INLAND WATERWAYS TRANSPORTATION

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ABSTRACT

India has an extensive network of inland waterways in the form of rivers, canals, backwaters and creeks. The total navigable length is 14,500 km, out of which about 5200 km of the river and 4000 km of canals can be used by mechanized crafts. If by using modern and green technologies and advancements we are able to design small yachts which can be used for leisure as well as for inland transportation, then automatically the load on railways and road transportation will be reduced, the economy of nation will rise up.
Keyword: green technologies; modern hybrid yachts.

INTRODUCTION

Bringing together the elements of modern styling, ecofriendly technology, and the desires of an aspirational owner we are now focusing toward new vision and modern hybrid vehicles which can be used for inland waterways transportation so that people may use yacht for travelling rather than totally relying on road ways and airways and can use small size green ships for transportation purpose.

APPENDIX A

NATIONAL WATERWAYS

Inland Waterways in India are developed and regulated through the Inland Waterways Authority of India (IWAI) from October 27, 1986.

The National Waterways in India are:

- **National Waterway – 1:** Ganga-Bhagirathi-Hooghly river system from Allahabad to Haldia (1620 km), declared as National Waterway in 1986.
- **National Waterway – 2:** The Brahmaputra River from Sadiya to Dhubri (891 km), declared as National Waterway in 1988.

- **National Waterway – 3:** The West Coast Canal (205 km), declared as National Waterway in 1993.
  - Kollam to Kottapuram: 168 km
  - Champakara canal: 14 km
  - Udyogmandal canal: 23 km
- **National Waterway – 4:** Kakinada – Puducherry canal along with rivers Godavari and Krishna (1095 km) declared as National Waterway in 2008, covering states of Andhra Pradesh (888 Km), Tamil Nadu (205 Km) and Union Territory of Puducherry (2 Km).
  - Godavari river from Bhadrachalam to Rajahmundry – 171 km
  - Krishna river from Wazirabad to Vijayawada – 157 km
  - Kaluvelli tank from Mercanum to Puducherry – 22 km
- **National Waterway – 5** : East Coast Canal integrated with Brahmani and Mahanadi delta river system (623 km), declared as National Waterway in 2008, covering states of West Bengal (91 km) and Orissa (532 km).
  - Geonkhali- Charbatia stretch of East Coast Canal: 217 km
  - Proposed National Waterway: River Barak, Lakhipur – Bhanga (121 kms)

APPENDIX B

MODERN HYBRID INLAND WATERWAYS VEHICLES

ORCELLE

The multi-disciplinary team that is working on the conceptual design of the E/S Orcelle includes naval architects, environmental experts and industrial designers. The challenge presented to the design team was to investigate the use of alternative energy sources, rather than fossil fuel oil, for the vessel's power and propulsion.

Other important design requirements included zero emissions and optimum cargo capacity. Weight and displacement, hull design and speed were also design considerations that the team explored.

This concept vessel does not release any emissions into the atmosphere or into the ocean. It uses renewable energy sources and fuel cells to generate the energy required to power the vessel. Its highly advanced design provides optimum cargo capacity to transport cars and other goods around the world more efficiently.

ECOFRIENDLY DESIGN

Orcelle is completely designed to be ecofriendly or rather ship with 0 pollution as it rely on the renewable energy available in sea like sun, wind and waves and uses fuel cell as main primary source of energy. Some of the hydrogen for the fuel cells will be produced on board by solar, wind and wave energy. The only by-products of the production of electricity from fuel cells are

water and heat. It also focuses on optimizing cargo capacity and lowering energy consumption per transported unit, moreover taking into consideration other environmental challenges, such as completely eliminating the problems related to ballast water and ballast tank by introducing new and modern type of hull i.e. known as pentamaran hull design and the elimination of a traditional stern propeller and rudder and also not requiring any ballast tanks on the ship.

The lightweight materials are also used on the proposed idea of the ship like aluminum and thermoplastic composite materials as they offer them distinct advantages over common carbon steels like:

_ High tensile strength
_ less maintenance
_ Easy to shape
_ Lightweight
_ Fatigue resistant
_ Recyclable

The E/S Orcelle will have five hulls; a long, slender main hull and four support hulls provide stability at sea. The stability offered by the pentamaran hull and its fins, combined with the use of new propulsion systems, will eliminate the need for the vessel to take on and release ballast water. In addition, the pentamaran hull design will contribute to the improved utilization of energy and to the clean flow of water around vessel.

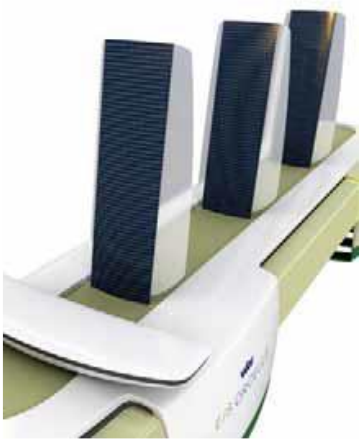
CLEAN SAILING

a) SOLAR ENERGY

Solar energy will be utilized through photovoltaic panels located in the vessel's sails. When not in use for wind propulsion, the sails may be tilted, laid down or in other ways directed for maximum solar energy collection. The solar energy will then be transformed into electricity for immediate use, or for storage.

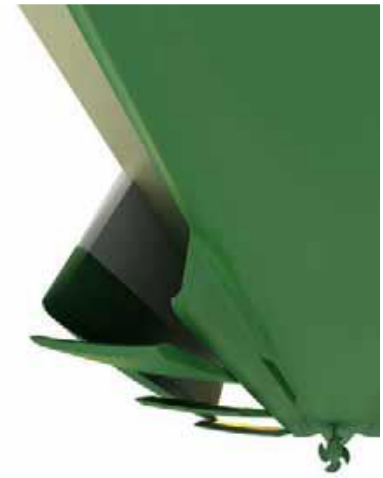
b) **WIND ENERGY**

Wind energy will mainly be utilized for propulsion directly through three sails constructed of lightweight composite material; a uniquely new twist to the age-old art of sailing. Capable of folding upward and outward, the rigid sails can rotate about the masthead to fix the best position to extract wind energy through the creation of drag force or lift force, or a combination of the two.



c) 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. The E/S Orcelle will have a total of 12 fins in all, enabling the vessel to harness and transform wave energy into hydrogen, electricity or mechanical energy. The fins are also propulsion units that are driven by wave energy or by the electricity or mechanical energy available on board.



ENERGY CONSUMPTION

a) PROPULSION SYSTEM

The E/S Orcelle will have two variable speed electric propulsion systems, known as pods, to complement the vessel's sail and fin propulsion systems. Each pod will house a motor, gearbox and propeller in a single compact unit. One pod will be fitted at each end of the main hull, providing full power and a 360-degree field of manoeuverability and this 360 degree pod is commonly known as azipode propeller.

b) MANOEUVRING

Electric and hydraulic power supply will be required to operate the two aft rudders. The rudders will provide steering capabilities during operations when the electric propulsion systems are not in use.

APPENDIX C

OTHER HYBRID DESIGN

GREENLINE HYBRID DESIGN

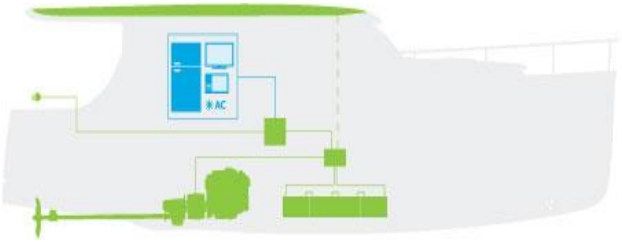
SUPER DISPLACEMENT HULL

Greenline's protected Superdisplacement hull shape generates less drag, less wake, creates the ability to use less fuel, generates lower CO2 emissions, and enables the use of (limited) electric power. This hull geometry produces less wake, offers better seaworthiness and easier handling than any comparable hull.

The reduced energy requirement means less running cost, less refueling stops.

The twin sacrificial stabilizers are a further advantage of this hull, and have three functions: they deliver roll stability, tracking stability, and protect the drive and rudder. If the stabilizers get damaged, the structure of the boat will not be affected. The fins can be quickly and inexpensively replaced moreover because of these advancements the cost will also be reduced and yacht will have easy manoeuvring.

A) DRIVE SYSTEM



The vehicle consists of:

- A single switch to choose between the 2 drive modes – Diesel and Electric
- A fully electronically managed and maintenance-free electric motor/generator (7 kW in drive mode and 5 kW in generator mode)
- A hydraulically operated clutch between the diesel engine and the electric motor/generator
- A 5 kW inverter/charger delivering AC 230 or 120 V power at all times
- A 1.4 kW solar array delivering green electric power to the batteries during daytime. No cost and emission-free sailing is possible at low speed
- A Lithium battery pack (same as the one driving your mobile phone or laptop computer) with a capacity of 23 kWh (double motorization). Lightweight and compact (seven times

lighter and one third of lead battery size) these batteries are rated at thousands of cycles. With a life expectancy of 10 years they represent the best choice for a hybrid boat.

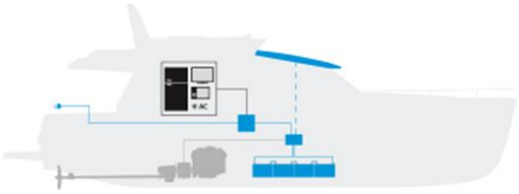
B) SOLAR ROOF

The solar roof array keeps the batteries fully charged and provides additional energy for the boat's electric drive system. No-cost and emission-free sailing is possible at low speed where the amount of energy harvested from the sun and the system's energy consumption are equal, making the Greenline Hybrid a solar sailboat.6 standard photovoltaic solar panels with forced air cooling deliver up to 1.4 kW of electric power in daylight conditions.

As the solar cells are protected against hail by a 3.2 mm glass shield and are easy to access for cleaning, it is capable of supplying constant power to on-board consumers like the refrigerator and TVs and can recharge the batteries to 100% when exposed to a full day of sunlight.

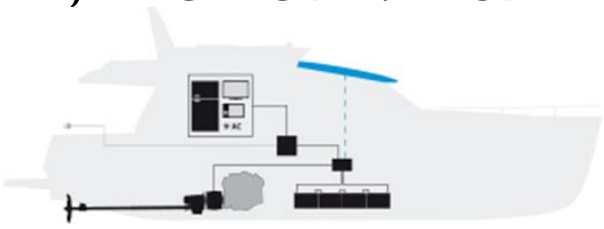
C) MODES OF OPERATION

1) AT DOCK



The boat on the dockyard is plugged into the 230 V (120 V) AC shore power supply. The battery pack is under charge and the inverter provides AC power to run home appliances like the fridge, TVs, etc.

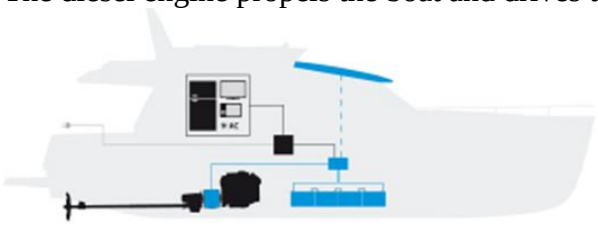
2) ELECTRIC DRIVE MODE



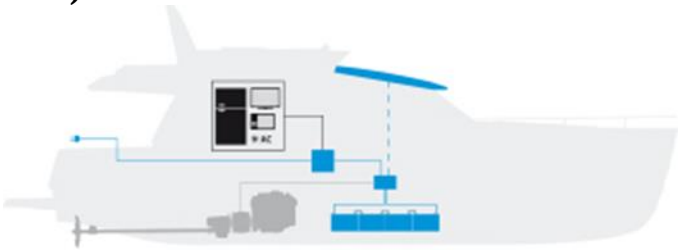
The yacht is powered by the electric motor/generator, which produces electric power. This mode is used to sail in and out of a marina or anchorage with no noise, no smoke and an insignificant wake. At 4 knots a fully charged battery pack provides a range of up to 20 miles.

3) DIESEL DRIVE MODE

The diesel engine propels the boat and drives the generator, which recharges the battery pack.



4) AT ANCHOR



At anchorage the solar roof array charges the batteries, which provide a 230V AC power supply to the appliances via an inverter. If the level of battery charge drops below a set value, the diesel engine is switched on in order to drive the generator and charge the battery pack via generator(s). The propeller is disengaged (the gearbox is in neutral). This is the anchor charge mode.

APPENDIX D

SOME MORE LOW EMISSION & COST EFFECTIVE SOLUTIONS FOR INLAND WATERWAYS.

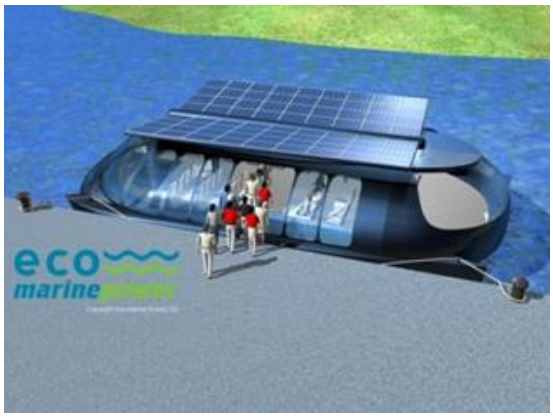
Tonbo Solar-Electric HMP Ferry, this cutting edge green passenger ferry will include a Hybrid Marine Power system that will use specially designed solar module panels and the latest Lithium-Ion battery technology.

The Tonbo will be able to use energy collected via the solar modules to charge on-board batteries to reduce fuel consumption and will also be able to rapidly re-charge these batteries by using shore power when alongside.

The solar module panel assembly is being developed by Eco Marine Power and will be controlled by an easy to use computer system. The solar panels can be raised as the ship cruises or lowered so that the Tonbo can pass under a low bridges or other obstacles. A variation of the Tonbo with fixed solar panels will also be available.

Another innovative solar ferry designed by EMP is the Medaka Eco Ferry. This smaller solar-electric ferry is being developed to operate as an eco-friendly urban commuter ferry especially in cities where noise & air pollution levels are high. It is anticipated that vessels like the Medaka will play an important role in making urban water transport networks more

environmentally friendly. Eco Marine Power is also currently studying innovative ways to incorporate wind power into ships of less than 500 tonnes whilst for larger ocean going ships it has developed the Aquarius System.
The innovative hybrid marine concepts and designs developed by Eco Marine Power will not only reduce fuel costs, but they will also play an important role in assisting ship owners/operators meet the requirements of operating in Emission Control Areas (ECA), marine parks and nature reserves etc. Additionally solar-electric commuter ferries will fulfil an important role in energy-efficient cities near harbors, bays and waterways.



Apart from all these technological advancements and proposed hybrid vehicles designed by some ship builders there are many opportunity to develop new techniques to make inland waterways ecofriendly and successful in India so that we can use all the natural resources provided by nature to us to great extent and decrease our dependence on road and air ways.

ACKNOWLEDGEMENT

We would specially like to thank Mr. A.N.S NETI Sir for his kind support and guidance which helped us to make this paper. Also we would like to thank all respected faculty member who guided us and all our friends who showed their full support to us.

APPENDIX

A: Discuss about the different National Waterways of India.
B: Discuss about modern hybrid inland waterways vehicles which may be possibly used in upcoming time.
C: Discuss about few other hybrid waterways.
D: Discuss some more low emission & cost effective solutions for inland waterways.

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