Sustainable Ship Design

Sustainable Shipping Conference Miami

20 – 22 October 2010

Thibaut **Tincelin** MSc (Eng)

Managing Director

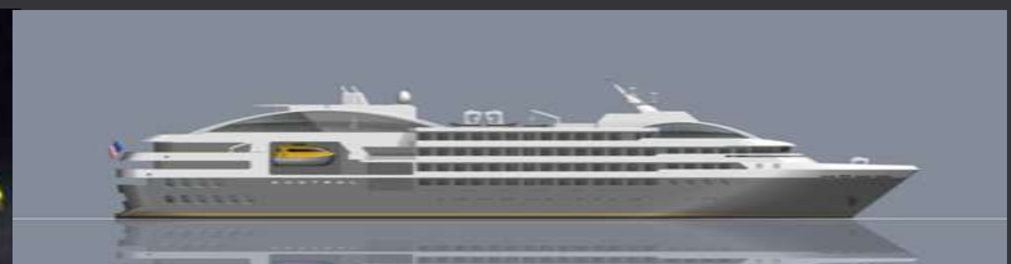
Stirling Design International

Stirling Design International - Founded in 1976

- Conceptual Design
- Interior and Exterior Styling
- Naval Architecture and Marine Engineering

Joël **Brétécher**: Founder - *Senior Designer - Former designer at Pininfarina*

Thibaut **Tincelin Msc (Eng)**: Managing Director - *Naval Architect - Former naval architect at STX Europe*



Stirling Design International

Specialized in Passenger Vessel, Cruise Vessels and Yacht Design.

Le Ponant
88 m *Cruise Vessels*
1500 m² sail area
14 – 16 knots under sail

Private Yachts
Seanest 85

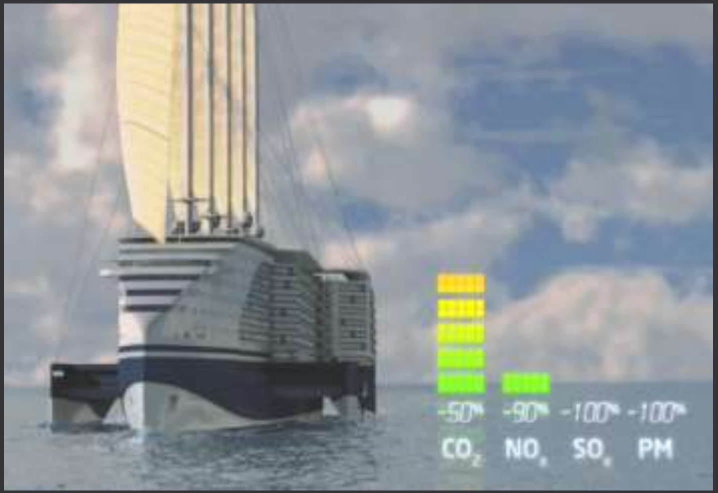
L'Austral
&
Le Boréal
142 m Cruise Vessels
264 Passengers
Delivery Spring 2010
Spring 2011

EOSEAS Green Cruise Ship Concept

Eoseas project objectives

- Development of a low environmental impact cruise ship concept
- Main objectives :
  - **GHG emission cut by 2**
  - Enhance **design, creativity and innovation**. Find new architectural solutions.
  - Build a **R&D road map** to bring selected green technologies to maturity
- **Novel esthetical and technological propositions**

Power consumption reduction	**50 %**
CO2 emission reduction:	**50 %**
SO2 emission reduction	**100%**
NOX emission reduction	**90%**
Ash emission reduction	**100 %**

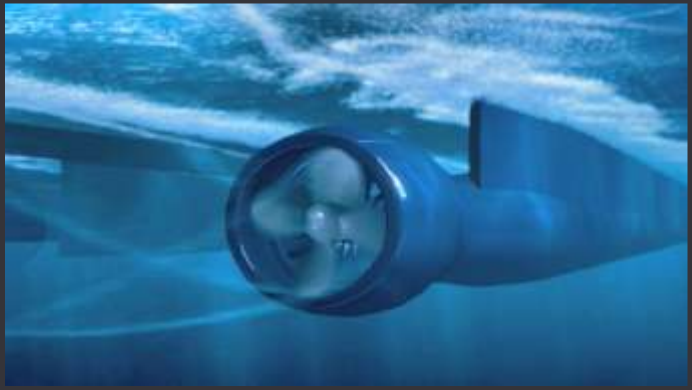


Energy management : Wind assisted propulsion

Patented rig concept (STX Europe)

SAILS

- Use of **wind energy**
- Development of an **innovative sails concept**
- Operation and maintenance as a priority
- Total surface : 12 400 m2.



PUMP PROPELLERS

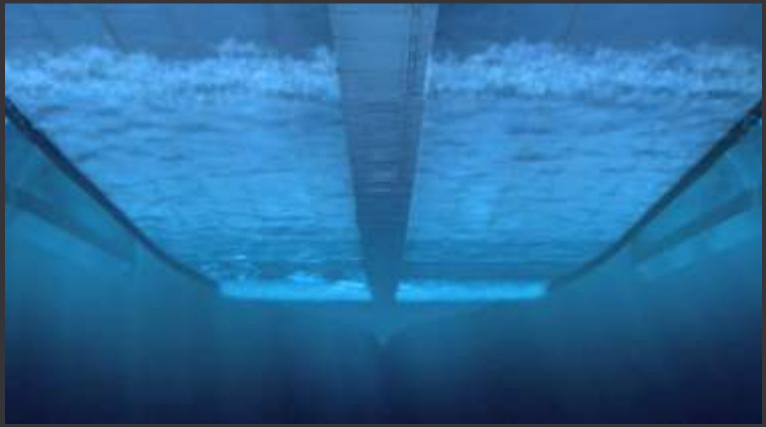
- Innovative pump propellers, on shaft lines and pods
- Enhance **fuel efficiency, redundancy and maneuvering**

Energy management : Propulsion

Patented rig concept during wind tunnel trials (STX Europe)

<u>**AERODYNAMICS DEVELOPMENT**</u>

- Technology patented by STX France
- Numerical studies and CFD
- **Tested in Wind tunnel**



<u>**HYDRODYNAMICS DEVELOPMENT**</u>

- 13 **tank tests** in 2008-2009 on different propulsion and hull architectures

State of the Art in Environmental sustainability of Ships

- Major aspects of Ship Design:
  - Performance / Weight / Cost
  - Environmental aspects ?

- A long history of environmental progress in term of :
  - Ship systems
  - Industrial site : ISO 14001
  - Environmentally hazardous substances : MEPC.179(59) adopted on 17 July 2009

- Existing studies of the environmental impact of ships through Life Cycle Analysis:
  - *Norwegian University of Science* (2002)
  - *Maritime Research Institute of Japan* (2004)
  - *Swedish Maritime Organization (2004)*

SSD Project : An Industrial Consortium

- Project leaders :
  - An industrial network : **NEOPOLIA**
  - Coordinating company: **Stirling Design International**
- Industrial Consortium of the French Marine Industry:
  - **STX France Cruise**
  - **DCNS**
  - **BUREAU VERITAS**
  - A team of 10 **SME**
- An expert in Life Cycle Analysis software :
  - **EVEA** (Simapro dealer in France)

A common goal : to find holistic and optimum solutions for Sustainable Ship Design (SSD)

- **Study of the ship and components as a whole**
- **Study of the ship through the entire life cycle :**
  - *Raw materials*
  - *Transport*
  - *Pre-transformation*
  - *Assembly at the yard*
  - *Ship operation*
  - *Maintenance*
  - *Dismantling*
  - *Recycling of materials*
- **Study of major environmental impacts through a selection of environmental criteria**

SDI
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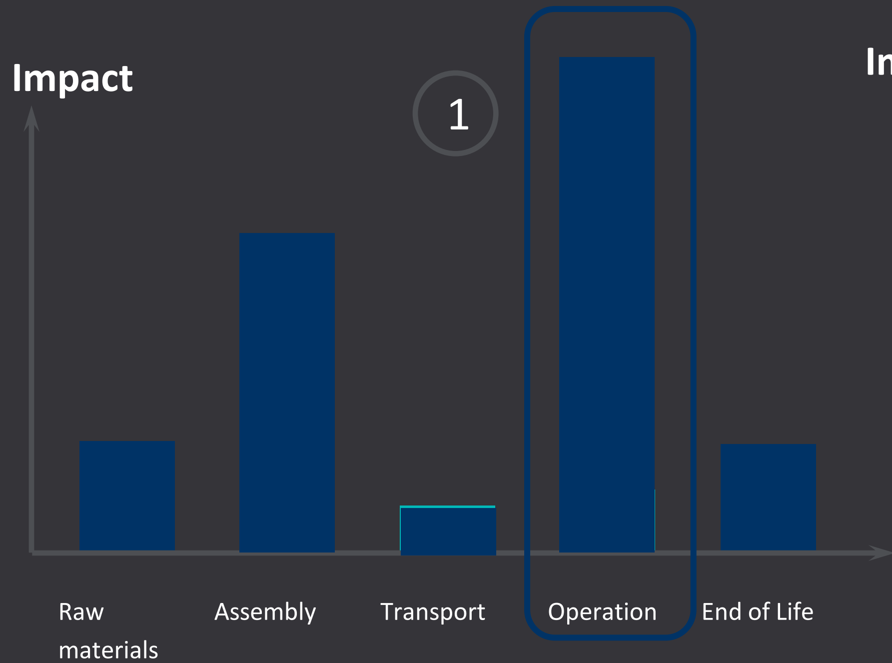
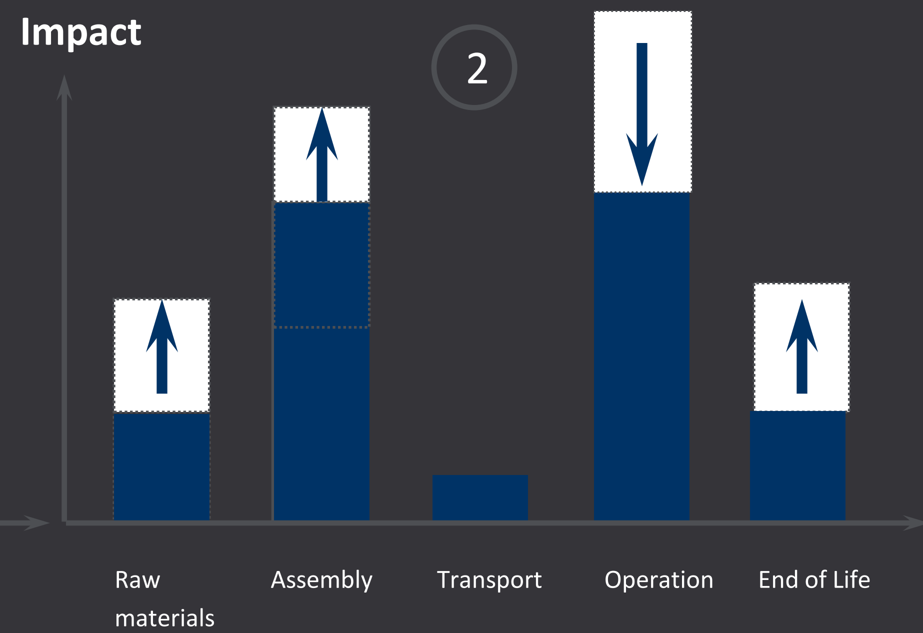
Avoiding pollution transfers





Major environmental Impacts are generated during ship operation

Reduction of environmental impacts during ship operation may induce increased pollution during construction phase and end of life of the ship.

SSD Project : An innovative approach

- **Global sharing of environmental data among a large industrial consortium**
  - Definition of specific materials and process of the marine industry
  - Definition of the ship life cycle: transports / consumptions / wastes

- SimaPro 7.1 : The Modular and Flexible Architecture of a commercial software
  - Flexible modeling
  - Interactive results analysis
  - Large database (Eco-invent).
  - Updates and user support
  - International recognition

Environnemental Impacts

Impact Indicators

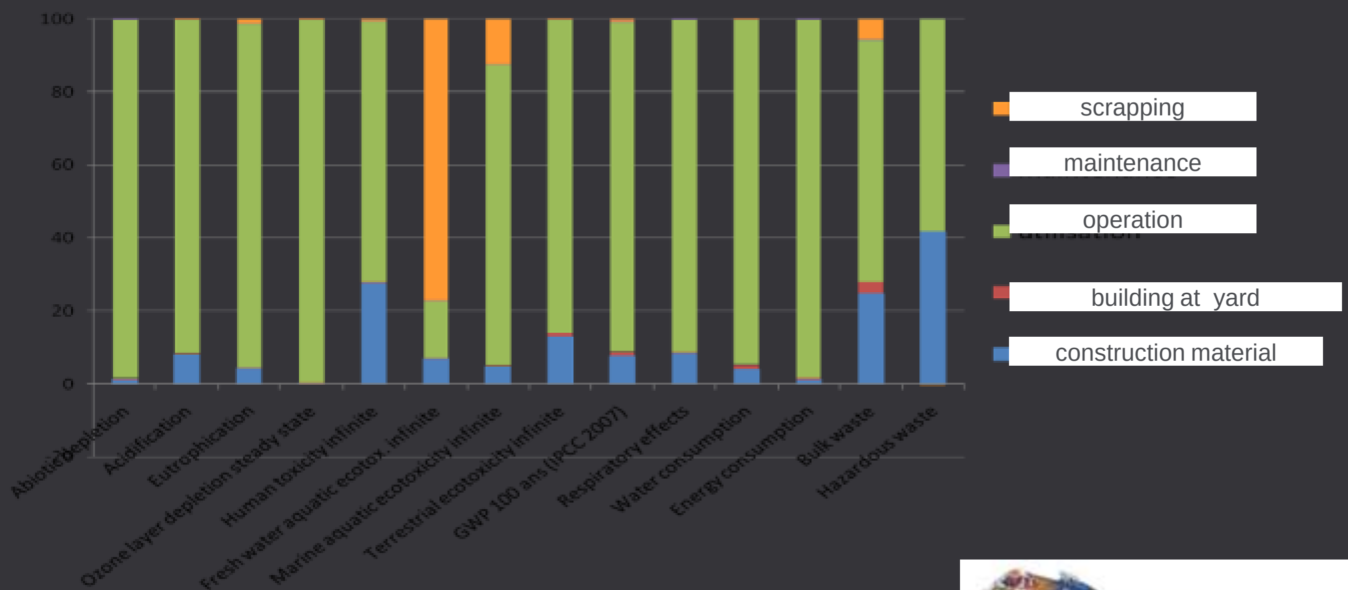
- Global warming – IPCC 2007 (CO_2 equivalent)
- Eutrophication (PO_4 equivalent)
- Atmospheric acidification (SO_2 equivalent)
- Ozone layer depletion (CFC11 equivalent)
- Human toxicity (1.4-DB equivalent)
- Fresh water aquatic eco toxicity (1.4-DB eq.)
- Marine aquatic ecotoxicity (1.4-DB eq.)
- Terrestrial ecotoxicity (1.4-DB eq.)
- Respiratory effects (PM 2.5 equivalent)
- Abiotic depletion (Antimony - Sb - equivalent)

Flow Indicators

- Water (m3),
- Energy consumption (MJ eq.),
- Bulk waste production (kg)
- Hazardous waste production (kg)

Ship Life Cycle Assessment (LCA)

- **Life Cycle Assessment** confirms and quantifies that main environmental impact is created by fuel consumption during operation
- **Fuel efficiency** is clearly the main opportunity to reduce life cycle emissions
- **Emission reduction** is also achieved by using cleaner fuel and renewable energy



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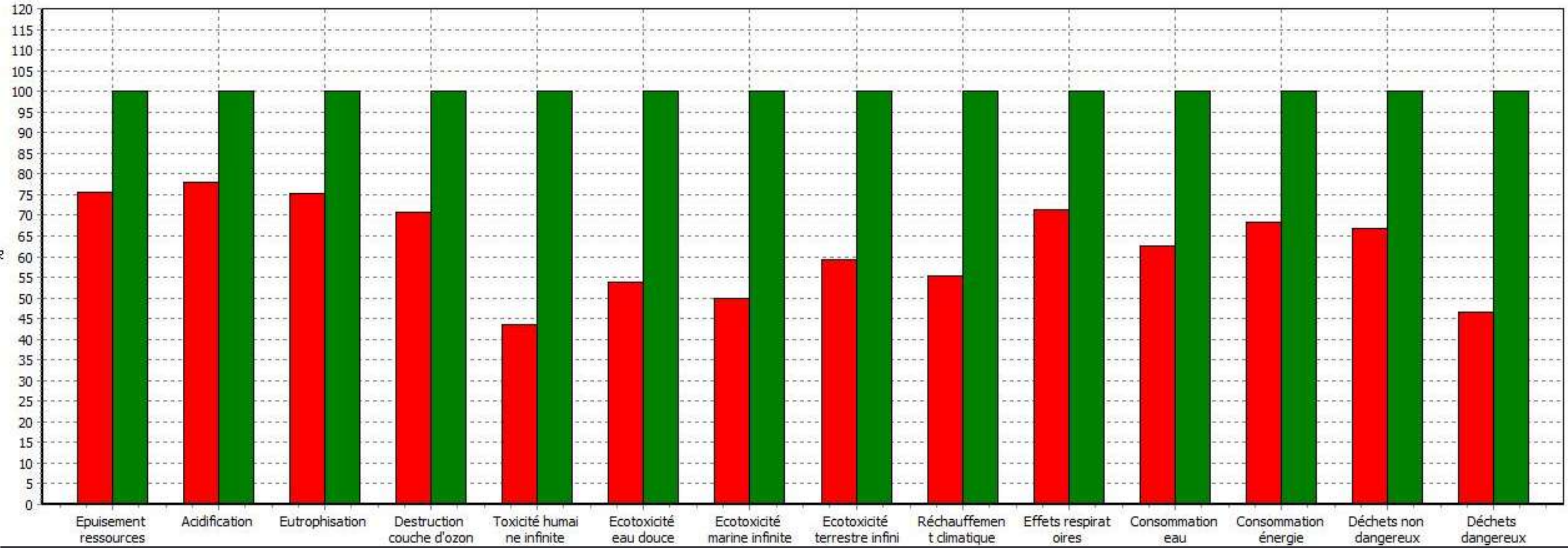
Construction Phase

Reduced impacts for steel compared to aluminum



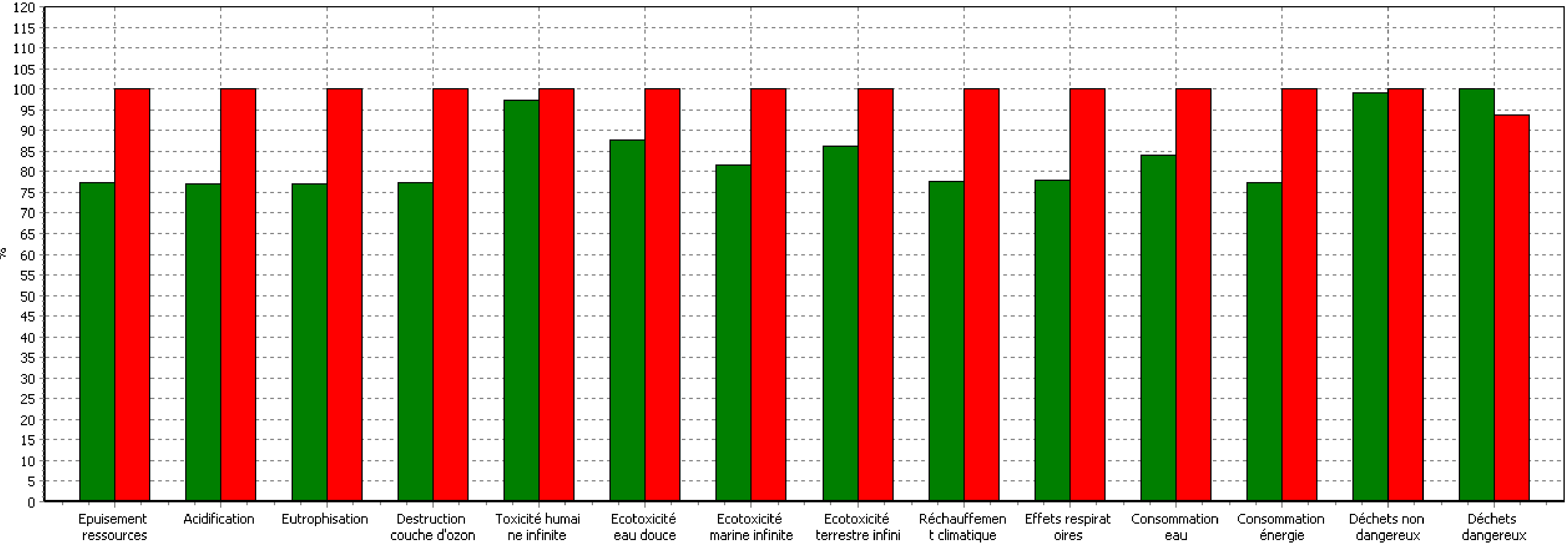
Ship in steel

Ship in Aluminum

Environmental impact indicators

Life Cycle

Reduced impact for aluminum compared to steel



Environmental impact indicators

Ship in steel

Ship in Aluminum

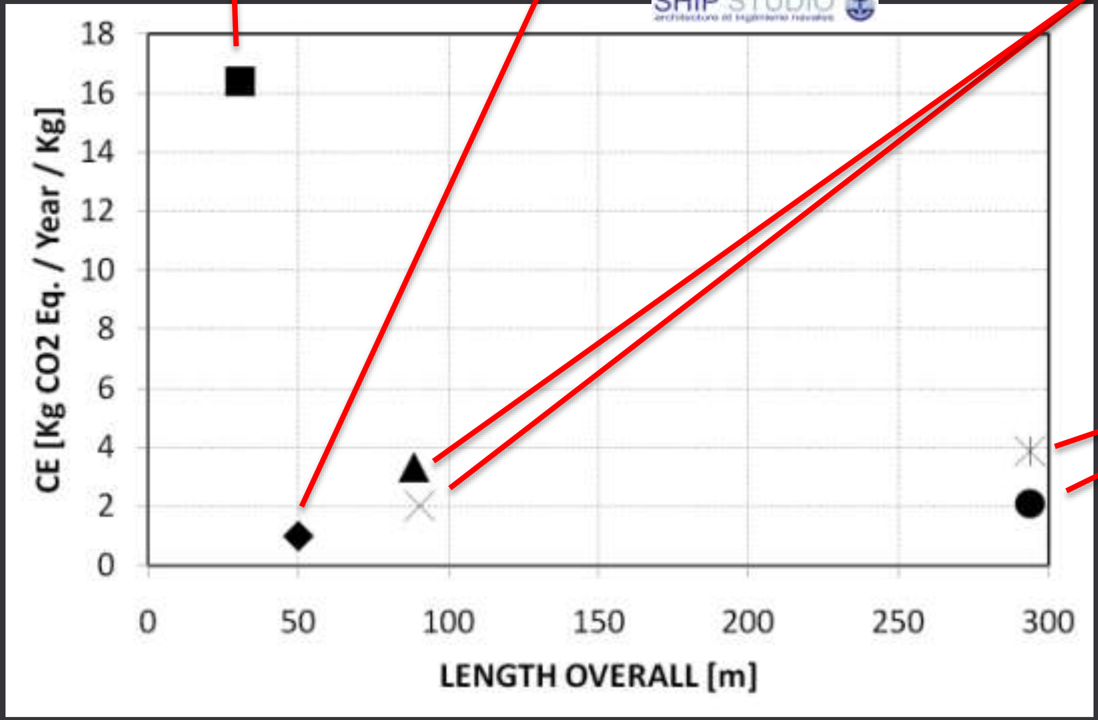
Case studies : Environmental Design index (for CO2 eq.)

SHIP STUDIO

SHIP STUDIO

DCNS

stx Europe



$$C_E = \frac{2}{3} \cdot \frac{\alpha . E}{\Delta}$$

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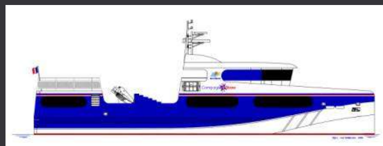
Case studies : Environmental Design index (for SO2 eq.)



SHIP STUDIO

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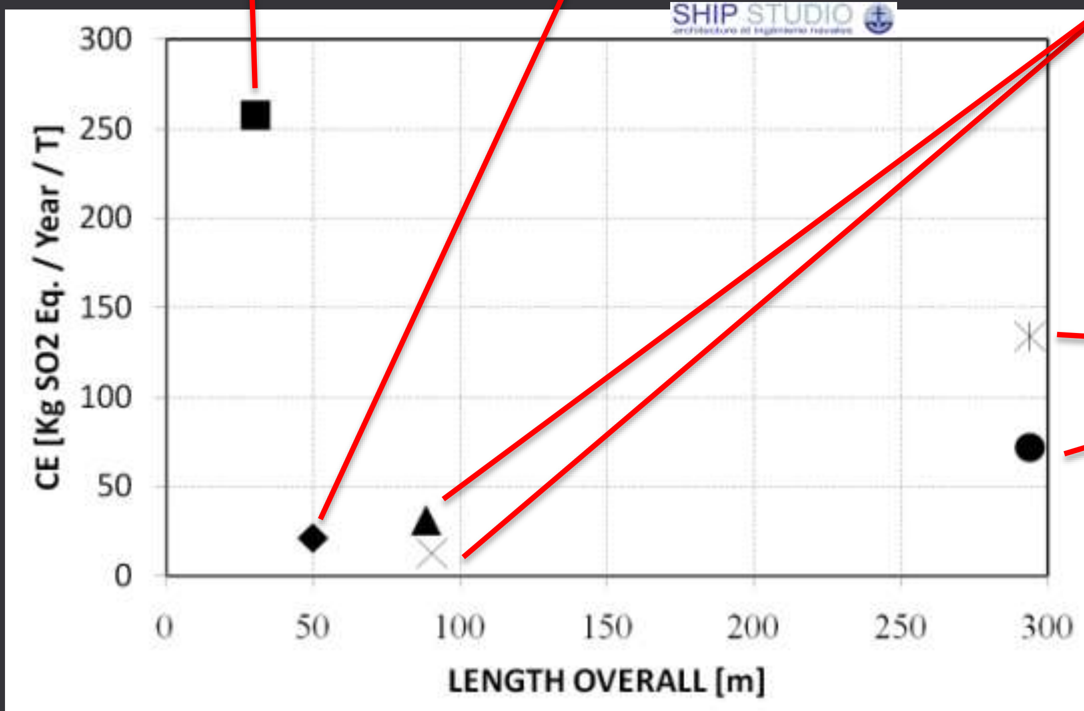
DCNS



stx Europe

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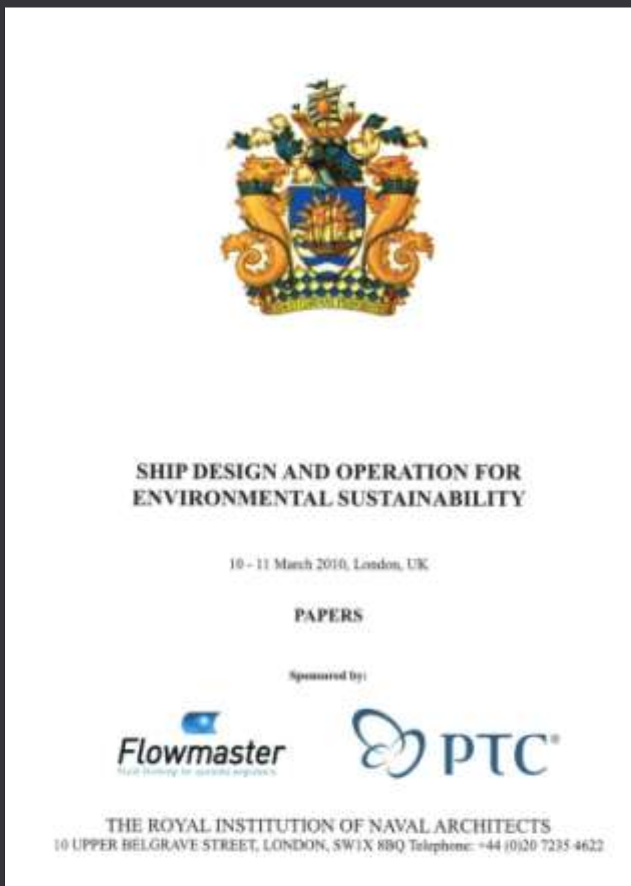
$$C_E = \frac{2}{3}.\frac{\alpha.E}{\Delta}$$

For further information:

www.sustainableshipdesign.com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Thank you for your attention