LouisDreyfus
ARMATEURS

REDUCING OUR ENVIRONMENTAL FOOTPRINT THROUGH INNOVATION

90%
of the world's goods are transported by sea

Wind energy represented

4,8%
of worldwide electric production in 2018

Undersea fiber-optic cables carry

99%
of international telecommunications

INNOVATION AND IMPROVEMENT OF OUR VESSELS' ENVIRONMENTAL FOOTPRINT

Maritime transport and services are an essential link in the economy of our modern societies.

Whether transporting raw materials, finished products, oversized parcels, or installing undersea cables essential to people's access to networks, ships have a central role in the global economy. With the tremendous growth of marine renewable energies, a significant part of today's green energy is produced at sea.

These missions make the decarbonization challenge all the more important.
On a global scale, international maritime transportation represents 2.5% of greenhouse gas emissions.
In June 2021, as part of the 76th Marine Environment Protection Committee (MEPC), the International Maritime Organization (IMO) set carbon intensity reduction target for shipping to 11% between 2020 and 2026. The challenge of decarbonization will be crucial to achieve by 2030 the sustainable development goals set by the Paris Agreement.

Louis Dreyfus Armateurs gives particular attention to environmental protection. This concern is reflected in our active innovation policy, our commitment in favour of speed limits for ships, and our ISO 14001 company certification since 2018.

Our engineering and innovation teams are working on decarbonization on every ship in our fleet: RoRo, Service Operation Vessels, Crew Transfer Vessels, cable ships, bulk carriers…
Our teams have built close relationships with key innovation players in France and Europe and have established partnerships enabling the implementation of innovative and environmentally friendly solutions.

Our research is structured along two lines:

Short-term objectives:
- Search for energy sobriety: how to rapidly reduce energy requirements.
- Search for optimized vessel environmental performance.

Mid-term objectives: search for fully decarbonized solutions.

Discover in this brochure an overview of our innovation initiatives.

01

Sobriety: reducing our energy requirements

SPEED REDUCTION

IN OPERATION

A ship's fuel consumption generally evolves according to the cube of its speed. Thereby,

a 25% reduction in the maximum speed of ships allows approximately for a 60% reduction in fuel consumption, therefore in emissions of atmospheric pollutants (CO2, nitrogen and sulfur oxides, particles). This straightforward measure does not require significant changes in the active worldwide fleet. This is the first way to reduce a ship's fuel consumption and greenhouse gas (GHG) emissions. No investment is needed and results are immediate. However, increased attention should be paid to ship maintenance. We have established recommendations in this area.

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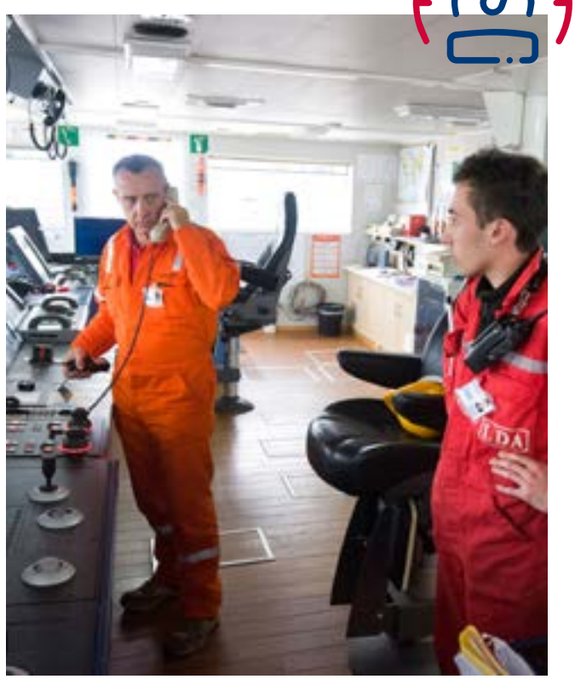


02

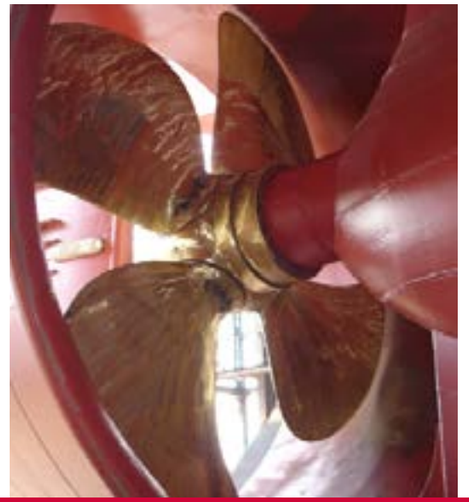
Sobriety: reducing our energy requirements

RECOVERING HEAT FROM ENGINES OR OTHER HEATING SOURCES

IN OPERATION

The heat produced by engines can be converted into electricity using a mini power station.

The device operates on the principle of the Organic Rankine Cycle (ORC) and recovers previously unusable energy to convert it into usable electricity. This technology increases energy efficiency and reduces fuel consumption.



03

Sobriety: reducing our energy requirements

IMPROVING HYDRODYNAMICS

Reduced hull drag can result in

7-10%

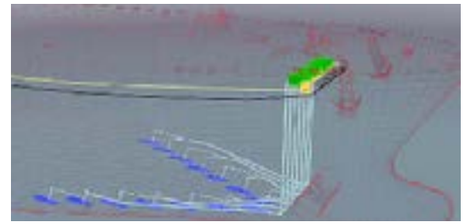
fuel savings

Hydrodynamics consists in reducing resistance to the ship's progress.

By reducing the vessel's drag, power demand decreases and allows target speed to be reached with optimized fuel consumption. This can lead up to 7 to 10% savings in fuel consumption in our Group's fleet, depending on operational profiles and whether gains generated by the various systems can be combined. As an example, the operational profile of cable ships or SOVs, whose transit phase at commercial speed is less than 30% of the time, is very different from that of bulk carriers or RoRo ships whose transit phase at commercial speed is much higher.

Our teams have identified 3 systems:

Under-hull bubbling consists in creating a kind of carpet on which the ship slides, by injecting air bubbles under water using air compressors installed on the ship and nozzles cleverly distributed under the hull. This technique reduces friction under the hull.



Pitch reduction

Equipped with retractable fins at bow level under the keel, the carrying surface helps reduce pitching movements induced by the swell. The additional drag caused by pitching is therefore reduced or removed. This gives greater stability to the vessel while reducing its movements, sinkage, and any related energy consumption.

Hull cleaning with a robot
Afloat cleaning of the hull every 6 months or every year to remove dirt can save around 5% of energy.

04

Sobriety: reducing our energy requirements

ADDING WIND-ASSISTED PROPULSION

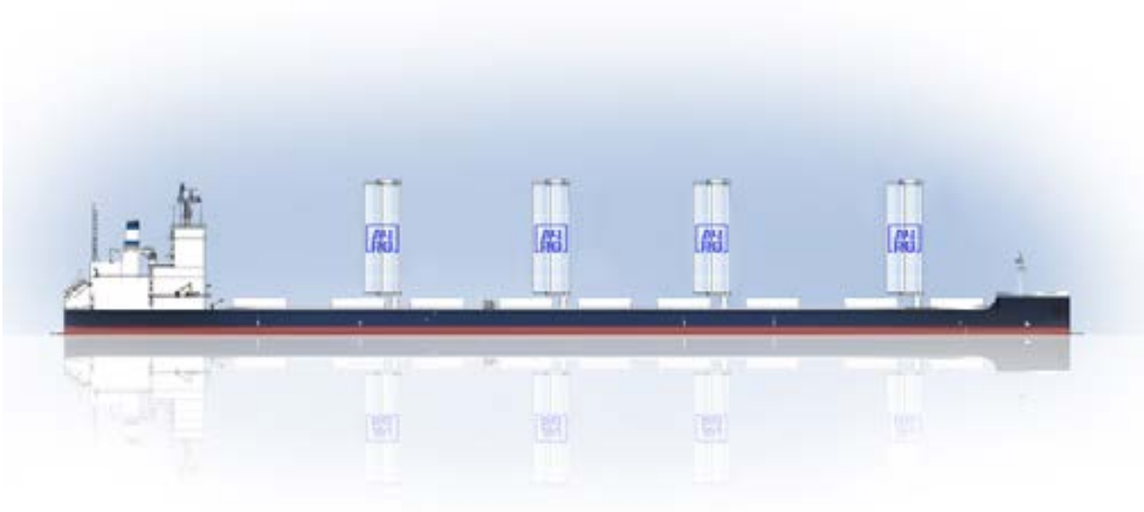
BEING DEPLOYED

"We take advantage of the real wind and the apparent wind to generate additional thrust."

Adding wind-assisted propulsion creates a lift force on the ship.

We take advantage of the real wind and the apparent wind to generate additional thrust through the sail propulsion system. This device generally comes in addition to mechanical propulsion, as a support to the propulsion engines, and generates less fuel consumption.

Wind-assisted propulsion can take several forms: rotating vertical cylinders (Flettner rotor operating on the Magnus effect), flexible sails, rigid sails, wings.



04

Sobriety: reducing our energy requirements

The expected fuel savings will reduce the

CO_2

environmental footprint for a vessel equipped with this kite.

The resulting savings vary according to the selected systems, routes and ships, but it is estimated that 5 to 15% of fuel savings can be achieved through to these technologies, and above 15% on average

These devices can be retrofitted on adapted existing ships, with well-suited operational profiles (Ro-Ro, Ropax, LoLo, bulk carriers, tankers) but generally in a less optimized way. The gain may be greater for new vessels designed specifically around wind-assisted propulsion. Many French and European players have emerged in the sector in recent years and continue to do so. [This environment is structured around the «International Windship Association» (IWSA).]

Louis Dreyfus Armateurs works alongside AirSeas, an Airbus spin-off company, for the integration of Seawing, an innovative solution.

Seawing is an automated kite based on parafoil technology, used to tow commercial vessels. Seawing also analyzes a large quantity of complex data in real time and autonomously adapts to current conditions to optimize the vessel's performance while guaranteeing maximum safety. The expected fuel savings will reduce the CO_2 environmental footprint for a vessel equipped with this kite.

The Group is also in regular contact with several sailing concept developers.

It is estimated that

5 to 15%

of fuel savings can be achieved through wind-assisted propulsion.

05

Sobriety: reducing our energy requirements

BIOMIMICRY: TROCHOIDAL PROPELLERS

an average improvement of

20%

in propulsive efficiency compared to conventional propellers

Vertical-axis trochoidal propellers improve propulsive efficiency by approximately 20% compared to conventional propellers.

The blades' movement is biomimetic, like a fish tail. A crown rotating around 500 rpm is equipped with mounted vertical blades, oriented by a gear mechanism throughout their rotation to perform a trochoidal movement.
These propellers have superior efficiency and allow high speeds.

01

Optimized vessel operations

MONITORING

IN OPERATION

In addition to monitoring fuel consumption and CO2 emissions according to international rules, we are working on continuously improving our consumption and maintenance.

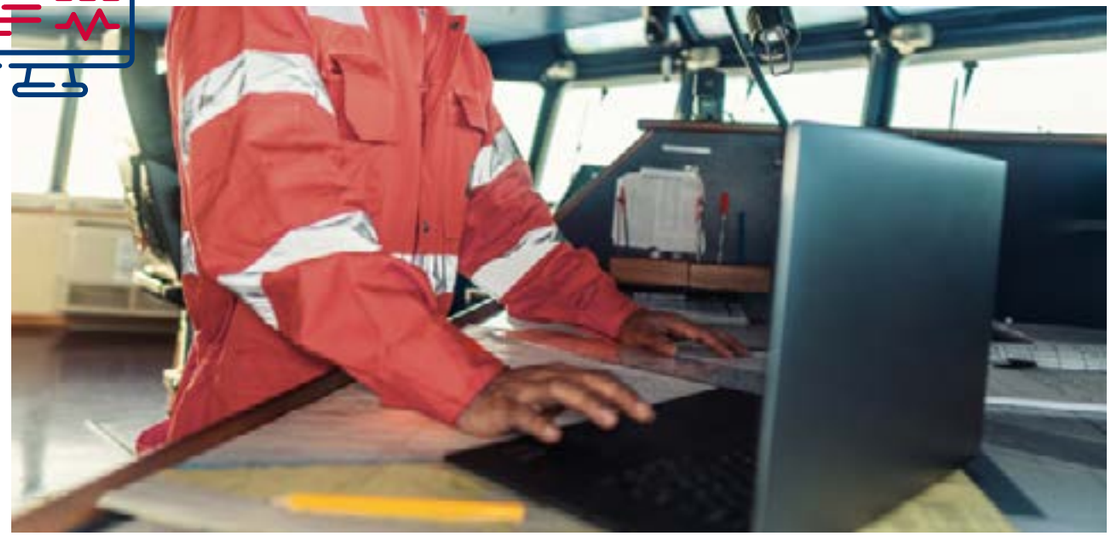
Over years of research, Louis Dreyfus Armateurs developed through its Computerized Maintenance Management System (CMMS) optimized maintenance adapted to each type of vessel in its fleet.

Based on feedback, collection of information, recordings and thorough monitoring of machine parameters, this new approach allows us to achieve two objectives: greater cost control and consumption reduction (parts, consumables and services), both contributing to carbon footprint reduction.

We have been involved in the development and launch of two software programs, MyOpteLog and MyOpteMar, which we use to monitor machine and engine parameters, and which gives an alert in case of abnormal deviation according to predefined parameters.

Lastly, our SOVs are equipped with onboard software Octopus, a Vessel Monitoring System allowing access to the ship's operational data from an internet platform, which makes it possible to better view the actual use of the ship as part of a continuous improvement process.

"Our ships have saved almost 4,300 tons of CO2 in one year"



02

Optimized vessel operations

SECURITY

IN OPERATION

To detect any abnormal operation,

our technical teams have set up vibration measurement equipment, electric engine diagnostic tools, thermal imaging cameras to detect hot spots through electrical panels, partitions or piping.

All these investments provide more safety to our crews.

03

Optimized vessel operations

Searching for weight gain through the extensive use of composite materials or aluminium gain

04

Optimized vessel operations

SHIP ERGONOMICS AND VERSATILITY

IN OPERATION

LDA was the first shipowner to order 40k and 43k dwt generation BDelta for its fleet of Handysize bulk carriers.

These high-performance vessels help reduce sulfur and CO2 emissions.
Our technical teams have modified the design of the propeller blades on the Ville de Bordeaux, Lodbrog and Île de Ré to improve their efficiency.
Our specialists can also optimize storage in our RoRo ships to offer the best service to our clients.

"BDelta bulk carriers help reduce CO2 emissions"

"Storage optimization in our RoRo ships to offer the best service to our clients"

05

Optimized vessel operations

IMPROVING CREW TRANSFER AND CABLE-LAYING OPERATIONS

IN OPERATION

Horizon™, an all-electric "walk-to-work" motion-compensated gangway, is the result of the Group's choice in favour of an innovative «full electric» technology developed by MacGregor/TTS.
The motion-compensated gangway allows for a fixed, stable and secure connection between the ship and the platform located at the foot of a wind turbine so that crew and packages are transferred safely, whatever the movements of the ship, even in adverse sea conditions.

"Our collective ability to bear the risk will bring out future solutions"

The Horizon™ gangway has been designed around a fully electric architecture, using innovatively configured proven technology.

Key elements of this development are moderate weight, high expected performance, and reduced noise level.

Colibri™, a crane installed on board Wind of Change and Wind of Hope, is an innovative 3D crane (horizontal and vertical) adapted to difficult weather conditions to allow safe

Designed and manufactured by Louis Dreyfus TRAVOCEAN, TM05 is a cable-loading machine operated from the surface without assistance from any divers. Depending on ground type, it can be equipped with different tools.
These solutions may require more maintenance, equipment, test periods to prove their reliability, etc.
Innovation is a demanding process requiring investment and risk-taking. Louis Dreyfus Armateurs has always believed in the need to establish partnerships, share risks and have development costs borne by several parties. Our collective ability to bear the risk will bring out future solutions.

01

Innovation to drive decarbonization

The energy transition plan for maritime transport requires decarbonization of used energy. Our efforts, supported by French and international sector institutions, focus on the electrification of ships, and development of fuels such as hydrogen, ammonia, methanol, and biofuels including biomethane derived from waste or algae.

HYBRID SHIPS

IN OPERATION

Hybridization consists in using an electric battery, or any other electrical energy storage device, in addition to conventional motorization.

Our two SOVs Wind of Hope and Wind of Change have hybrid electric propulsion systems. A hybrid ship has reduced CO2 emissions thanks to an optimized use of the internal combustion engine(s).
Fuel savings may vary as they are closely linked to the ship's operational profile and hybridization level.
Hybridization efforts also contribute to the reduction of underwater noise and vibrations emitted by the ship.

Hybridization also makes it possible for vessels on wind farms to operate in zero emission mode for a short time. Recharging the ship at sea is also possible thanks to a buoy allowing the supply of 'green' energy produced on the wind farm.
Eventually, if a recharging solution of sufficient capacity gets available at any time on the wind farm, an all-electric, emission-free operation should be possible.

"By partnering with the most innovative suppliers in the industry, LDA has been able to provide reliable and efficient commercial solutions meeting the growing needs of the market"

02

Innovation to drive decarbonization

ZEST: "ZERO EMISSION & SAFE TRANSFER" VESSEL

Louis Dreyfus Armateurs and his partners Mauric, Barillec Marine, SEAir and ADV Propulse have joined forces to develop a "Zero Emission & Safe Transfer" Crew Transfer Vessel ("ZEST" project).

"It will offer a more suitable and secure solution for transfer operations at sea, will be more manageable and better suited to maintenance operations"

With the ZEST project, a new type of innovative and energy-efficient CTV will see the light of day in 2025. This CTV will offer safer and more efficient transfer for wind turbine maintenance personnel, particularly thanks to excellent seakeeping characteristics and the integration of sea state monitoring systems.

Compared to other wind turbine maintenance personnel transfer vessels currently on the market, it will offer a more suitable and secure solution for transfer operations at sea, will be more manageable and better suited to maintenance operations.

ZEST will operate at low power consumption and greenhouse gas (GHG) emissions thanks to innovative technological bricks and an optimized architecture.

The use of recyclable composite materials will improve the ship's environmental impact from construction to dismantling. Every impact will be assessed via a Life Cycle Assessment. By getting closer to zero GHG emissions while gaining operational capabilities and safety, the ZEST CTV will have a privileged position in a growing market.

03

Innovation to drive decarbonization

ALTERNATIVE SOLUTIONS

BEING DEPLOYED

As they fall outside the IMO's regulatory framework and engine manufacturers' standard specifications, we collaborate with insurers, manufacturers, classification societies and the French Flag Register for the use of new fuels aimed at reducing CO2

E-methanol - methanol synthesized from hydrogen (H2) - seems to be the most promising solution in the short and medium term as a replacement for diesel.

The hydrogen itself is produced by hydrolysis using carbon-free electricity (wind, solar, hydroelectric, or nuclear energy) and CO2 captured from highly emitting industrial sources. We are currently discussing with energy suppliers about e-methanol production.

Hydrogen does not generate any greenhouse gas during combustion, which is a significant asset. However, carbon-free hydrogen production is in its early days and only in the form of a pilot project. Hydrogen can be used either as fuel in specific internal combustion engines or in the supply of fuel cells (FC) which generate electricity from the oxidation of hydrogen.
However, beyond its production, availability and distribution, storing hydrogen in sufficient quantity on board is a major challenge. Several technologies exist: gaseous storage in very high pressure tanks; storage in liquid form at -253°C; storage on fluids or solids both capable of storing and releasing hydrogen on demand. None of these solutions is currently mature enough for efficient onboard use.

Ammonia generates no greenhouse gas either during combustion in an engine or a fuel cell. Ammonia is easier to store and to handle in large quantities. However, as a very toxic liquid, its use raises security concerns. The combustion of ammonia in an internal combustion engine generates significant quantities of NOx which must be treated before emission into the atmosphere.

Biofuels raise questions about a fuel's life cycle and imply an analysis of the environmental and social cost of using necessary raw materials until reprocessing of waste material.

We are therefore focused on microalgae-based solutions and, as part of a circular logic, on organic waste, used frying oil, etc. The cost of these biofuels requires a significant commitment and investment from all players in the sector and decision-making authorities.

"The quest for performance and initiative, trademark of the Louis Dreyfus Armateurs Group, enables us to identify all-encompassing solutions. Tests were successfully carried out in 2020 on board the Wind of Change. The tested solution showed its stability and energy performance"

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