines integrated into providing shipboard power, the presence of ESS allows attainment of efficiency and redundancy by collective usage and management of the sources. The reduction of one auxiliary generator in the chemical tanker studied in this paper allows the remaining generators to operate near their maximum power, allowing better Specific Fuel Consumption (SFC), and increased efficiency, which can result in significant fuel and cost saving, along with the mass of fuel to be carried on-board.

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