Abstract:

. Among the present modes of transport, it has been found from extensive studies that shipping is the most economical mode of transport. **The object** of green shipping is to minimize the overall harmful emissions during design, manufacturing, service and laying up in order to reduce the pollution to air, water and soil, save resources and improve economic and social benefits. The scope of green shipbuilding includes “green ship” and “green shipyard” Green ship mainly depends on green design. Ships should be designed to enable them give the minimal effect on the environment during manufacturing and service. **The keys to green design are 3R.**

1) Reduce the consumption of materials and energy and the pollution to environment in ship manufacturing and service.
2) Recycle the parts and accessories in ship maintenance. Reuse the majority of materials after ship laying up.
3) Green shipyard shall ensure the high efficiency of materials and energy in shipbuilding, reduce the harmful Emissions and smoothen the process of integrated hull construction, outfitting and painting. Generally, the key to green shipbuilding is green design.

Key words:

Renewable energy, emission, sea environment, energy recovery, ballast water, hydrodynamic shape and oil spillage.

Introduction: Greenhouse emissions have been studied by some of the countries and a relative comparison may be made with world emissions in the same percentage fractions.

2009 greenhouse gas emissions by sector according to the U.S. Environmental Protection Agency.

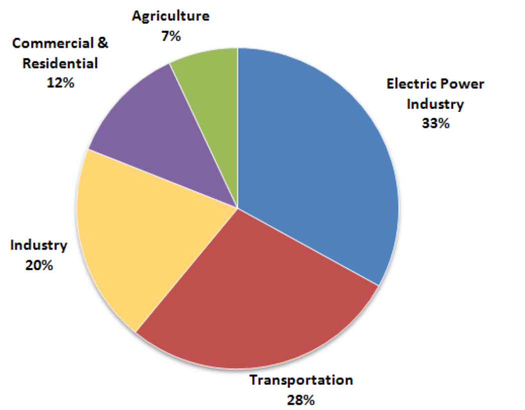
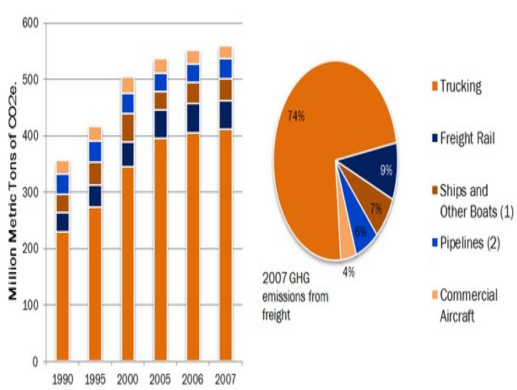
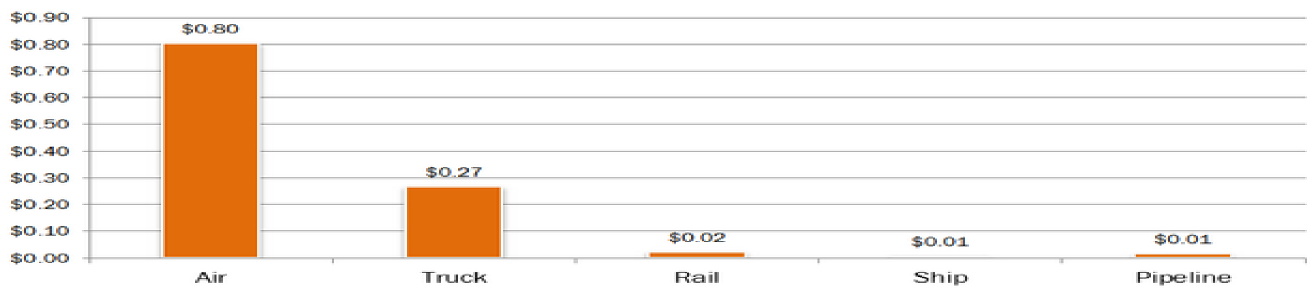


Figure 4: GHG Emissions from Transportation from 1990 to 2007 in Million Metric Tons of CO_2e.



Transportation accounts for 28% of the global emissions out if which ships emit only around 7 % of the emissions.

Figure 2: Average freight revenue per ton-mile (2006 $)



Source: U.S. Department of Transportation, *National Transportation Statistics*, 2009.

As shown in the above figure ,transportation from shipping accounts to less than 0.01 dollar/ton mile transportation cost or roughly 3.3 paisa /ton-km .

Table 1: Global GHG Emissions Abatement for Marine Shipping Sector

Category	**Measures**	**Reductions from "Business as Usual" in 2050 (%)**
Operations	Speed reduction, optimized routing, reduced port time	27**
Ship Design and Propulsion	Novel hull coatings, propellers, fuel efficiency optimization, combined cycle operation, multiple engines	17
Alternative Fuels	Marine diesel oil (MDO), liquefied natural gas (LNG), mind power (sails)	38
Total Reduction from BAU Emissions in 2050		62
*** These reductions could be met by 2025*		

Figure 3: Global GHG Mitigation Potential from the Marine Shipping Sector

<u>Air pollution:</u> Reduction of air emissions can be achieved by reducing the temperature of the exhaust gases in the combustion chamber. This can be effectively achieved by reducing the speed of the vessel.

MEASURE / METHOD	CO2 Reduction	NOx Reduction	SOx Reduction
MACHINERY			
Dual / Multi MCR certification	1 to 3 %		1 to 3 %
Turbo charging with variable nozzle ring			
WHR systems (Waste Heat Recovery)	8 to 10 %	8 to 10	8 to 10 %
EGR systems (Exhaust Gas Recirculating)	-2 to -3 %	80%	19%
Auxiliary systems optimisation	1,5 %	1,5 %	1,5 %
Automated engine monitoring	1 %		1 %
Scrubber systems	3 %		98 %
Optimized control for ship cooling			
LNG fuel	25 %	35 %	100 %
WIF systems (Water In Fuel)	increase 1 to 2 %	30 to 35 %	increase 1 to 2 %
PROPULSION			
ACS (Air lubrication system)	5 to 10 %	5 to 10 %	5 to 10 %
Innovative propeller	Not yet known	Not yet known	Not yet known
OPERATION			
SIMAC GSF student forum	Not yet known	Not yet known	Not yet known
Performance monitoring of silicone antifouling	4 to 8 %	4 to 8 %	4 to 8 %
Lab on a ship	0 to 5 %	0 to 5 %	0 to 5 %

Slow steaming and engine performance monitoring:

To cut emissions of CO_2, NOx, SOx and soot is reducing sailing speed. In commercial shipping this approach to clean ship operations is a hot item as it does not only significantly reduce emissions and fuel consumption but meanwhile also reduces operational costs at a similar pace.

Low Sulphur fuels:

Low sulphur distillate marine fuels are generally used meet higher international requirements for air quality, ship safety, engine performance and crew health.

Improved ship hull design:

Improved hull designs can add up significantly fuel efficiency and thus reduced emissions. In relation to this the design speed, if aiming at slower operational profiles, determines the hull's shape and dimensions. Innovative hulls like trimaran or swath forms can further reduce drag while maintaining stability and reducing the need for ballast water.

Improved propeller and rudder design:

The proper propeller/rudder system will also help in improving propulsive efficiency and consequently decrease exhaust emissions. Reblading propellers have been reported to reduce fuel consumption an average to about 10%, with a maximum of 17%. Novel propeller designs like the Contracted Loaded Tip (CLT) propeller have been effective in reducing fuel consumption and noise/vibrations.

Engine performance monitoring:

Several commercially available software tools allow crew to enhance fuel consumption and thus reduce exhaust pollution. Based on individual ship engine rooms and 'historical' data, benchmarking and reference information such techniques may also allow for improved maintenance schemes of the engines and auxiliary systems and thus cleaner exhausts.

Waste Heat Recovery:

The energy stored in main engine exhaust can be recuperated and thus provide savings in primary energy consumption and hence in a reduction of emissions. Modern diesel engines have superior heath efficiency to older engines but not exceeding 50%. Using this wasted energy with the new breed of heath recovery systems allows generating electricity (turbo chargers) to supplement propulsion or other energy requirements like heating accommodations. It may reduce the number of generators needed on board.

LNG as fuel:

LNG not only provides a SOx free and significantly reduced NOx and CO2 emissions but also an economically interesting fuel at today's oil prices. The major drawbacks for using LNG as fuel are found in need for space for the holding tanks and a supply chain that is not always fully and/or region wide operational

Water in fuel (WIF):

Operating on WIF gives the following possibilities: Based on already obtained experience the effect of adding 50 % water to the fuel is expected to give a 30-35% NOx reduction of the exhaust gas, at the expense of an increase in CO2 emissions of 1-2%. WIF is believed to decrease the NOx formation because the peak temperature is lowered due to the higher heat capacity of water vapour (compared to ambient air) and the heat absorption by water vaporization. It has also been observed, that the formation of PM is lowered when WIF is employed

Exhaust gas scrubber:

Scrubbers can be used for washing the exhaust gas from the main engine and can, in principle, be compared to a large shower cabinet placed in the funnel of the ship. With Aalborg Industries' newly developed scrubbing system, it is possible to reduce the sulphur emissions to a level as low as if low sulphur fuel oil was used. But because low sulphur fuel oil has significantly higher cost makes good sense in using scrubbers to clean off the exhaust gas and thereby continue using heavy fuel oil.

Cooling systems:

The cooling system is a key component in the ship's safety, and the main challenge is to keep the low temperature cooling system stable. In order to obtain these savings, variable frequency drive smart control algorithms need to be implemented. VFD's and valves are already off-the-shelf items but safe and energy-optimal control algorithms for ships have not been developed yet.

Being in tune reduces fuel consumption:

Auto-tuning ensures that the combustion process of a MAN Diesel engine is always optimized. This allows for continuous adaptation to wear, changed fuel properties and operating conditions. The result is a reduction of fuel consumption, CO2 emissions and particulates.

Constant measuring and tuning: The Auto-tuning concept is based on online measurements of the combustion pressures in the cylinder chambers. This is an extremely harsh environment for a sensor to function in as the exhaust gas passes with high temperature and at high pressure. the control system will automatically adjust the timing of the fuel injection in accordance with the deviation between the measured value and the reference value.

Being in tune reduces fuel consumption: This offers wide range of benefits namely reduction in fuel consumption, CO2 emission and carbon particles, as well as reduced maintenance costs and risk of damage. The reduction in fuel consumption for the average vessel is expected to be above 1%, whereas some vessels will have a potential of more than a 3% reduction.

Turbocharger:

A turbocharger is a small radial fan pump driven by the energy of the exhaust gases of an engine. The purpose of a turbocharger is to increase the density of air entering the engine to create more power. By increasing the amount of air reaching the combustion chamber, the engine can burn fuel more completely. This offers some obvious advantages as more complete combustion results in increased power, producing fewer emissions. Lower fuel consumption automatically means lower emissions of the greenhouse gas carbon dioxide.

Installation of ballast water treatment System (BWT):

A special kind of pollution of the seas is the problem of invasive species, now being addressed by the IMO ballast water convention, which, though still in the process of being ratified, will require ballast water to be treated in order to prevent the spread of invasive species. Ballast water treatment is, strictly speaking, outside the scope of Green Ship of the Future; but depending of the type of system selected, it has potentially a large impact on the ship design, operation and energy consumption, which is the reason for it to be included. The basic principle is the use of 30 u filters plus a so called active substance, called 'Anolyte'. An interesting feature is that the active substance is being produced onboard, while the ship is in service, and collected in a special tank. The tank capacity needed is about 60 m3, and may in principle be arranged in a part of a ballast tank, but in this case a part of the aft peak tank is used for this purpose. The active substance is made from fresh water and ordinary salt (NaCl), by an electrolytic process. The average power requirement for the process is about 2 kW if the process takes place during the ballast voyage. The corresponding fresh water requirement is app. 2.2 tons per 24 hours.

OIL POLLUTION:

Operational oil pollution from shipping activities remains an important environmental impact. Oils and oily residuals continuously enter the environment through either direct release via oil lubricated propeller shafts or from deck run off. The yearly amount of oily substances that enters the marine environment through simple ship operations is larger than caused by incidents or accidents. MARPOL also still allows discharge of bilge water at concentrations below 15ppm and under strict circumstances. High speed centrifuges or membrane microfiltration technologies may clean bilge water to much lower concentrations than required by MARPOL. The use of biodegradable oils and lubes is also a technique that has been widely available and used. Biodegradable oils and lubes have been applied in many other industries and their use in the maritime sector is still growing (Lundquist 2011). By standard a biodegradable oil/lube is a product that is degraded by 60% over a period of 28 days, which is three to four times faster than conventional oil break down (Honary 2001),operational oil loss from stern tubes would amount annually over 80 million litres.A water lubed stern tube is not a novel technique but as technology of bearings for water lubricated shafts has improved recently, water lubed propeller shafts are being installed on vessels and this almost totally eliminates operational oil loss (Carter 2009).

Pollution by sewage:

Ships may discharge sewage (black water) at an appropriate distance to shore. To ensure less of impact sewage treatment systems can be installed on board vessels.

Vacuum toilets are an elegant way to reduce the amount of black water that is produced making storage on board easier. The remaining sludge of the bioreactor needs to be disposed of in harbours.

Pollution by garbage:

All wastes, not only plastic as before but also glass, packing materials, metal, and paper can no longer be discarded at sea. Garbage should be compressed carefully as disposal costs on land will increase as recycling becomes troublesome when various fractions cannot be separated. Heat produced by incinerators should be recycled and used for electric power production with turbines.

Propulsion: By using various advance propellers we can reduce co2 foot print and slight modification can bring about significant change like:

- Pre swirl systems--- reduction of rotational loss.

- Pre duct ----improvement of inflow.
- Hub device----- reduction of hub vortex.
- Electrical propulsion--- noise reduction, and also in air pollution.

Education and training:

- Quality training
- In-depth knowledge of air currents and sail.
- Green with conscious
- Optimal training

IDIOLOGIES

Solar panel

- We can put solar panel over ship in form of V-shape or tilted at 45 degree.
- We can put solar panel as sail also research are going on to make solar cum sail design which will utilised best of both world and generate green energy.
- We can make transparent solar plates so that they can be used extensively.
- In case fouling research is going on to extract and understand the mystery behind shark not having algae on its surface.
- In case of swath it can on sides also.

Silicon based coatings:

Resins and coatings systems using silicon-based technologies have historically operated in a distinct portion of the market for high-temperature and weather able maintenance coatings. In recent years, however, newly discovered synergies between SBT materials and organic polymers have led to improvements in both traditional silicones and what were once solely organic coatings. Moisture cure systems, ablative polymers, improved chemical, corrosion and abrasion resistant coatings and ease of cleaning.

Sky sail:

Wind can be used for propulsion; it is usually a source of resistance. High-sided ships such as car carriers and box ships are especially susceptible. It introduced the *Courageous Ace*, which is shaped to reduce wind resistance and incorporated what MOL calls wind channels along the sides at the top of the garage deck.

Air lubrication:

The frictional resistance of the hull can be quite significantly reduced by the introduction of a thin layer of air pumped between hull and water. There are two main variants of this idea.

Air Cavity System

Developed by the pioneers of air lubrication for the marine market, DK Group, the technology was originally applied to custom new builds, where a cavity is designed along the length of the hull into which compressed air is pumped. A retrofit version has recently become available.

Micro-Bubbles

In this variant, a stream of bubbles (rather than a single air cushion) is injected below the hull.

Challenges remain, in particular how to ensure the air remains under the hull when the ship is rolling or pitching. A micro bubble system it reduced the savings from lower friction by 42%. Results of sea-keeping and manoeuvring tests carried out by MARIN show that air lubrication has minimal effect on manoeuvring and no noticeable effect on sea keeping behaviour.

Hydrogen fuel cell:

This type of fuel cell-electric drive lines are the most efficient that exist and produce zero emissions such as greenhouse and other harmful gasses. Only water is generated as waste product.

No ballast water:

According to IMO, ballast water is one of the four major threats to the world's oceans. The E/S Orcelle will effectively eliminate this threat by eliminating the need for ballast water. Thanks to the vessel's pentamaran hull design and the elimination of a traditional stern propeller and rudder, no ballast water will be required on board.

Wave energy:

Wave energy may be transformed into various types of energy by combining the relative movements of the waves, the fins and the vessel.

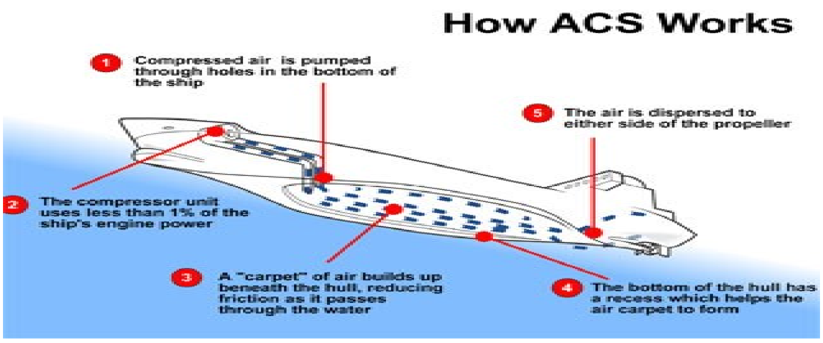


Fig.1: Air cavity hull

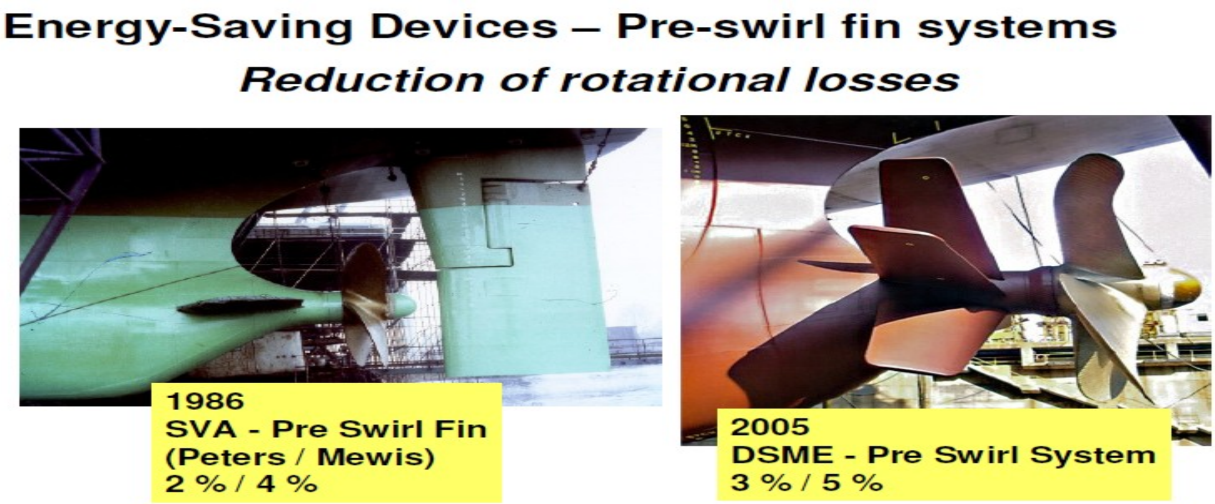


Fig. 2(a): improved propeller design

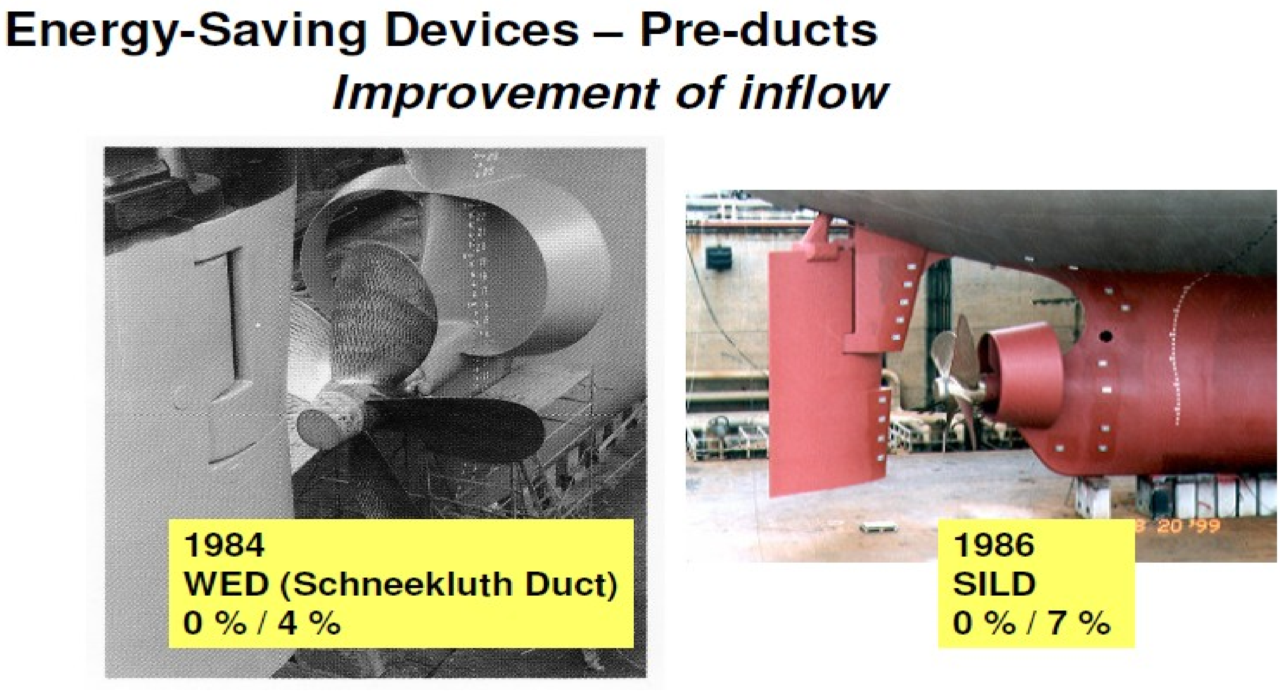


Fig. 2(b): improved propeller design

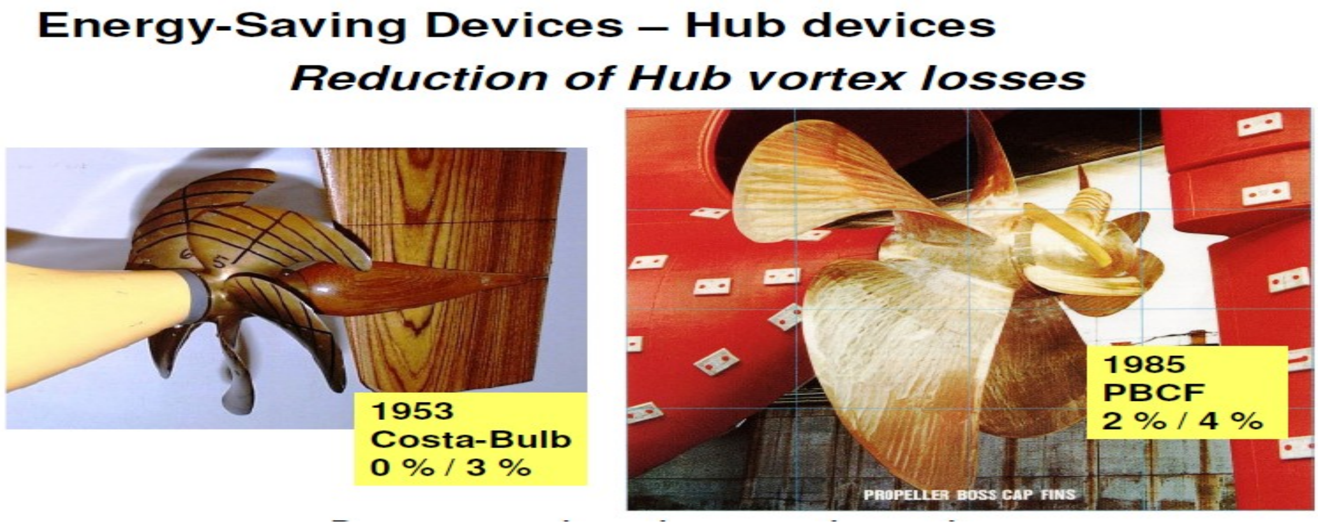


Fig. 2(c): improved propeller design

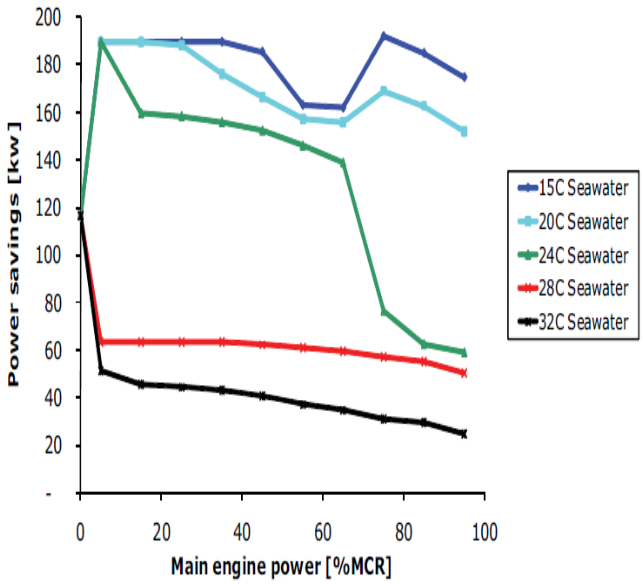
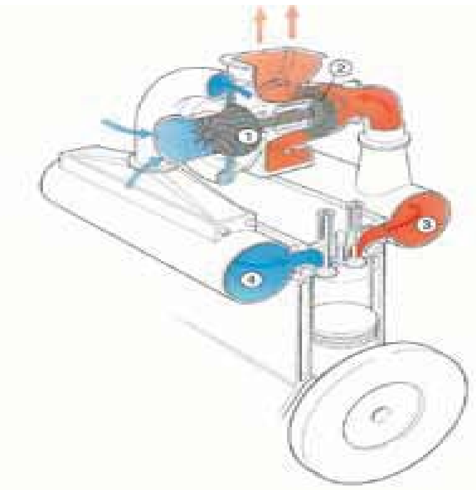


Fig.: Scrubber system arrangement.

Fig.: Cooling system arrangement.



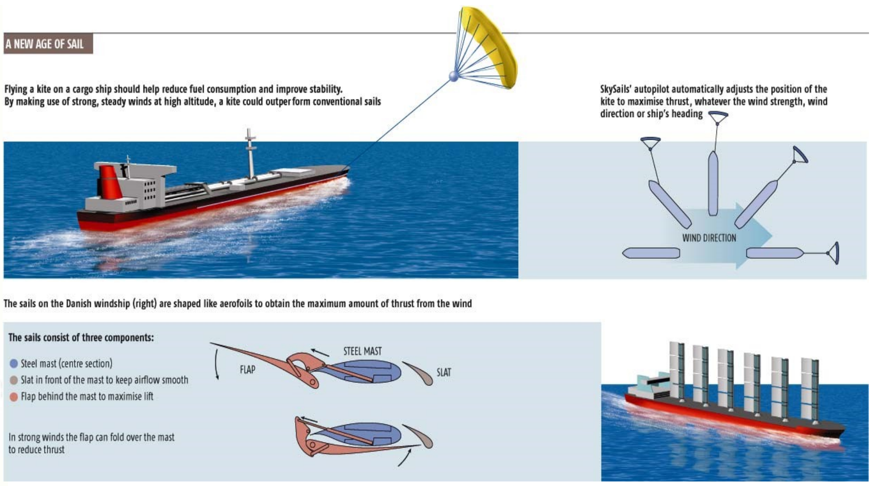
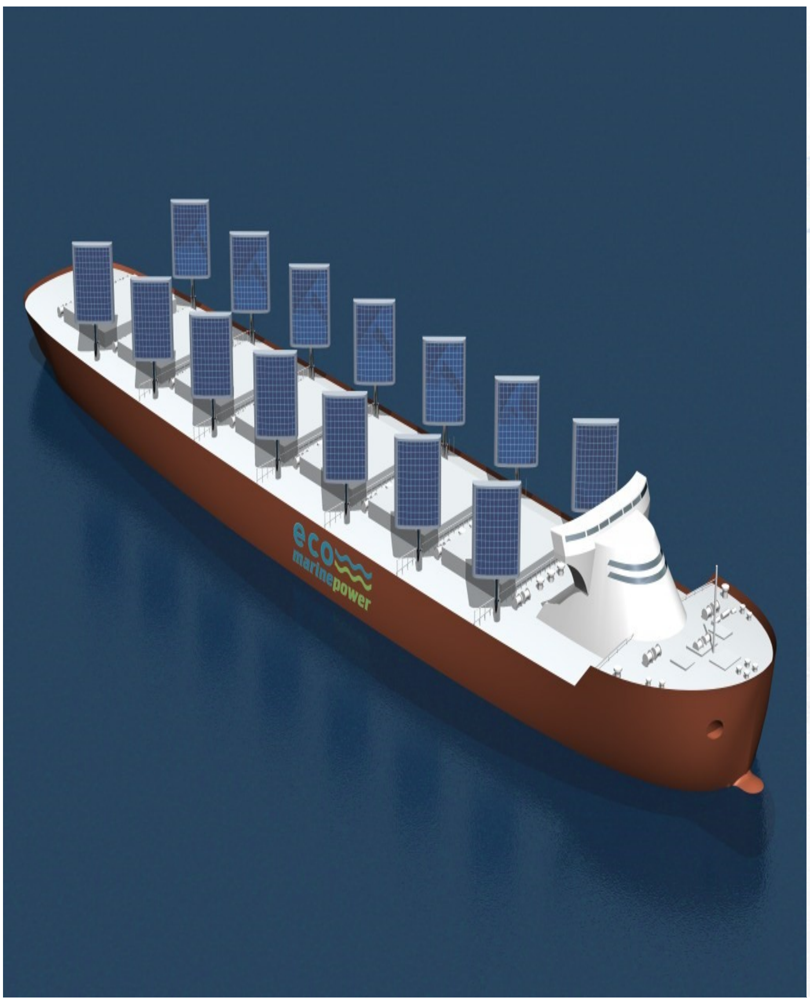


Fig. Turbocharger

Fig.: Sky sail ship

Fig.: solid ballast ship



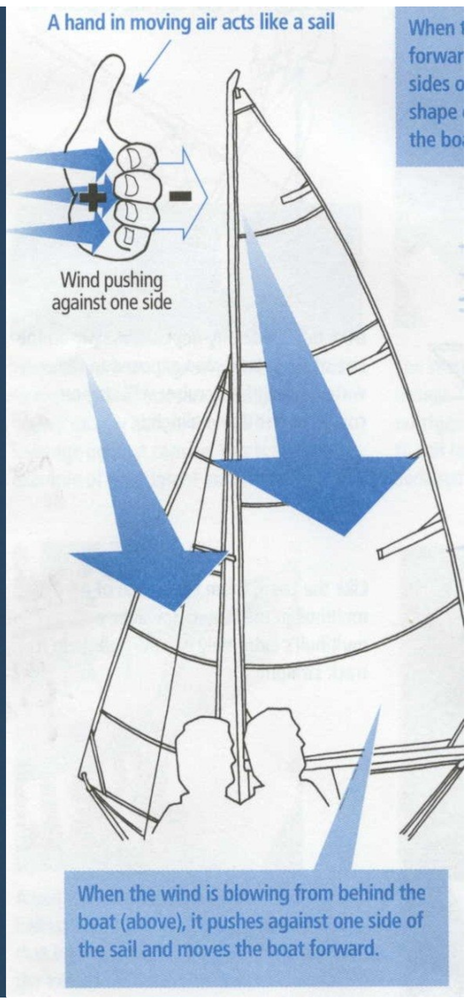


fig.: sail ship

fig.: solar panel ship

Acknowledgement:

We would like thank TRANSTECH 2012 team for organising such an event. Which will encourage sharing of new ideas and moulding student citizen of india.
We would also like to thank our academic co-ordinator, Dr. B.V. Rao and director sir, prof. S.C. Misra for giving us chance to participate in event.
We would be failing in our duties if we don't thank our mentor Chandersekhar M, who had helped us a lot in finishing this paper. Under his guidance we feel complete.
We would like express our gratitude to associated with us from the day one including the one who are with us without our conscious.
We also like to thank various other people whose reference we had took while preparing for paper.
We, Mahesh Kumar and Prathamesh S. Chari would give our best to lift the level of competition and college.

Conclusion:

Mother earth has taken care of all our needs till date, now it's time we should take care of our earth. It's high time for now or nothing. We with our presentation have talked about future of shipping sector.
With implementation of all mention above techniques and concepts we will surely make it greener sea.
Going Green at any Cost.

References:

Green ship magazine

Controlling GHGs: For love or money?
Paper submitted by
Mr. Paul Gunton
Managing Editor, Lloyd's Register - Fairplay
Title: Towards an alliance of European research fleets by eurofleets

Chapter 1.2.7 SHIP DESIGN: TECHNOLOGY www.fathomshipping.com

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Friedrich Mewis
Mewis Ship Hydrodynamics, MSH,
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Australian Ship Powered by Hydrogen Fuel Cell System
By Patrick Stelmach, PATH intern

Air-cavity ships are ready

For a wider market www.speedatsea.com
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