

# Fuelling the future



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## Marine biofuels are gaining acceptance but the industry's adoption of alternative fuels faces challenges *Gill Langham*

The marine biofuel sector is still in its infancy but with regulatory and market drivers in place, it could comprise between 5% and 10% of the global marine fuel mix by 2030, according to a report by the International Energy Agency Bioenergy (IEA Bioenergy).

Globally the shipping sector consumes more than 330M tonnes of fuel annually, according to the European Technology and Innovation Platform (ETIP), with the bulk of marine fuels produced from crude oil.

However, a combination of decreasing supplies of crude oil, pressure on the sector to reduce its environmental impact and tighter marine fuel regulations are prompting the industry to seek alternative fuel sources with lower sulphur content and a reduced carbon footprint.

On 1 January 2020, the sulphur cap for marine fuels dropped from 3.5% to 0.5% in areas outside current emission control areas (ECAs) – essentially affecting

everywhere around the world apart from the existing Baltic Sea, North Sea, North American and US Caribbean ECAs, where the sulphur limit is 0.1%.

Because the shipping sector is the highest emitter of toxic sulphur oxide in the transportation industry, these limits have been set by the United Nation's International Maritime Organization. In order to comply, ship owners must either use low-sulphur fuel, install scrubbers on their ships to clean up emissions, or switch to alternative fuels such as liquefied natural gas (LNG).

The regulation affects the world's entire shipping fleet of some 60,000 vessels.

According to the IEA Bioenergy: Task 39 report 'Biofuels for the Marine Shipping Sector', biofuels will be a key lever in the gradual process of decarbonisation of transportation, mainly from 2030 and in sectors where electrification presents challenges, such as aviation and maritime transport.

However, the development of biofuels compatible with marine engines is still in its early stages, and having sufficient feedstock supply and reliable processing technologies to produce price-competitive biofuel at a large scale remains challenging.

Against this backdrop, research into

new biofuel products is underway and industry sources say the sector is, in turn, becoming more open to alternative fuel sources.

"Over the next few years, biofuel will be the only available option to significantly reduce the carbon footprint of marine fuel, which is essential if shipping is to play its part in reaching global carbon reduction targets," says Olivier Benny, marketing director at international biodiesel distributor Targray.

"Acceptance has grown rapidly in the international shipping sector these past few years. One major shipping company has already converted to biodiesel and another is currently engaged in testing."

However, according to Richard Matthews, a director at EA Gibson Shipbrokers, the industry is not yet fully committed to making the change to biofuels.

"Gradually we are seeing companies experiment with biofuels, conducting test voyages for example, but we are not yet seeing companies commit to using large volumes on a regular basis."

DNV GL, which provides advice to the maritime industry, says it receives many requests regarding safe operation and how to comply with international regulations for the use of biofuels and/

# MARINE BIOFUELS

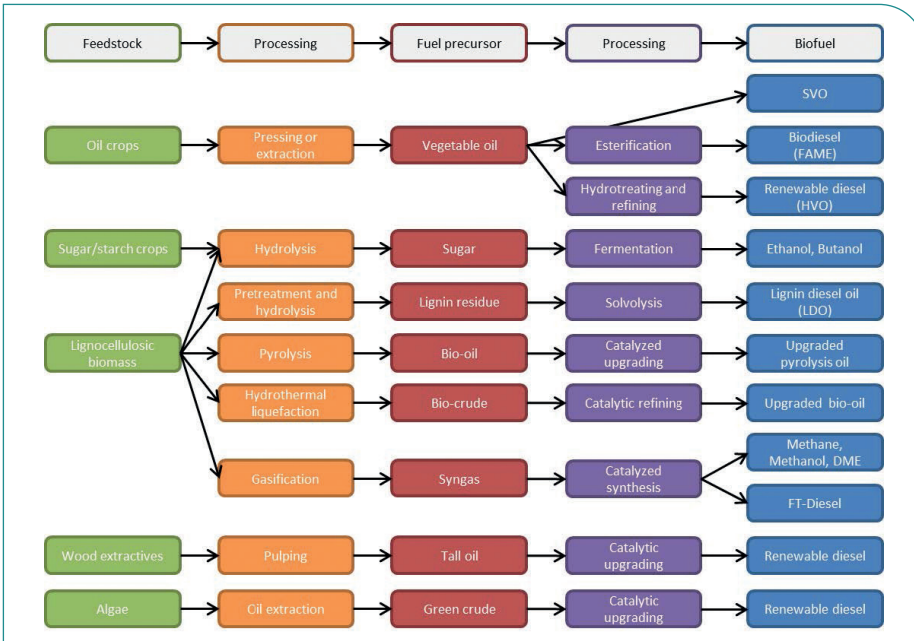


Figure 1: Overview of different feedstock conversion routes to marine biofuels

Source: IEA Bioenergy: Task 39 report

or biofuel blends. However, marine biofuels were not currently used in any significant volumes. Over the last year there had been a lot of testing of various types of biofuels by many ship operators, according to Cristos Chryssakis, business development manager at DNV GL (Maritime).

“From a technical perspective the experience is generally good, but the main barriers are the fuel cost, availability and a lack of a clear regulatory framework,” he says.

## Current biofuels

The potential supply of sustainable renewable diesel with the current technology is an estimated 10-20M tonnes, according to the IEA Bioenergy report.

Types of biofuel include FAME (fatty acid methyl ester), HVO (hydrotreated vegetable oil), and BTL (biomass to liquid fuels).

Blending conventional fuels with biofuels is an alternative way to reduce fossil fuel consumption while introducing compatible drop-in fuels in the fuel mix, the report says. According to DNV GL, FAME is the most widely available type of biodiesel in the industry and is often blended with regular marine diesel.

## Feedstocks

Crops with a high lipid content, including palm, soyabean and rapeseed, are currently the main feedstocks for biodiesel, according to the IEA Bioenergy report. However, the report notes that these feedstocks are generally difficult to source cheaply and sustainably for an expanded

commercial production of marine biofuels. Rapeseed oil is the preferred feedstock in the EU due to its favourable properties (oxidation stability, high yields per hectare).

## Challenges

The immediate challenge is that the shipping sector has little knowledge on handling and applying biofuels as part of its fuel supply, according to the IEA Bioenergy report.

Another factor is that the volumes of biofuels required to supply the shipping sector are so high, with a single large ship potentially consuming the annual production from a single medium-sized biofuel facility.

Of the current biofuels commercially available, the IEA Bioenergy report says that only plant biodiesel derived from plant oil or pulping residues and bioethanol are produced at a level to supply significant volumes of fuel.

Another issue is that plant oil-based fuels are currently used at a significant scale for bio jet fuels, leading to competition for feedstocks between the shipping and aviation sectors.

In a report jointly produced by Channoil Consulting and EA Gibson Shipbrokers in December 2020, the authors note that although HVO is actively being developed by some bunker marketing organisations and producers, the demand for HVO in the road diesel market is much stronger, driven by aggressive mandates in Europe and California. The report notes that there is also increasing demand for HVO into the aviation sector. All these factors would probably eclipse HVO on the marine fuel scene.

“While HVO production capacity is increasing at a fast rate, there is going to be a global shortage of sustainable feedstocks suitable for either biodiesel or HVO production,” the report says.

For this reason, the report concludes that it seems likely that biofuels will play a minimal role in decarbonisation of the maritime sector, thanks mainly to it being more attractive for other applications.

The cost of biofuels is also higher than the cost of fossil fuels and is expected to remain so in the short to medium term.

“Marine biofuels are currently up to twice as expensive as conventional fuels, which is an important barrier for any ship operator who wants to use these fuels,” says Hans Anton Tvette, DNV GL’s maritime programme director in Group Technology and Research.

“Most biofuels today are supplied through ports in the Netherlands, due to price incentives that reduce the price premium and make these fuels more attractive.”

However, future regulations or market-based mechanisms, such as CO<sub>2</sub> taxes, could make biofuels more economically competitive, he says.

## Test runs

Several companies and research institutes are working on both the production of marine biofuels and testing of their compatibility with current infrastructure, of which the US Navy has been a major player.

As an initiative of the US federal government, the IEA Energy Bioenergy report says the US Navy has developed a scheme to establish the Great Green Fleet to provide the navy with half of its fuel and power from clean, fossil-alternative sources by 2020, with biofuels providing a significant portion of the alternative fuel mix.

German car manufacturer Volkswagen is using fuel made from used vegetable oil from the catering and food industries for the sea transportation of its vehicles.

“We are putting the old oils to a climate-friendly subsequent use. With 85% less CO<sub>2</sub> emissions compared to conventional fossil fuel, the contribution to climate protection is enormous,” says Thomas Zernechel, head of Volkswagen group logistics.

Dutch biofuels supplier GoodFuels, produces its MR1-100 fuel, which is comprised entirely from organic waste products and its use does not require any engine modifications.

Alfa Laval plans to test biofuel in the DNV GL-classed *DFDS Pearl Seaways*. The fuel, which is created through pyrolysis



of waste biomass, would be produced in India by MASH Energy.

“New fuel alternatives are constantly being introduced to the marine industry, but the knowledge about their behaviour in marine fuel systems is limited. We want to extend that knowledge through testing, beginning with biofuels,” says Lars Bo Andersen, Alfa Laval test & training centre manager.

International maritime infrastructure company Jan de Nul Group announced in September 2020 that its trailing suction hopper dredger, *Alexander von Humboldt*, had completed 2,000 hours operation on 100% renewable, second-generation biofuel oil (BFO).

Introduced by GoodFuels in 2018, the BFO is completely derived from sustainable waste feedstock in line with the latest European Renewable Energy Directive (RED).

GoodFuels also teamed up with leading tanker shipping company Stena Bulk to complete a successful trial of heavy fuel oil (HFO)-equivalent BFO on *Stena Immortal*.

“The industry needs pioneers willing to collaborate, share knowledge and push the development towards more sustainable shipping,” said Stena Bulk’s president and CEO Erik Hånell.

Singapore-based tonnage provider Eastern Pacific Shipping (EPS) also appointed GoodFuels to supply biofuel bunkers for its tanker *M/T Pacific Beryl* in October 2020. The BFO’s performance will be tested and analysed on *M/T Pacific Beryl* and on other EPS-managed ships.

“We believe that sustainability begins with accountability, which is why we are taking a mixed marine approach towards reducing our emissions,” said EPS CEO Cyril Ducau.

International energy company ExxonMobil has completed a successful sea trial of the company’s first marine biofuel oil with Stena Bulk. The marine biofuel oil is a 0.5% sulphur residual-based fuel (VLSFO) processed with a second generation waste-based FAME component.

## Research

Researchers in Germany have been looking into the development of drop-in fuels based on sustainable biogenic raw materials which could, in the long term, replace at least part of petroleum-based fuels.

Conducted at Fraunhofer UMSICHT, the PyroMar project involves the mapping of the entire process chain for the production of bio-based blending components. The raw material used in



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**Plant oil-based fuels are used at a significant scale for bio jet fuels, leading to competition for feedstocks between the shipping and aviation sectors**

the project is unused biomass, such as straw, autumn leaves, landscape hay or shrubbery. Tests are currently being finalised at the University of Rostock to ensure that no special modifications to the engine are needed for the bio-based admixture components.

“What will be viable, ecologically and economically, in the near future is blending bio-based admixture components with fossil fuels,” says PyroMar project leader Dr Volker Heil from Fraunhofer UMSICHT.

Dr Heil and his team from Oberhausen are developing the technology for producing these components, jointly with project partners from Rostock and Heidelberg.

The IDEALFUEL project aims to develop a method to convert woody residual and waste materials such as sawdust and wood chips into a biogenic heavy fuel oil (bio-HFO) with ultra-low sulphur levels to be used as a drop-in renewable marine fuel.

Using a two-step chemical process, lignin – the polymer found in the structural materials of plants and trees – from dry plant matter (known as lignocellulosic biomass) is converted into marine biofuel.

In the first step, lignin is extracted from lignocellulosic biomass in the form of crude lignin oil (CLO), leaving behind a solid cellulose material that can be used in the paper industry or converted into ethanol.

The second step involves the CLO being refined and converted into a bio-HFO that can be blended with traditional fossil fuels or used directly in engines without technical modifications.

A collaboration between research institutions and industry, the EU-funded

project is coordinated by Eindhoven University of Technology (NL) and involves participants from four different EU and associated countries. Participants include GoodFuels and ThyssenKrupp Marine Systems.

Marine fuel supplier Auramarine has teamed up with a number of other companies, including Neste and FG-Shipping, on the BioFlex project to aid the development of cost-effective biofuels.

Funded by Business Finland, the aim of the three-year collaborative study headed by VTT Technical Research Centre of Finland is to find low-emission bio-based liquid fuels for use in existing diesel engines in the maritime and power sectors. The project aims to ensure sulphur, nitrogen and particulate matter emissions are minimised, blending properties are considered, and that the chosen biofuel fulfils the engine requirements.

“It is this attention to detail and providing assurance that all aspects of the supply chain have been covered, that will be the foundation in enhancing industry confidence, driving widespread adoption, and ensuring biofuels play a significant role in the future fuels market,” says Auramarine’s director of engineering & products, Teemul Jutila.

## The future

The sustainability of feedstock and cost of biofuels will be an important factor in the future manufacture and use of biofuels in the maritime sector.

However, the main driver for the introduction of marine biofuels for the first decades of the 21st century in the shipping sector will largely be regulatory, according to the IEA Bioenergy report. Gill Langham is the assistant editor of OFI