Aquarius MRE - Wind and Solar Power for Ships

Renewable Energy for Greener Shipping

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Introduction

The trend towards using renewable and alternative energy sources on land has gathered momentum over the last decade as governments; companies and the general public tackle the issues of air pollution, energy security and climate change. However at sea, the shift towards the widespread adoption of alternative energy is only now beginning to take shape.

Recently the shipping industry has begun to seriously look at ways to reduce fossil fuel consumption and operate in a more environmentally friendly way. The concepts of "Green Shipping", “Green Logistics” and "Sustainable Shipping" are now important issues for ship owners, shipping lines and ship builders globally.

In addition various regulations and initiatives are being implemented aimed at reducing emissions from ship. Examples of these include Emission Control Areas (ECA’s) and limits on the sulphur content in marine fuels.

Now at sea, as well as on land – the use of renewable energy is increasingly being seen as part of the energy mix. Wind and solar power will most likely play an important role in helping to reduce fuel use and emissions from ships especially as further renewable energy related technologies are developed.

Rigid Sails on Ships

In the 1980's several Japanese ships were fitted with rigid sails with the aim of reducing fuel consumption. This was driven largely by the oil crisis in the 1970's which resulted in oil shortages and the price of oil soaring. However the oil crisis passed and when oil prices fell in the 1980's the viability of rigid sails in terms of cost was undermined.

Figure 1: Shin Aitoku with JAMDA rigid sails

However Japanese ships such as the Shin Aitoku Maru and Usuki Pioneer which were fitted with JAMDA (Japan Machinery Development Association) sails did prove that rigid sails reduced fuel consumption. More than a dozen ships were fitted with these JAMDA sails and fuel reductions of approximately 10-30% were reported.

Various rigid sail concepts have also been applied to a range of smaller vessels but these have not gained widespread acceptance to date on either large ships due to numerous engineering & operational challenges.

Marine Solar Power

Another way to reduce fuel consumption on-board ships is through the use of solar power. Recent advances in solar cell and photovoltaic module technologies have led to solar power becoming a cost effective fuel reduction option on pleasure boats, ferries and tourist vessels. However on large ships the amount of fuel saved through the use of solar power alone is relatively small. So the idea of a commercially viable solar ship seems impractical at the moment, or is it?

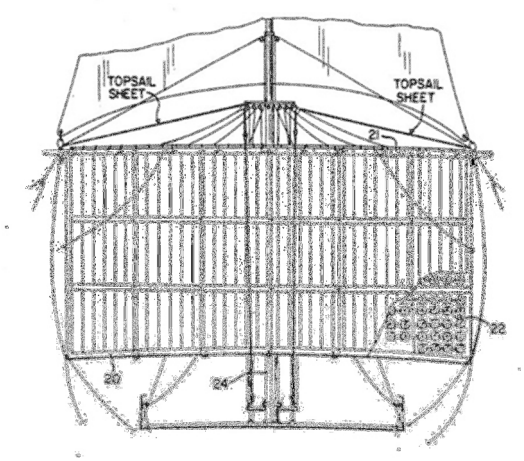

Figure 2: Solar Powered Electric Ship System (1992)

Perhaps rather than having a ship with rigid sails or a ship with solar panels a better approach would be to design a system that could tap into the power of the wind and sun together. The challenge in developing such a solution is to overcome many of the practical problems entailed in trying to use sails and solar panels on large ships operating in the harsh marine environment.

This idea of combining the power of the wind and solar power is not new and in the 1990's a patent was granted in the United States for a solar powered electric ship concept that incorporated a traditional soft sail fitted with photovoltaic cells.

Ideas and concepts that combine sails with solar power probably pre-date the 1990's however to date, no combined wind power and solar power system that incorporates rigid sails has been deployed on large commercial ocean going ships. But this situation is about to change.

Aquarius MRE® - Wind & Solar Power for Ships

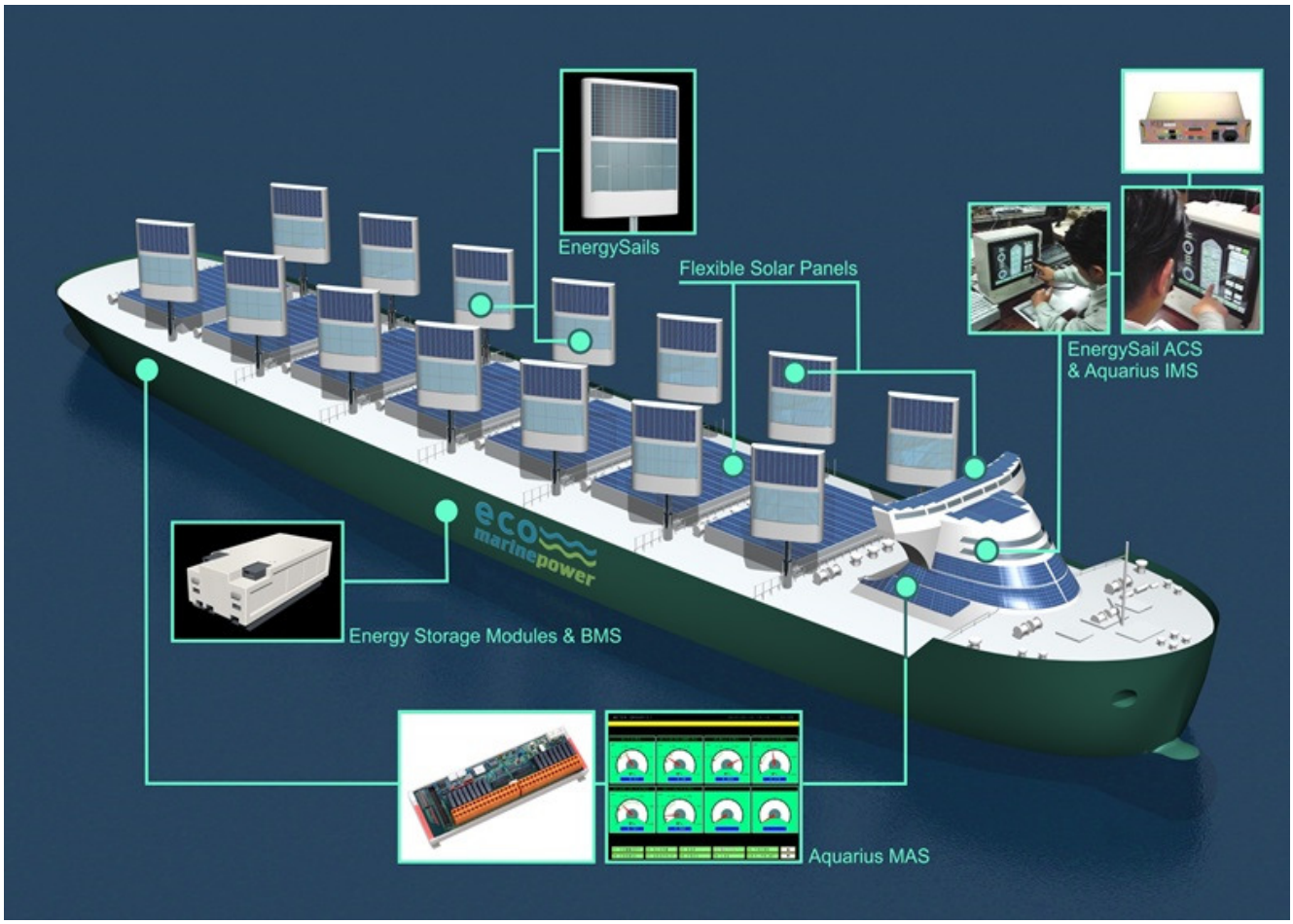

Figure 3: Aquarius Eco Ship with Aquarius MRE (System)

There is a combined wind & solar power solution for shipping on the horizon – Aquarius MRE® (Marine Renewable Energy). This patented wind and solar solution is designed so that the practical limitations of using rigid sails and solar panels on ships are overcome.

A ship fitted with Aquarius MRE® such as a passenger ferry, cruise ship, bulk carrier, survey vessel or tanker will be able to tap into the limitless power of the wind and sun.

These "hybrid powered" ships will use wind and solar power together as a source of energy and propulsion (along with the ship's main engines) in order to reduce harmful emissions and lower fuel consumption.

On a large ship, 1000 tonnes or more of bunker fuel could be saved annually by using Aquarius MRE® and CO2 emissions reduced by approximately 3000 tonnes.

An on-board solar power array can either mounted on the sails or on deck areas of the vessel (or both). The solar panel array(s) will in turn charge batteries or the power will be fed into the DC or AC power distribution system. The energy stored in the batteries could also be a useful source of emergency or back-up power.

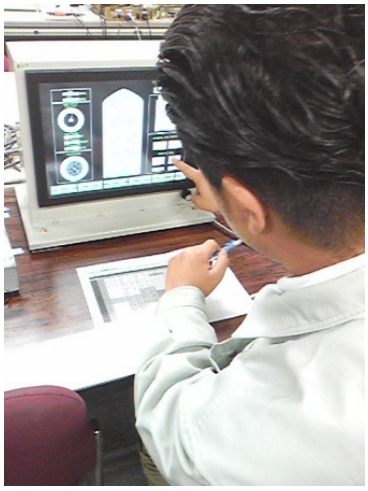

Figure 4: EnergySail Control System

At the centre of Aquarius MRE® is a rigid sail technology called the EnergySail®. This innovative device can incorporate a number of renewable energy technologies and can be installed on wide variety of ships. The EnergySail® can be used as a standalone device or as part of an array and is positioned automatically by a computer control system developed joint by Eco Marine Power and KEI System Ltd of Osaka, Japan. This computer system is known as the EnergySail® Automated Control System (ACS). In addition to control functions, the EnergySail® ACS will also incorporate a management interface and a data logging capability.

Figure 5: Folding JAMDA sail manufactured by Teramoto Iron Works on a ship in the 1980's

In a link with history, EnergySail® production and engineering design is being carried out by Teramoto Iron Works of Onomichi, Japan. Teramoto Iron Works was one of the companies involved in the manufacture of JAMDA rigid sails in 1980's. This innovative company has a long history of manufacturing high quality products for the shipping industry and is one of the few companies in the world that has manufactured and installed large rigid sails on ships.

To interface with other equipment on the ship such as the main engines & generators another computer system jointly developed by EMP and KEI System - the Aquarius MAS (Management & Automation System) - is incorporated into the Aquarius MRE® system architecture. This marine computer system also calculates vessel airborne emissions, monitors fuel consumption, logs data, displays system alarms and can interface with a range of marine renewable energy solutions.

Aquarius MRE® with its combination of technologies will offer ship owners and shipping companies an attractive return on investment (ROI) proposition. This combined with the environmental benefits will help this hybrid marine power technology gain widespread acceptance across the maritime industry.

The technologies being developed or incorporated into Aquarius MRE® also have applications outside shipping and are suitable for land based renewable energy systems and offshore marine energy projects.

The Future is Now!

The concept of using wind and solar power together on ships is not science fiction nor is it decades away. Eco Marine Power has completed lab tests of the EnergySail® along with the EnergySail® ACS and sea trials involving elements of Aquarius MRE® have commenced. The first factory produced EnergySail® has been manufactured and will undergo testing at the Onomichi MTTC (Maritime Tech Test Center) before being installed on a ship for sea trials.

Figure 6: Aquarius Marine Solar Power on Blue Star Delos

In October 2014, Eco Marine Power along with a number of strategic partners installed the first Aquarius Marine Solar Power solution on the Blue Star Delos - a large high speed passenger and car ferry operated by Blue Star Ferries in Greece. This system includes an Aquarius MAS CPU/AGU, ILS unit, MPPT charge controllers, an energy storage solution (Supplied by The Furukawa Battery Company) and marine-grade solar panels.

Eco Marine Power along with its strategic partners are continuing their pioneering work towards developing a fully integrated wind & solar power system for ships. Together these companies will work with ship owners, ship managers and shipyards to help make sustainable shipping a reality!

Author Profile

Greg Atkinson is the Chief Technology Officer at Eco Marine Power (EMP). He started his career in technology in 1983 in the electrical engineering branch of the Royal Australian Navy and then subsequently moved to the telecoms sector before founding EMP in Japan in 2010. His qualifications include an Associate Diploma in Electronic Systems Maintenance, a Bachelor of Science in Electrical Engineering and a Master of Business Administration. He is a member of the Institute of Marine Engineering, Science and Technology (IMarEST) and currently a part-time student at the Australian Maritime College, University of Tasmania.

Image Credits

Figure 1: Shin Aitoku Maru. Source: Wikipedia Commons.

Figure 2: Solar powered electric ship system. Source: US Patent 5131341A. Edwin Newman. 1992.

Figure 3: Aquarius Eco Ship Concept Design with Aquarius MRE®. Source: Eco Marine Power Co., Ltd.

Figure 4. EnergySail® Computer Control System. Source: Eco Marine Power Co., Ltd.

Figure 5. Folding JAMDA sail manufactured by Teramoto Iron Works on a ship in the 1980's - used with permission. Source: Teramoto Iron Works Co., Ltd.

Figure 6: Aquarius Marine Solar Power on Blue Star Delos. Source: Eco Marine Power Co., Ltd.

Published 23rd July, 2016.