EOSEAS Green Cruise Ship Concept

7th Annual Green Ship Technology conference

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STX France SA

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Stirling Design International

stx Europe in partnership with SDI

STX Europe: 15 yards in 6 countries

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stx Europe

STX France SA

2 shipyards in France

- 2400 employees
- Two shipyards in France, Lorient and Saint-Nazaire, specialized in high added value and complex ships from 30m to 300m+
- STX France Solutions is recognized in Marine engineering
- STX France Services provides assistance, engineering and manage retrofit works

Lorient

Complex ships from 30 to 120m : low environmental impact passenger ships

Saint Nazaire

One of leading shipyards in cruise ships, ferries, navy vessels and offshore

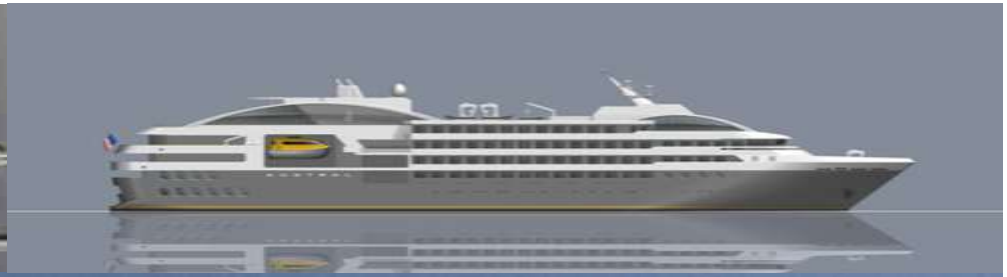
R&D, Engineering, Services.

Stirling Design International - Founded in 1976

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

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

Thibaut Tincelin: Naval Architect & Manager - Former naval architect at STX Europe



Stirling Design International

Specialised in Passenger Vessel, Cuise 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
140 m Cruise Vessels
264 Passengers
Delivery Spring 2010

Summary

Ecorizon® program presentation

Eoseas project objectives

Concept description

Main results

RCCL - MILLENNIUM (2000) Gas turbine, Co-génération, Podded electrical propulsion

CUNARD QUEEN MARY 2 (2003) – 345m – 29,7 knots

PROVALYS (2006) 290 m 154 500 m³ CS1 containment

History made of technical premiere and innovations

MSC FANTASIA (2008) Diesel electric propulsion, CLEANSHIP 2 AWT

NCL Norwegian EPIC (2010) – DNV CLEAN

FERRIES NESSODEN (2009)

Green cruise ship concept

Low emission innovative ferries

Offshore and Marine Energy

ECORIZON® Program :

Ecorizon® is a technical development program launched by STX France in 2007.

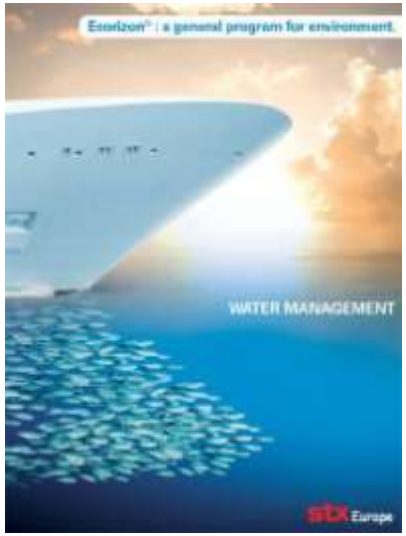
Main features :

- Development of a holistic and structured approach in the fields of **energy and environment**
- Development of dedicated **assessment tools and methodologies**
- Development and integration of **innovative marine clean technologies, including environmental systems and alternative to oil fuel** (gas, renewable energy, biomass, energy storage, hydrogen, …)
- **Dedicated team of engineers**, experts and naval architects

stx Europe

Ecorizon® 5 Main Work Programs :

- Energy Management
- Air Emission Management
- Water Management
- Waste Management
- Sustainable Design



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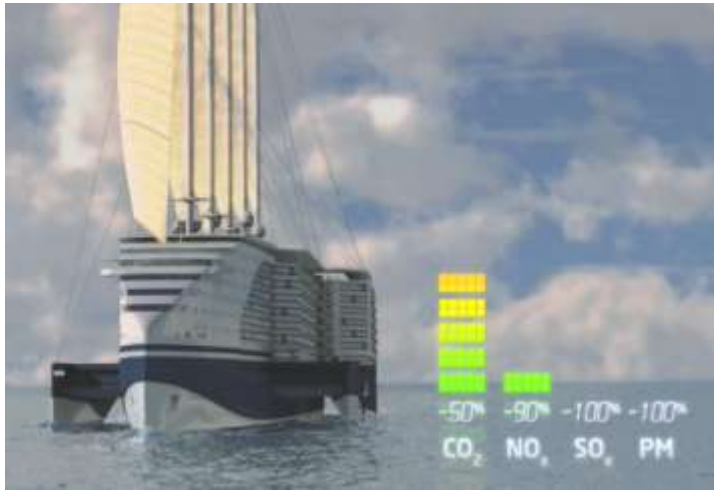
Eoseas project objectives

- Development of a low environmental impact cruise ship concept
- Main objectives :
  - **Green House Gas Emission divided by 2**
  - Enhance **design, creativity and innovation**. Find new architectural solutions.
  - Build a **R&D road map** to bring selected green technologies to maturity
- **Innovative aesthetical, architectural and technological propositions**

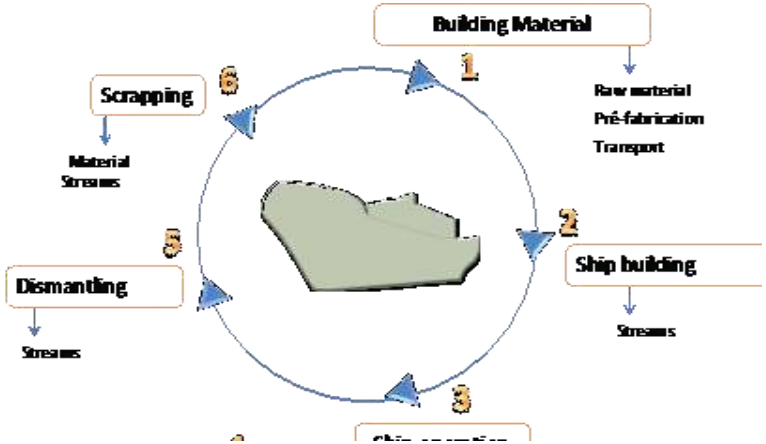
Main Eoseas Objectives

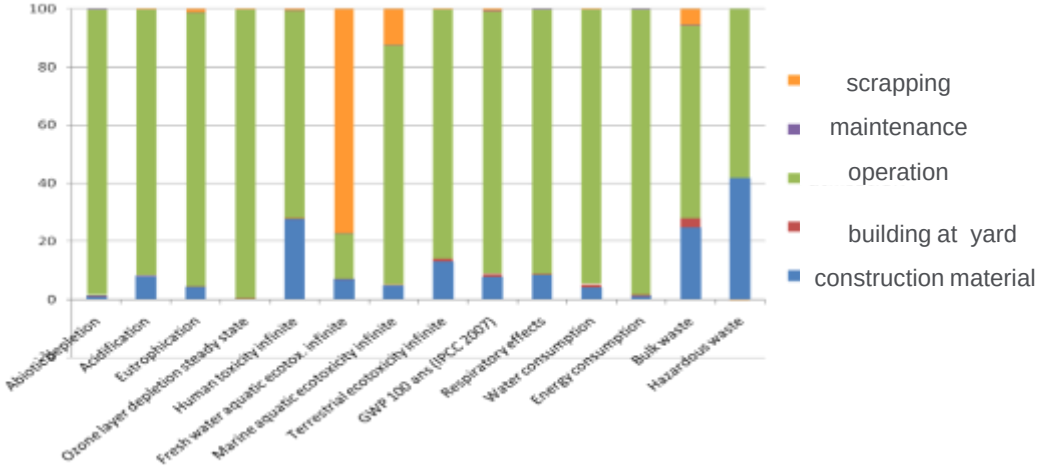
Power consumption reduction	**50 %**
CO2 emission reduction:	**50 %**
SO2 emission reduction	**100%**
NOX emission reduction	**90%**
Ash emission reduction	**100 %**



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



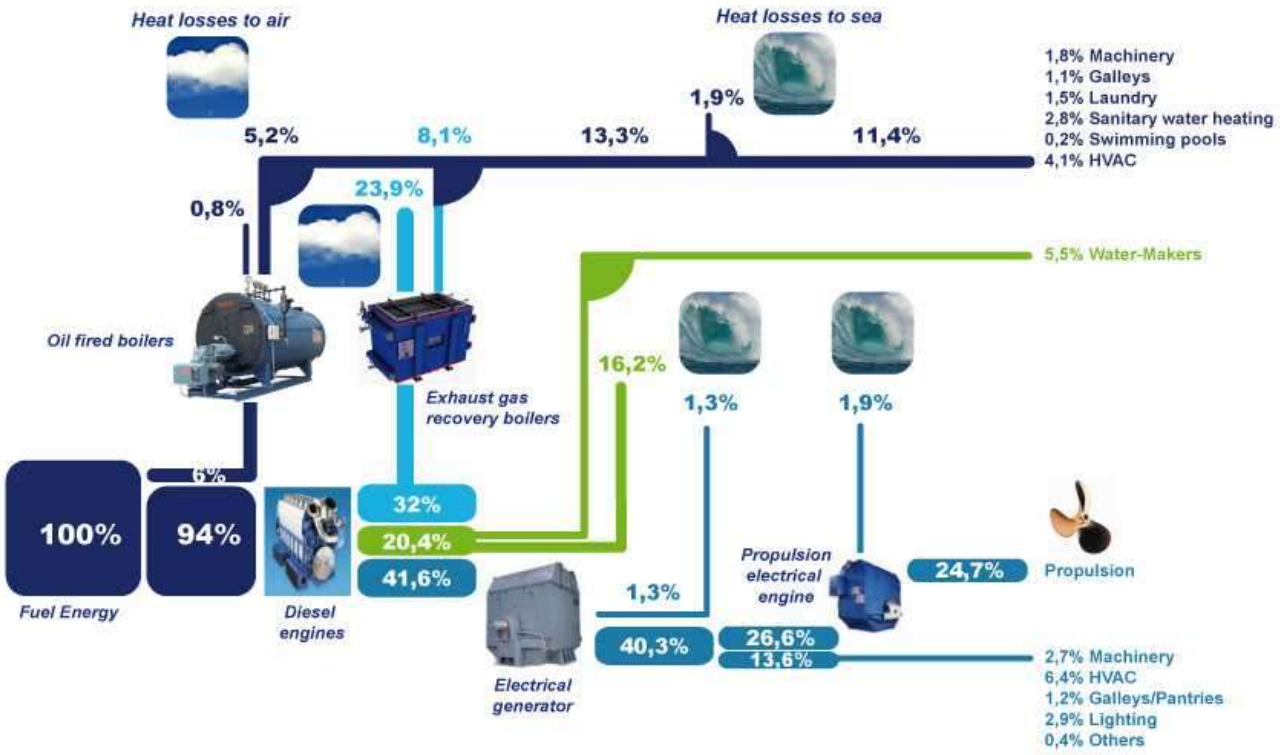


« SSD »: LCA tool developped by SDI, STX France and partners

*Dedicated website : **www.sustainableshipdesign.com***

stx Europe in partnership with SDI

Ship energy efficiency assessment



Ship energy efficiency assessment on operational profile using STX Europe tool : it is a global approach, not limited to installed power

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« EOSEAS »

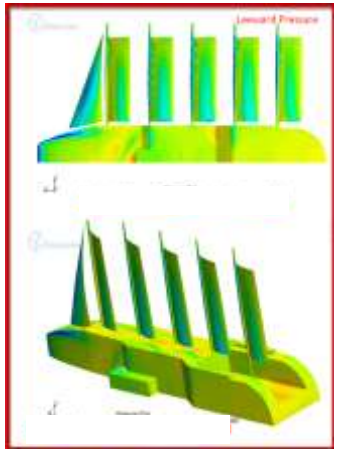
Loa : 305 m
Gross Tonnage : 105 000 UMS
Passenger cabins : 1430

Energy management : Wind assisted propulsion

Patented STX France rig concept during wind tunnel trials

SAILS

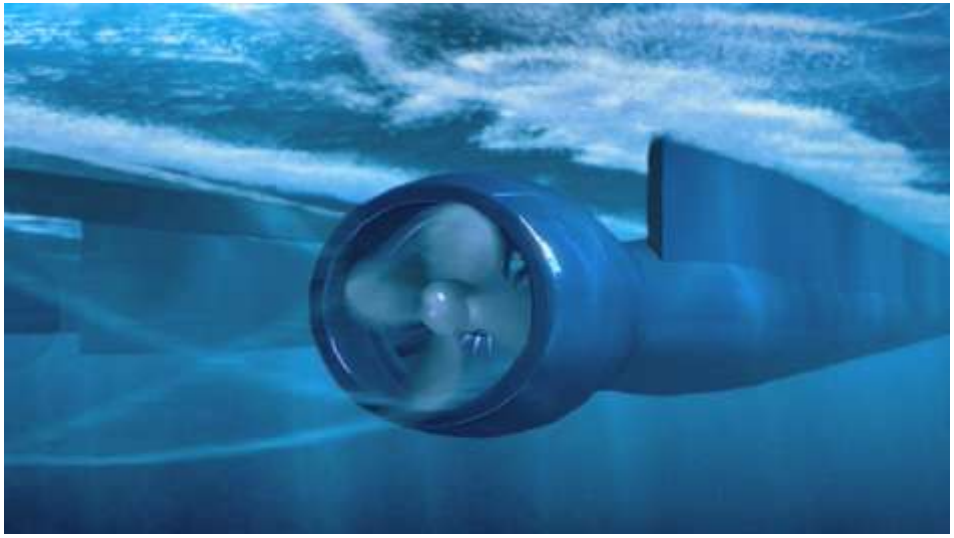
- Significant use of **wind energy**
- Development of an **innovative sail concept** (patented by STX France)
- Operation and maintenance as a priority
- Total sail area : 12 400 m².



AERODYNAMICS DEVELOPMENT

- Technology patented by STX France
- Numerical studies and CFD
- **Tested in Wind tunnel**
- Confirmation of 10% saving on fuel bill

Energy Management : Propulsion



INNOVATIVE PUMP PROPELLERS

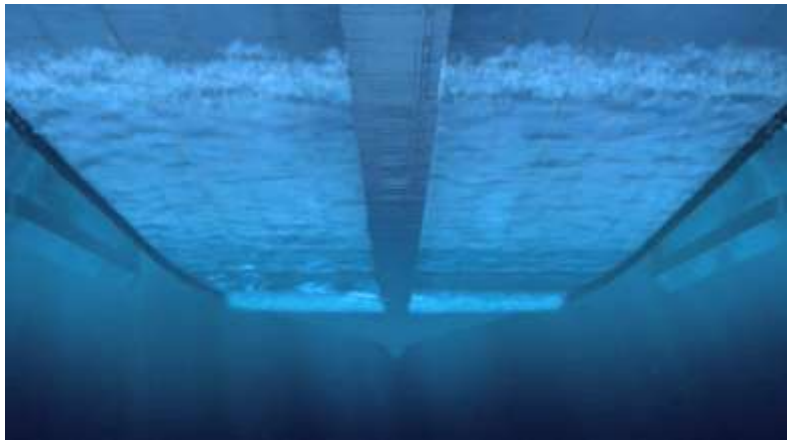
- Two pump propellers with shaft lines on outriggers
- Two pump propeller pods on central hull
- Enhance **fuel efficiency, redundancy and maneuvering**

HYDRODYNAMICS DEVELOPMENT

- STX France has a continuous development program (13 **tank tests** with different hulls and propulsive configurations in 2008-2009)
- Up to 17% improvements versus conventional propulsion/hull demonstrated

Frictional Resistance and Wave Resistance Reduction

- Air film injection to **reduce friction**



Air lubrication during tank tests

- **Vertical bow** to reduce Froude Number

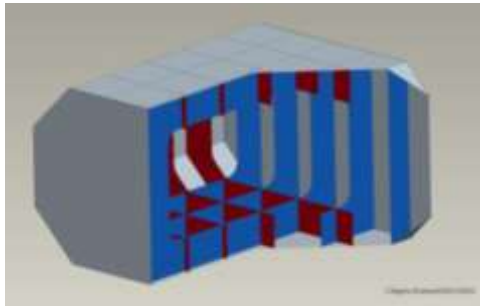
Speed/power curve Eoseas versus conventional ship

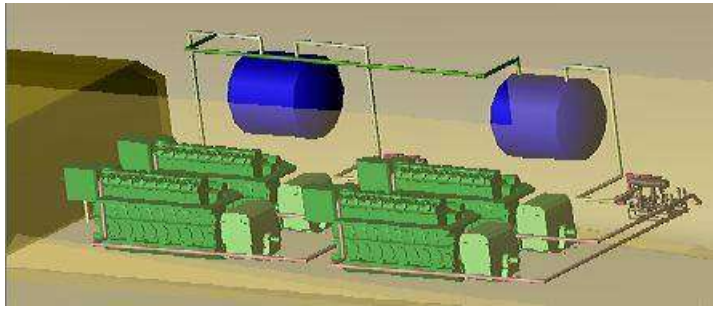
Energy and air emission management : LNG plant

Power plant uses Liquefied Natural Gas (LNG) as fuel.

4 Dual Fuel Gensets, 8MW per unit, producing electrical energy for propulsion and hotel load.

LNG is stored in a storage system similar to LNG carrier and transferred in pressurized service tank.





Thermal energy is recovered by an Advanced Heat Recovery Plant (Patented by STX France).

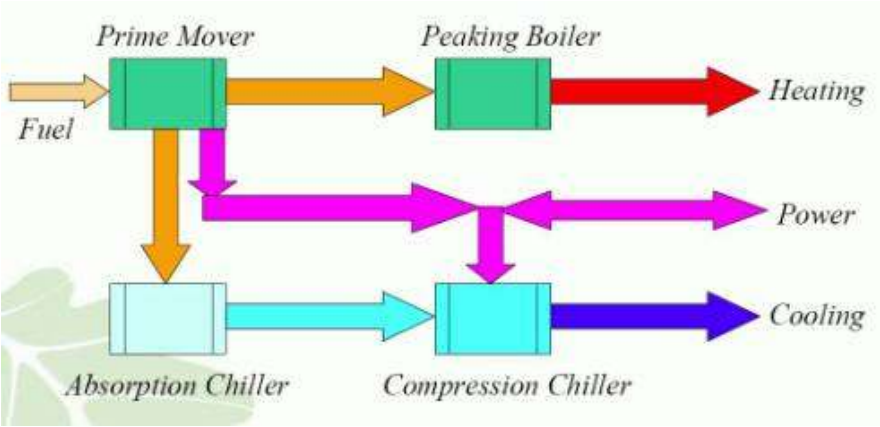
➢ Emission reduction with LNG :

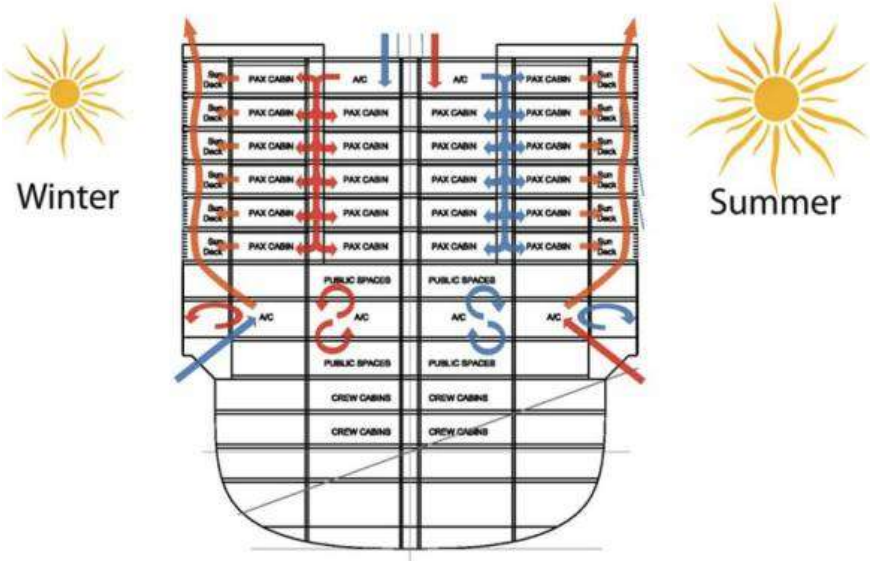
▪CO2	25% (*)
▪SO2	100 %
▪NOX	85%
▪Particulate Matter Reduction	100%

(*)Including only engine LNG consumption consideration

Energy management : Hotel load

- **HVAC**
  - Absorption chiller uses heat from engines **(Tri generation principle)**
  - LNG vaporization is used to reduce chillers energy consumption
  - Double skin concept is used to reduce AC needs in the superstructures (Patented)





Energy management : Hotel load

- **Lighting**
  - Extensive use of Natural lighting. Low consumption lighting.
  - Presence sensors and light sensors. Lighting management systems.

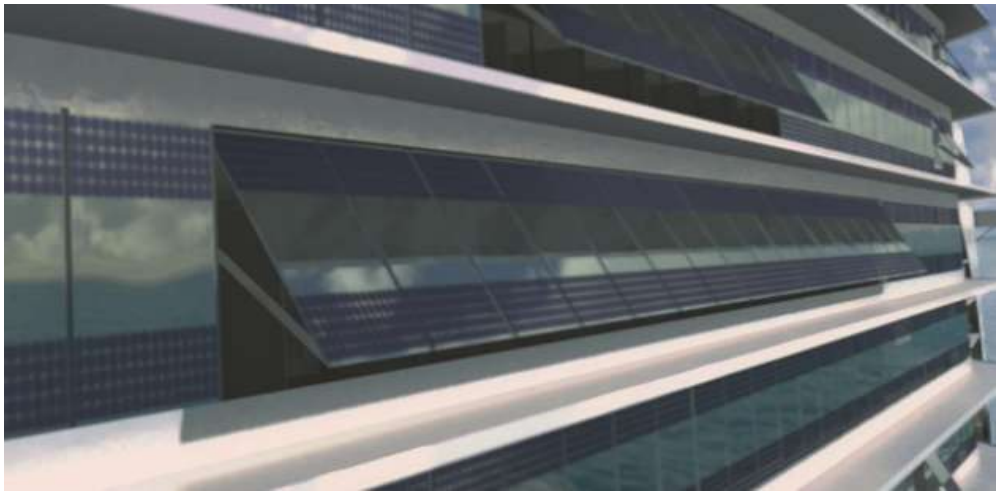
- **Machinery**
  - High efficient pumps and fans. Variable speed.

➢ **These technologies reduce hotel consumption by 30%.**

Energy management : Renewable energy

Use of renewable energy to reduce fossil fuel consumption and carbon footprint

- 8 300 M² of photovoltaic panels on double skin and upper deck produce max 1,08MWc and average **270kWe**.

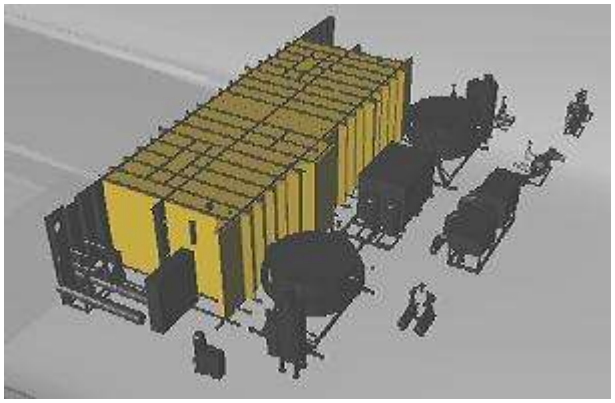


- Shipboard **organic waste gasification** generates 300 kWe in the generator sets burning “syn gas”.

Water management

- Fresh water generation by high efficient multi stage evaporators and Reverse Osmosis with **energy recovery**.

- **AWP** (Advanced Wastewater Purification) system treats grey and black waters to highest standards. For clean cruising in sensitive areas.



- **Laundry grey water** is separately treated and **reuse**

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Fuel consumption and C02 emission calculations

- Energy efficiency and environmental performances assessment on different operational profiles : allows to quantify gains brought by the energy saving technologies.
- **STX France energy modeling tool** has been used. This energy assessment tool is used to optimize STX France ship designs on operational profiles.

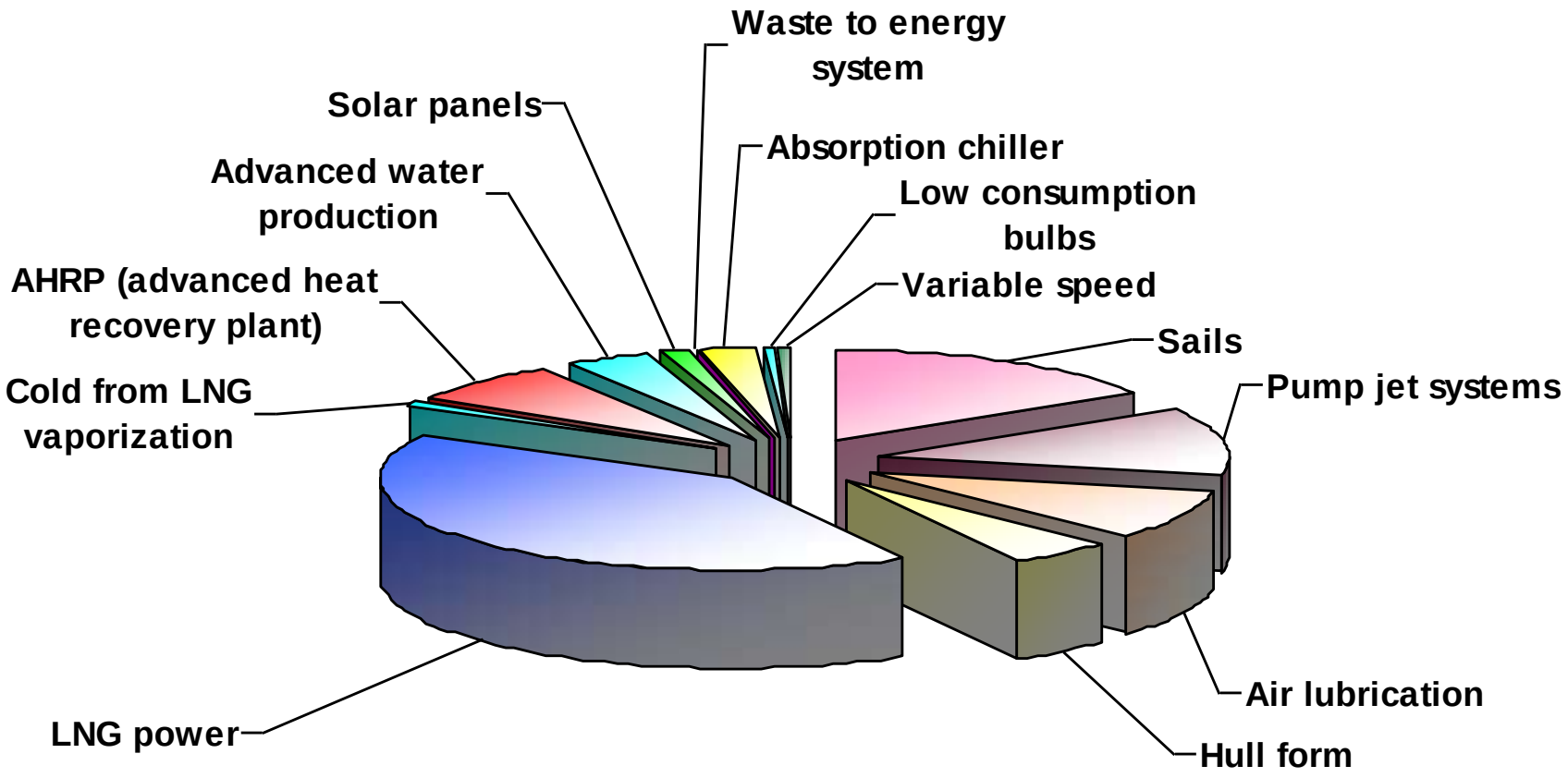
Energy sharing graph for reference ship

Cruise profile

Duration :
7 days

Average speed :
17,3 kts

CO2 Emission Reduction : Contribution Diagram



Energy Saving Technologies
Contributions to Global CO2 Emission Reduction

Propulsion/Hydrodynamics :	**18%**
Sails :	8%
Propellers :	5%
Hull shape and air lubrication :	5%
Power Plant and energy recovery :	**31%**
LNG (including life cycle consideration) :	20%
Thermal energy recovery :	9%
Renewable energy (excl. sails) :	2%
Hotel load :	**3%**
HVAC :	2%
Other electrical consumers :	1%
TOTAL :	**52%**

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Thank you for your attention

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