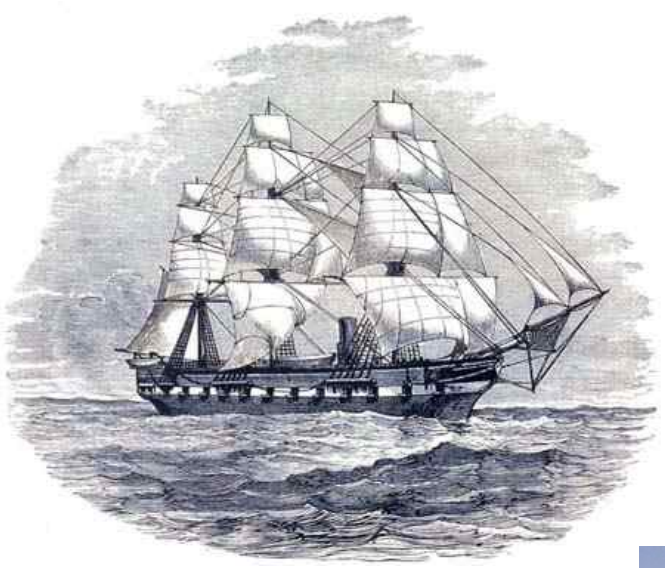
# GREEN SHIPS AND BLUE WATERS

## ENVIRONMENTAL CONSIDERATIONS FOR THE FUTURE UNOLS FLEET



http://www.geology.19thcenturyscience.org/books/hmsc.jpg

Solar Sailer- Syney, Australia


# 2010 UNOLS GOAL

"Greening the Fleet – UNOLS should explore how to make the present and future fleet more environmentally sustainable. New and existing technologies and practices should be used in the construction, operation, and recycling of research vessels and UNOLS should take a leadership role in promoting a green U.S. research fleet, as we move forward in developing the academic fleet."

# Creating a Green Fleet

Life Cycle of a Vessell:

1) Construction

2) Operation

3) Recycling


Hornblower Yachts- San Francisco: Ferry Design


# Construction and Operation

1) Hull and design
2) Propulsion, fuel and lubricants
3) Power systems
4) Fluids; water and sewage
5) Interior: cabins, labs, galley and mess areas (Leadership in Energy and Environmental Design-LEED)

# LEED Project Checklist

| | | |
|---|---|---|
| **Sustainable Sites** | | **14 Possible Points** |
| Prereq 1 | **Construction Activity Pollution Prevention** | Required |
| | *Reducing Pollution during Yacht Construction* | |
| Credit 1 | **Site Selection** | 1 |
| Credit 2 | **Development Density & Community Connectivity** | 1 |
| Credit 3 | **Brownfield Redevelopment** | 1 |
| Credit 4.1 | **Alternative Transportation**, Public Transportation Access | 1 |
| Credit 4.2 | **Alternative Transportation**, Bicycle Storage & Changing Rooms | 1 |
| Credit 4.3 | **Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles | 1 |
| Credit 4.4 | **Alternative Transportation**, Parking Capacity | 1 |
| Credit 5.1 | **Site Development**, Protect or Restore Habitat | 1 |
| Credit 5.2 | **Site Development**, Maximize Open Space | 1 |
| Credit 6.1 | **Stormwater Design**, Quantity Control | 1 |
| Credit 6.2 | **Stormwater Design**, Quality Control | 1 |
| Credit 7.1 | **Heat Island Effect**, Non-Roof | 1 |
| Credit 7.2 | **Heat Island Effect**, Roof | 1 |
| Credit 8 | **Light Pollution Reduction** | 1 |
| **Water Efficiency** | | **5 Possible Points** |
| Credit 1.1 | **Water Efficient Landscaping**, Reduce by 50% | 1 |
| Credit 1.2 | **Water Efficient Landscaping**, No Potable Use or No Irrigation | 1 |
| Credit 2 | **Innovative Wastewater Technologies** | 1 |
| | *Reducing potable water consumption and grey water generation* | |
| Credit 3.1 | **Water Use Reduction**, 20% Reduction | 1 |
| Credit 3.2 | **Water Use Reduction**, 30% Reduction | 1 |
| **Energy & Atmosphere** | | **17 Possible Points** |
| Prereq 1 | **Fundamental Commissioning of the Building Energy Systems** | Required |
| | *Ensuring that the energy-related systems are performing as designed.* | |
| Prereq 2 | **Minimum Energy Performance** | Required |
| | *Establishing a minimum level of energy efficiency.* | |
| Prereq 3 | **Fundamental Refrigerant Management** | Required |
| | *Eliminating ozone depletion by using non-CFC refrigerants.* | |
| Credit 1 | **Optimize Energy Performance** | 1–10 |
| | *Achieving energy cost savings by improving efficiencies.* | |

## LEED Criteria Applied to Boat Building

(From: Peters, M., 2009, The Large Green Yacht, Part 2, *Professsional Boatbuilder*, #117, February/March, 26-43.)


## OPERATION:

1) Propulsion

*New designs: solar, wind

*a) Solar Sailor*
*b) M/V Auriga Leader*

2) Fuels and lubricants: Biofuels

a) NOAA Green Ship Initiative
b) Cape Hatteras Biofuel Experiment

3. Power systems

# WIND

## Solar Sailor:

*Solar wings used as solar collectors and as sails

http://www.solarsailor.com/

# Power Systems

The *M/V Auriga Leader* has 328 solar panels to provide power for the ship's main electrical grid. (http://www.inhabitat.com/2009/07/06/auriga-leader-cargo-ship-gets-power-from-solar-panels/)

# BIOFUELS: Ethanol and Biodiesel

Objective: convert Great Lakes vessels with petroleum-based fuels to renewable and environmentally friendly products

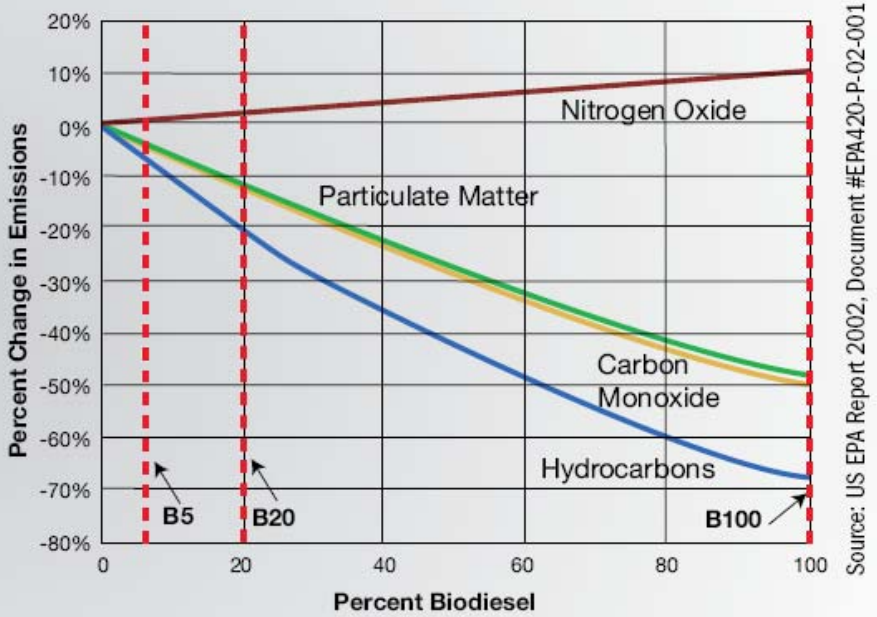
## NOAA GREEN SHIP INITIATIVE

### Development of Biodiesel and Bio-Products in Marine Applications

### *Environmental Research That's Environmentally Friendly*

There were many motivating factors for undertaking the Green Ships project. These include:

- Reducing ecosystem impact of ship-based research activities.
- Reducing workplace health and safety hazards.
- Advancing renewable technologies.
- Lessening dependence on fossil fuels.



# CAPE HATTERAS BIOFUEL EXPERIMENT
## Waste Vegetable Oil for Diesel Power

Cape Hatteras; Mark Smith, Chief Engineer and John Wilder, Marine Superintendent

## OPERATION

*Configured generator to run on waste vegetable oil (WVO)
*WVO preheated to 70$^{o}$C (heat exchange on generator)
*Initial start-up with diesel fuel and WVO heated
*Once heated, WVO introduced into generator fuel line
*Diesel fuel switched back near shutdown to remove WVO from system

## LOGISTICS

*Restaurants contacted; tank and pump mounted on trailer; WVO transferred, filtered, stored, and transferred to ship
*Reliable pick-up service on schedule (2-3 hours) from restaurant
*WVO filtered.
*Storage tanks-shore facility and vessel
*Install pipes/valves/heat exchange system on main engines

# RECYCLING

## Green Passport

- IMO's Guidelines on Ship Recycling (2003): Green Passport- inventory of material in ship's structure, systems, and equipment that may be hazardous to health and the environment
- Maintained through the life of the ship
- Green Passport can be used to formulate a safe and environmentally sound plan for decommissioning a ship
- Raises awareness of hazardous material
- Lloyd's Register- verifies Green Passport for both new and existing vessels

- http://www.lr.org/Industries/Marine/Services/Consultancy/Green+Passport.htm
- http://www.lr.org/NR/rdonlyres/5EA619D8-0788-47DE-806A-FE2E6C7FAC6F/43816/GreenPassport0606.pdf

(RINA Green Star: ballast water; chemicals)


# GREENING THE FLEET: FUNDING CONSIDERATIONS

*Additional costs will be incurred to address or incorporate "green" solutions

*Many of these expenses will be front-loaded: construction phase

*Opportunity for  philanthropic funding

# PLASTIKI


7th Annual

**Green Ship Technology Conference**

26 March 2010



# The 7th Green Ship Technology Conference

## Meeting the green technology challenges for sustainable shipping

**The 7th international Green Ship Technology conference**, organised by Informa Maritime Events, took place at a time of rapid developments for the maritime community, and a week before MEPC 60.

In terms of meeting the various **environmental challenges posed by the increasing focus on shipping's effect on the environment** and climate change, the conference participants discussed the key environmental issues facing the industry today, from developing technological innovations and efficient design to reduce shipping's environmental impact, to individual companies' roles in developing corporate responsibility plans to create effective environmental and vessel management plans.

## Speakers in 20

Keynote Adc
Betina Hage
Permanent S
Ministry for E
Business Af

Ryan Albert,
**Protection A**

Christian Bre
**Danish Mari**

Lars Vang C
CEO, hernin
Chairman, **D**

# Program Highlights:

- A discussion of environmental regulation v. self assessment
- Designing an environmentally sustainable ship
- Managing environmental hazards in the ship repair/ship building yard
- Alternatives for reducing emissions, including emissions trading and seawater scrubbing
- Current developments in ballast water treatment systems and the likelihood of adoption for commercial use

*Alternative propulsion methods and energy sources

- The challenges ahead for paints and coatings
- Port developments in reception facilities and monitoring of air quality

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**Kalender**

**GSF at SMM in Hamburg**
7. September 2010

Det Maritime Danmark

DTU FORCE TECHNOLOGY
Dansk Center for Maritim Teknologi

Skibsteknisk Selskab

## WELCOME TO GREEN SHIP OF THE FUTURE

*Green Ship of the Future* is a Danish joint industry project aiming at developing and demonstrating technologies for reduction of air emissions from ships.

Within the four main focus areas: Machinery, Propulsion, Operations and Logistics, the overall target is to

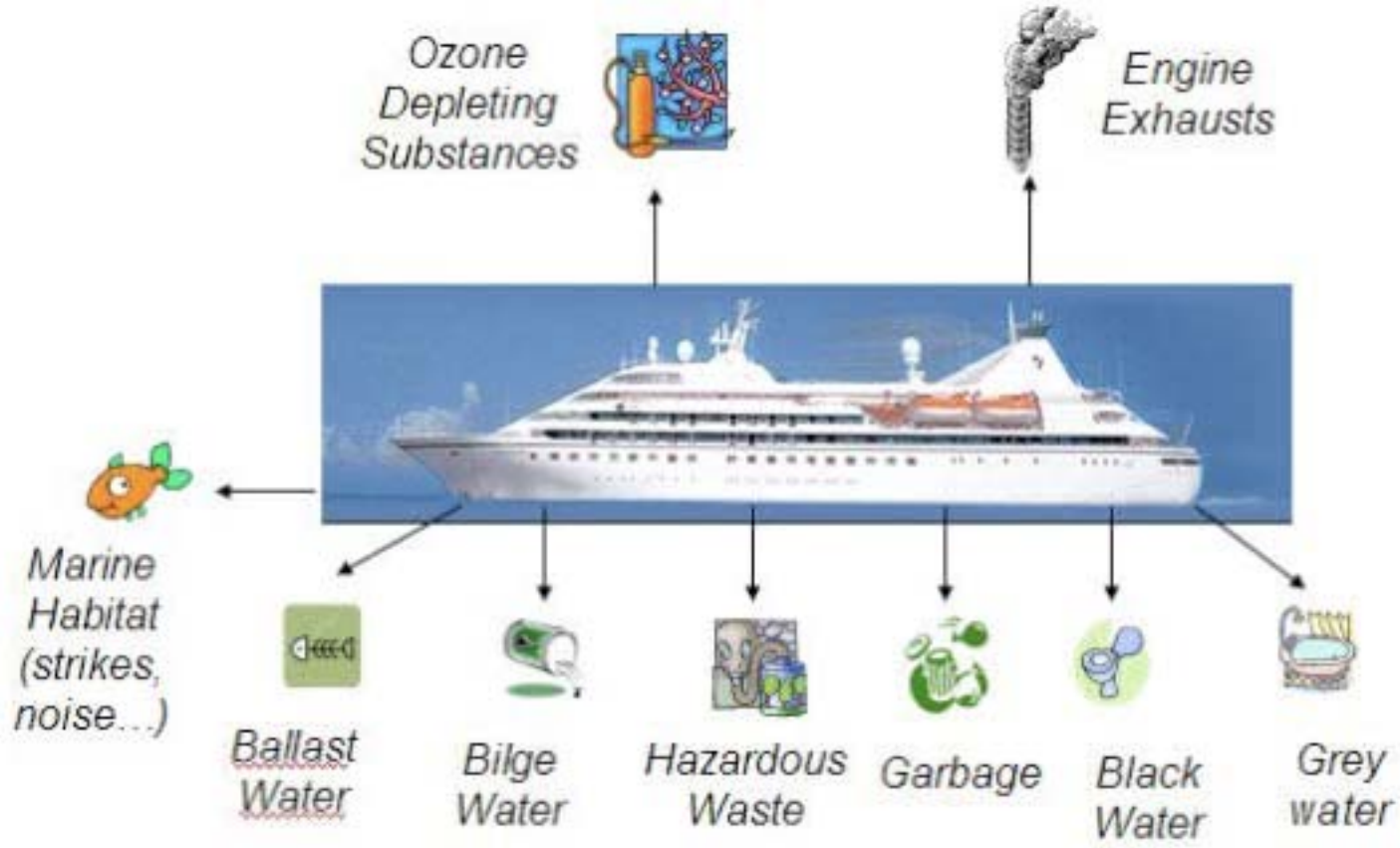
**Reduce $CO_2$ emissions by 30%** **Reduce $SO_x$ emissions by 90%** **Reduce $NO_x$ emissions by 90%**

Pathway to SUSTAINABILITY

# MV Explorer

V.Ships

## Onboard Environmental Management and Waste Streams



SEMESTER AT SEA®
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# MV Explorer

GO

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## *Goals: Pathway to Sustainability Initiative*

SEMESTER AT SEA AND THE INSTITUTE FOR SHIPBOARD EDUCATION HAVE A VISION FOR CREATING AN INNOVATIVE, CONSCIENTIOUS, AND INTERNATIONALLY RESPONSIBLE GREEN SHIP ENVIRONMENT.

- Verify and reduce environmental footprint
- Implement sustainable policies and programs

- Recycling and waste management
- Waste and emission reduction
- Energy conservation
- Sustainability awareness
- Carbon offset
- Corporate partnership

- Integrate the Academic Program
  **Begins Spring 2010**

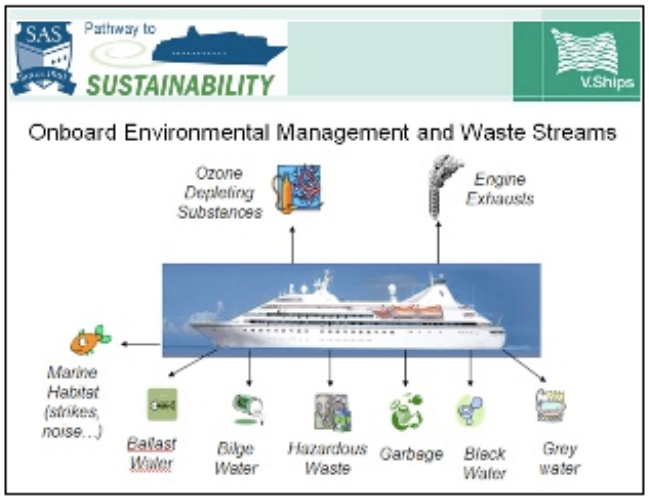
- Create themes around environmental issues
- Launch longitudinal research projects
- Integrate curricular activities

- Install Advanced Environmental Management Systems

- Waste treatment and management
- Exhaust emission scrubbers
- Ballast water management
- Emission control initiatives

- Create shore-side sustainable initiatives

- R&D on visionary initiatives




# Life Cycle Analysis:

Assess environmental and economic impacts of a product or service (Cradle to Grave)

1)Goal and scope
2)Inventory analysis
3)Impact assessment
4)Interpretation

# Patagonia: The Footprint Chronicles


http://www.patagonia.com/web/us/footprint/index.jsp


Materials Resources and Extraction
End-of Life Issues (recycling, etc)
Processing Impact on Environment
LIFE CYCLE ANALYSIS
Materials for Green Energy
Design for sustainability
Use of Sustainable Materials
Economic, Social and Legislative Issues


# A Pilot Study: Cape Hatteras Life Cycle Analysis

1. Fuel comparison: impact of diesel, waste oil and biodiesel

2. Study of emissions from the use of biodiesel and diesel fuel

3. Biodiesel for ancillary power

4. Lighting options


# Work in Progress:

1. Progress on MBARI replacement of the Western Flyer- Annette

2. RVOC questionnaire on how to make existing ship operations more environmentally friendly- Liz

3. NSF Workshop on Large Facilities- May, 2010, San Diego:  Greening the UNOLS Fleet presentation

4. Proposed UNOLS workshop


# Greening the U.S. Academic Fleet: A UNOLS Workshop

**Objective**: An Assessment of Current Technologies, Designs and Practices for Environmentally Sustainable Research Vessels

**Time**: Fall, 2010

**Location**: Nicholas School of the Environment, Duke University, Durham, NC

**Composition**: 25-30 invitees, with representation from Council, RVOC, RVTEC, FIC, NSF, Navy, NOAA, architects and naval designers, industry, and marine scientists interested in attending.


**Format**: 1 ½ day workshop with invited presentations on various aspects of green ships: design, technology, practices

**Funding:** Proposal for support of the workshop to be submitted to NSF and ONR, with help from a steering committee

**Announcement:** UNOLS website and mailing lists, advertisement for workshop in EOS


**Objectives**:

1) Promote environmental sustainability within UNOLS

2) Guidelines for construction, operation and recycling of UNOLS Research Vessels

3) Development of green vessel guidelines for U.S. vessels (outreach)

4) Promote environmental awareness on UNOLS ships with U.S. ocean scientists


PLASTIKI

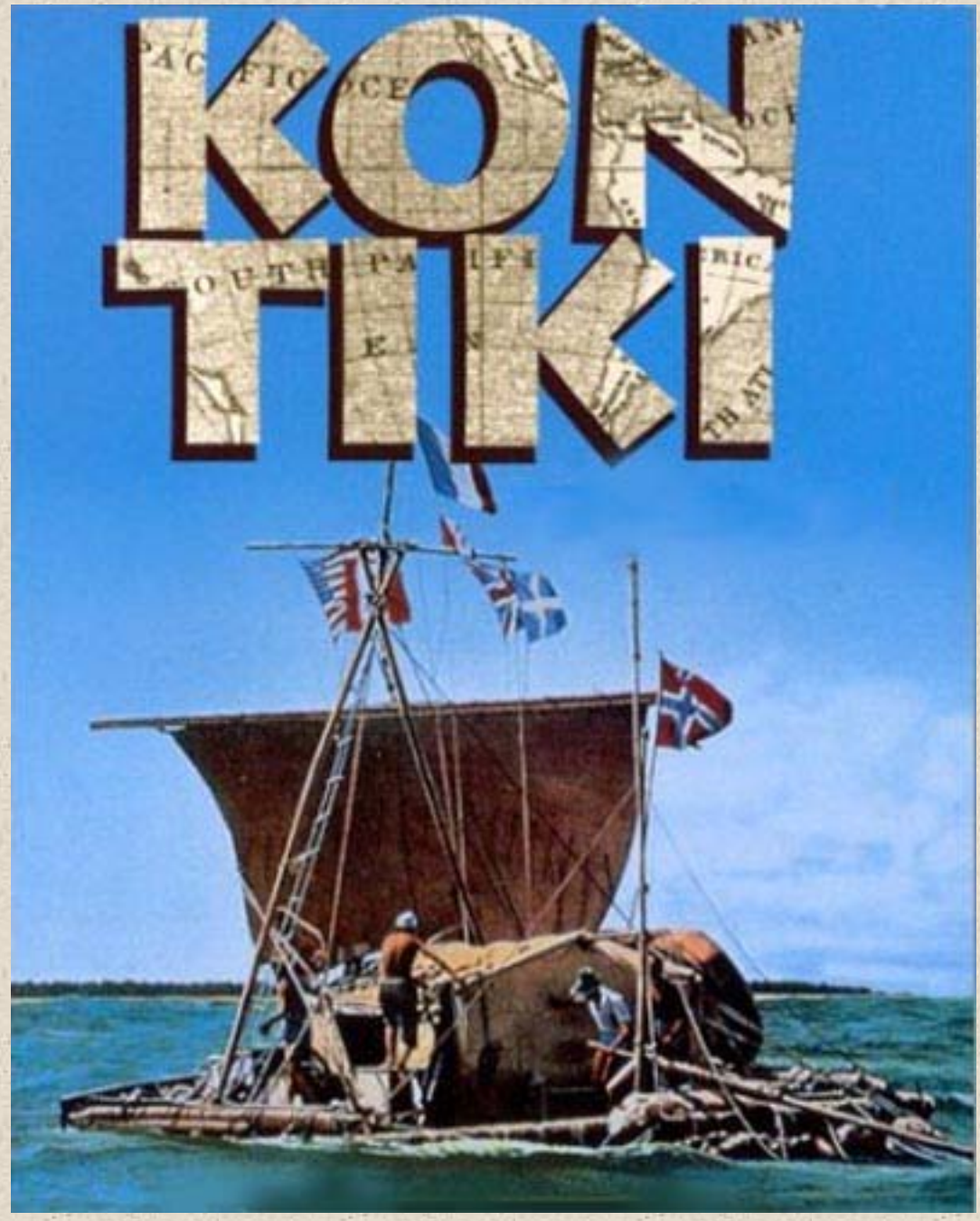

# OPTIONS FOR GREENING THE UNOLS FLEET

*Development of guidelines for a) existing and b) new vessels to be submitted to the federal agencies

1.FIC and/or
2. Council Subcommittee:
Members from Council, FIC, RVOC, RVTEC
3. Initiate discussions with designers, architects, LEED companies

*Incorporation of guidelines to existing vessels

*Incorporation of guidelines in design of new vessels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## Construction:

1) Hull and design
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