Eco Marine Power
Low Emission & Renewable Energy Solutions for Shipping

Greg Atkinson. Chief Technology Officer.
About Shipping…

- Approximately, 90% of world trade (by volume) is transported by the global shipping fleet. *(International Chamber of Shipping (ICS), 2014)*

- it is estimated that between 2007 and 2012 ships consumed on average approximately 250 million to 325 million tonnes of fuel per year resulting in approximately 740 - 795 million tonnes of CO₂ emissions. *(Smith et al., 2014)*

- Another estimate is that in 2007, CO₂ emissions from 45,620 vessels amounted to 943 million tonnes with the total fuel oil consumption (FOC) being 297 million tonnes. *(Psaraftis & Kontovas, 2008)*

- A Pure Car and Truck Carrier (PCTC) for example, may consume between 30 and 60 tonnes of fuel per day depending on its operating speed and weather conditions. *(Bialystocki & Konovessis, 2016)*

- In addition to CO2 emissions, a range of other substances, including NOₓ, SOₓ and particulate matter (PM) are released into the atmosphere as a result of global shipping activity. *(European Commission, 2015; Psaraftis & Kontovas, 2008)*

- Shipping emissions are a contributing factor in approximately 60,000 deaths per year. *(Corbett et al., 2007).*

- In the top 50 ports alone, approximately 230 million people are directly exposed to emissions from shipping. *(Merk, 2014).*

- Emissions are also a concern even when liquefied natural gas (LNG) is used as a fuel source. *(López-Aparicio & Tønnesen, 2015)*

Source: Considerations regarding the use of rigid sails on modern powered ships (Atkinson et al., 2018).
The Challenges for Shipping…

- Implementation of regulations & initiatives aimed at reducing emissions, pollution & environmental damage due to shipping. Examples of these include emission control areas (ECA’s), sulphur limit for marine fuels, ballast water management & the Poseidon Principles.

- Increased focus by governments, corporations, regulators, the media & the general public on the impact shipping has on the environment especially in regards to emissions. (SOx, NOx, PM & CO₂)

- The deployment of new solutions and technologies to reduce pollution & emissions plus enable ships to be more energy efficient, whilst navigating through a complex maze of regulations & organizations. (E.g. International Maritime Organization (IMO), Port Authorities, Classification Societies, Environmental Protection Agencies, Lobby Groups, Non-Profit Organizations etc.)

- Managing various operational issues including; the shift towards lower emission fuels & the increased utilization of digital & information technologies.

- Dealing with uncomfortable topics including; are there too many ships, are the “right” cargoes being carried, do ship designs need to be radically changed & is shipping well-regulated?

Aquarius Marine Solar Power – ship solar power solution developed by Eco Marine Power
Ships Behaving Badly...

“Cruise ships generate high levels of air pollution that could endanger the health of passengers, staff and port communities”
(CNN, January 26, 2019)*

"annually, oceangoing ships are estimated to emit 1.2-1.6 million metric tons (Tg) of particulate matter."
(Mortality from Ship Emissions: A Global Assessment, 2007)

Cruise ship belching thick black smoke while arriving in George Town, Grand Cayman. (Jim Walker's Cruise Law News, November 3, 2019)

Billions of dollars have been invested by ship owners in exhaust scrubbers, but are they really a clean or green technology?

“there is incomplete understanding of the impact of scrubber wash water discharge on marine chemistry, biodiversity, and biogeochemical processes. In particular, there is limited information on the amount and composition of wash water discharge and the associated marine biological impacts.”


Eco Marine Power: Guiding Principles...

• **Reduce pollution (air, sea, land)**

Use renewable energy for electrical power & as a source of supplementary propulsive power. Use technology to improve energy efficiency. Research measures to reduce fuel consumption via ship design changes & emerging technologies such as hydrogen fuel cells. Take into account the impact shipping has on air, sea & land pollution. (E.g. ship emissions due to use of fossil fuels, scrubber wastewater & disposal/scraping of ships and associated equipment)

• **Reduce waste**


• **Set clear objectives, not make unclear statements**

Base objectives on research & analysis of results whilst taking into account economic & operational issues. Be ambitious, but not unrealistic. Solutions solve problems, vague statements don’t.

“For a successful technology, reality must take precedence over public relations, for nature cannot be fooled.” - Richard Feynman.
Some Solutions from Eco Marine Power…

**Aquarius Marine Solar Power™**
Installed on large general cargo ship MV Panamana. Includes fuel consumption & emissions monitoring.

**Aquarius MRE®**
Patented rigid sail arrangement for ships that also incorporates solar power. Lower fuel use, lower emissions. Sea trials planned for 2020 subject to funding.

**Aquarius Eco Ship™**
Concept design project studying how renewable energy & other technologies can be used on ships.

**Co-Operating Organizations**
- **Furukawa Battery**
  Recyclable Marine Batteries & Energy Storage
- **Teramoto Iron Works**
  EnergySail Detailed Design and Production
- **KEI System**
  Computer Control and Management Systems
Aim: To reduce fuel consumption by 10% or more via the use of renewable energy & fuel saving solutions.

Aquarius MRE® - renewable energy for ships
Aquarius MRE® - lower emission shipping using renewable energy

- The patented Aquarius Marine Renewable Energy (MRE) solution is an advanced integrated system of rigid sails, marine-grade solar panels, energy storage modules and marine computers that will enable ships to tap into renewable energy by harnessing the power provided by the wind and sun.

- The array of rigid sails are based on EMP’s patented EnergySail® and are automatically positioned by a computer system to best suit the prevailing weather conditions and can be lowered and stored when not in use or in bad weather.

- The development of the system includes the development of a computer system and a control system architecture to integrate the Aquarius MRE System with other equipment and systems on-board ships.

- The development project also involves a number of companies working as strategic partners with Eco Marine Power including KEI System, Teramoto Iron Works & The Furukawa Battery Company.

- Key features of Aquarius MRE include patented technology, ease of use, robust design, fully automated control system, attractive Return on Investment (ROI) and reliable operation.

- Although the system is being initially designed for large ships, much of the technology being developed will also be suitable for smaller vessels such as coastal freighters, small passenger ferries, tourist boats and Unmanned Surface Vessels (USV's). Elements of the system are also suitable for offshore marine use and for land-based renewable energy projects.
Example of an Ongoing Project…

MV Panamana

- Ship solar power & fuel oil consumption/emissions monitoring (using Aquarius MAS).
- On-board battery optimization – increased battery life, improved safety, reduced waste & cost.
- Energy optimization study.
- Identification of ways to use solar power on ships & also reduce power consumption.

MV Panamana: 54,694 metric tonne (MT) open hatch general cargo/container carrier with 2 x 70 MT gantry cranes.

Aquarius Management & Automation System (MAS). Jointly developed by KEI System & Eco Marine Power

Project conducted with the cooperation & support of:

Masterbulk Pte Ltd.

Zeaborn Ship Management (Singapore) Pte. Ltd.
Major Challenges for Eco Marine Power...

- Difficulty in finding strategic partners & investors that are willing to work on long term plans & product development projects that will reduce the pollution caused by shipping.
- Dealing with the complex maze of shipping organizations, government bodies & regulators.
- Gaining acceptance of our innovative business model within the conservative structure of the shipping sector.
- Protecting intellectual property.
- Scaling-up resource as products reach commercial status.

Potential global market...

- Bulkers & cargo ships
- Survey & research ships
- RoRo vessels
- Coastguard
- Cruise ships & ferries
- Tankers
Thank you for your attention!

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Working Towards a Cleaner, Greener and Lower Emission Future for Shipping!

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