

International shipping, which carries over 80 per cent of the world trade by volume, is responsible for nearly 3 per cent of all global GHG emissions [UNCTAD](#).

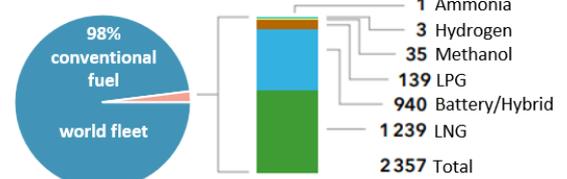
What types of fuels supply ships?

Currently, 98% of maritime vessels are fueled with conventional fuels, originally classified into two categories: (DNV, Petrobras):

- (i) residuals – use in main engines, for propulsion of large vessels. They are known as: bunker, MF (Marine fuel), VLSFO (Very Low Sulfur Fuel Oil) and ULSFO (Ultra Low Sulfur Fuel Oil)
- (ii) distillates - use in small and medium-sized vessel engines or in auxiliary engines for power generation or emergency use. They are called MGO (Marine Gasoil)

Note: The specifications and quality requirements for marine fuels are defined by the National Petroleum, Natural Gas and Biofuels Agency (RANP 903/22).

Number of ships in operation



Source: DNV

How marine vessel engines work?

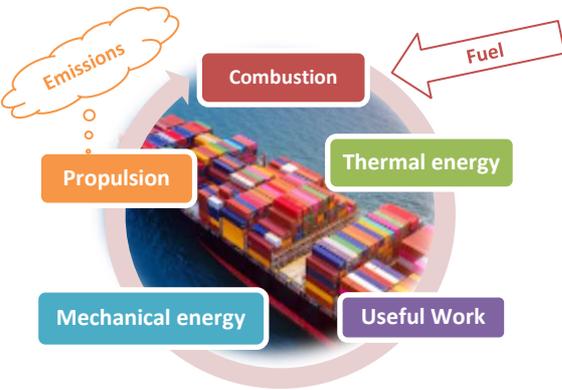
Most vessels operate with 2 or 4 stroke Diesel Cycle engines.

2-Stroke engines → have a high power/weight ratio → carry more weight → more load

4-Stroke engines → generally used to propel small vessels and also to produce electrical energy

Obs.: In a diesel-electric propulsion system, a diesel engine powers electric generators to drive the propeller (offshore vessels, passenger ferries, among other types, use this type of engine) [NAUTILUS](#).

Converting large ship engines to dual-fuel engines is one of the actions to reduce emissions in maritime transport. Currently, there are dual-fuel engines operating with liquefied natural gas (LNG) and liquefied petroleum gas (LPG). Bio-LNG, methanol and ammonia are also already included ([MAN](#)).



Why reduce GHG emissions from maritime transport?

The International Maritime Organization (IMO) is a specialized agency of the United Nations responsible for improving the safety of maritime transport and preventing pollution caused by ships. Sulfur oxide (SO_x) and nitrogen oxide (NO_x) in the air basin cause respiratory, cardiovascular and pulmonary diseases, promote the formation of acid rain, impacting crops, buildings, forests, aquatic species and the acidification of the oceans. Carbon dioxide (CO₂) contributes to global warming ([IMO](#)).

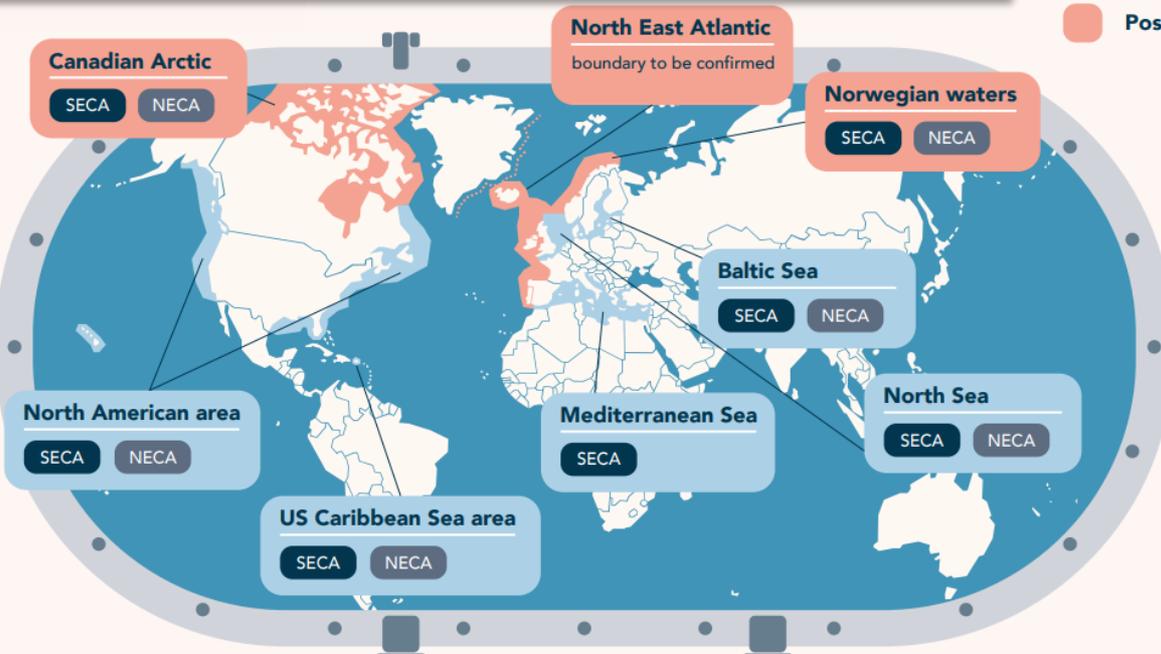
Emission Control Areas (ECAs)

ECAs are designed to reduce air pollutants from vessels (present in port and coastal cities). Operation in ECAs requires stricter controls on fuels and engines ([Cleanartc.org](#)).

Since 2015, the sulfur content of marine fuels in ECAs has been 0.10%. For regions outside the ECAs, the IMO established the maximum value of 0.50% in 2020. It should be noted that the use of fuels with higher percentages is authorized outside the ECAs, provided that the vessel is equipped with scrubbers*.

* Air pollution control device that helps reduce the emission of harmful gases and particles.

- Existing ECAs
- Possible future ECAs



Two types of ECAs

SECA

Reduce SO_x and PM emissions with co-benefits:

- Reduces **particulate matter (PM)** including short-lived climate pollutant – **black carbon (BC)**.
- Encourages ships to use **cleaner fuels**, potentially reducing CO₂ emissions.

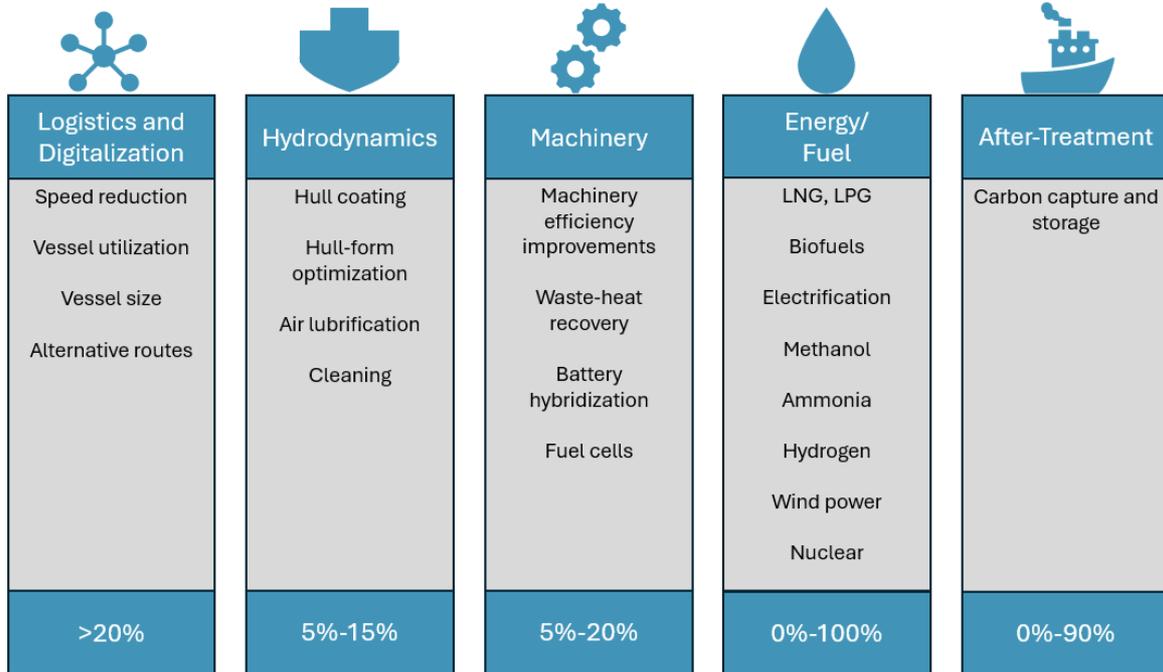
NECA

Reduce NO_x emissions.

Which actions can help decarbonize maritime transport?

In July 2023, IMO revised its strategy to significantly reduce greenhouse gas (GHG) emissions from international shipping. The new targets propose reduction of CO₂ emissions by at least 20%, striving for 30%, by 2030, compared to 2008; at least 70%, striving for 80%, by 2040; and achieving “net zero emissions” by 2050. To achieve these targets, operational optimization solutions, energy efficiency actions, deployment of new technologies and the use of low-carbon fuels to supply vessels shall be implemented (IMO).

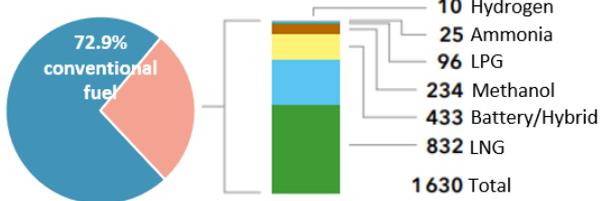
Solutions that contribute to the decarbonization of maritime transport and their reducing GHG emissions potential (%)



Source: adapted from DNV

... and ports, what can they do to decarbonize maritime transport?

Number of ships on order



Source: DNV

Ports can register as providers of incentives to reduce GHG emissions (with reductions in port fees), by evaluating the best performing vessels (ESI).

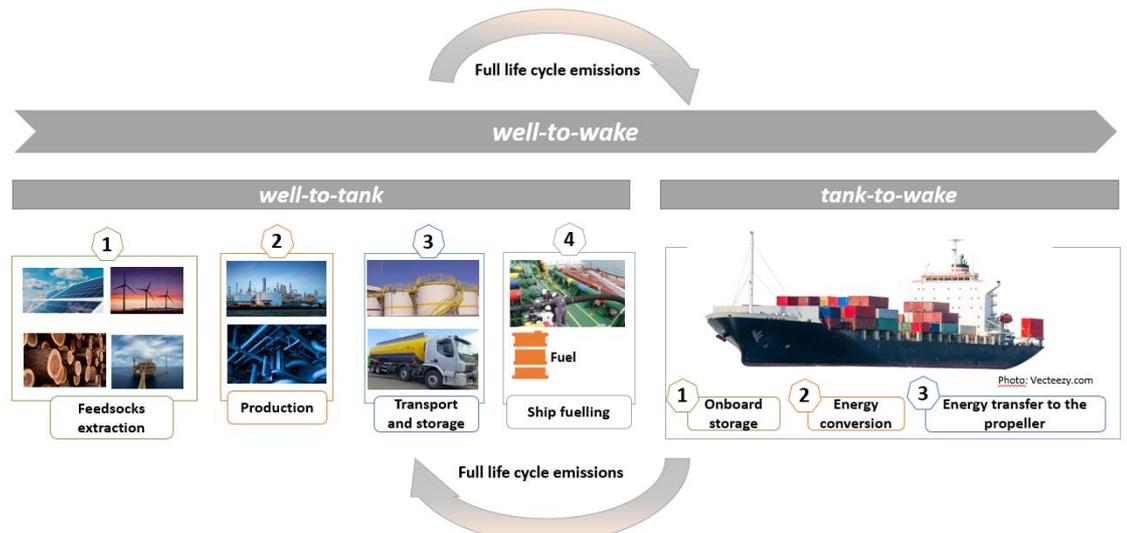
In June 2022, IMO adopted Resolution MEPC.366(79), which urges ports to promote voluntary cooperation with the shipping industry to reduce GHG emissions from vessels, highlighting the following actions: (IMO)

- adopt technical and operational actions at the ship-port interface;
- use of digital technologies to facilitate the arrival of ships at ports and operation automation systems;
- promote the installation of low-carbon alternative fuel supply infrastructure;
- promote the installation of onshore power supply infrastructure (OPS) for ships, preferably from renewable sources;
- encourage and promote the provision of various support services for ships, such as hull cleaning, propeller polishing and electrical services for pumps on land, for bulk liquids.

Maritime corridors (routes between two or more ports), called “green”, have specific characteristics. The viability of zero-emission maritime transport is catalysed by a combination of public services and private actions. It is an important mechanism for achieving decarbonization goals (DNV).

How the lifecycle carbon intensity of marine fuels will be assessed?

The well-to-wake approach is essential for assessing the full life-cycle GHG emissions of marine fuels.



What are the main challenges?



Short-term

- High number of global vessels in operation, with slow renewal rates;
- Potential fuels (H₂, ammonia, and methanol) still face challenges related to safety, low energy density, and low TRL¹;
- Prevalence of Diesel Cycle Combustion Engines in the Current Marine Fleet;
- Regulatory agreement between countries.

¹Technology Readiness Levels



Medium/Long term

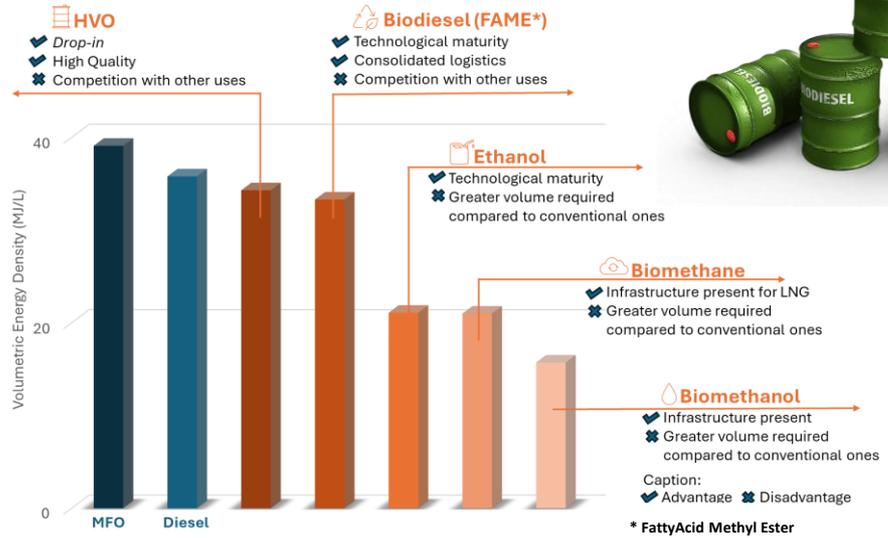
- High demand for alternative fuels, for supply of the maritime sector and other sectors;
- Availability of raw materials;
- Difficulty in achieving neutral or negative emissions with H₂, ammonia and methanol, considering the LCA² of each fuel;
- Investments in storage and supply infrastructure.

²Life Cycle Assessment

And the role of biofuels?

Biofuels can be an alternative to contribute to the reduction of GHG emissions in maritime transport:

- Have a lower carbon intensity than fossil fuels;
- Potential to meet the IMO target of adopting zero or near-zero emission technologies, fuels and/or energy sources, corresponding to at least 5% by 2030.



POSSIBILITIES



BIODIESEL (FAME)

- No need for structural adaptations to engines and vessels;
- Widespread production and infrastructure in Brazil, with idle installed capacity, which can be used to achieve this goal in a more agile way in the short term;
- In the revision of the 8217/2024 standard, ISO presented the specifications for the use of 100% biodiesel for navigation, with use conditioned to MARPOL/IMO evaluations;
- **ANP Authorization No. 402/2024** allowed, on a special basis, the commercialization by Petrobras of marine fuel oil (bunker) with up to 24% biodiesel (volume), subject to the established specifications;
- Companies have already used **the B100 as a substitute for fossil diesel** in Brazilian river vessels.



ETHANOL

- Widespread production and infrastructure in Brazil;
- Use on adapted cabotage vessels on the Brazilian coast;
- Need for modernization/retrofit of dual fuel vessels/engines.



BECCS/BIOCHAR

Medium/Long term:

The use of biofuels to replace fossil fuels has the potential to reach the levels of "zero or almost zero emissions", or even negative, once regenerative agricultural techniques (such as recovery of degraded areas) and/or carbon capture and sequestration techniques are applied (such as **BECCS** and **Biochar**).

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To learn more:

Technical Note – Analysis of Current Biofuels' Outlook 2023 
 IMO 2020: regulamentação de combustíveis marítimos 
 Plano Decenal de Expansão de Energia 

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