



Methanol as a Marine Fuel

A safe, clean-burning, technologically proven, cost-effective and globally available marine fuel for today and tomorrow.



A low emissions fuel that meets the most stringent IMO 2020 regulations including Tier III NOx emission standards without expensive after-treatment



Globally available in almost 90 of the world's top 100 ports with only minor modifications to existing bunkering and storage infrastructure needed



A future proofed solution that provides a clear pathway to future decarbonization compliance through a growing green methanol market



2nd generation, methanol dual-fuel technology built on the foundation of a traditional diesel engine



Safely shipped globally for over 100 years. A clear, colourless liquid that quickly dissolves in water, biodegrades, and is non-toxic to marine life



Proven technology with over 5 years experience on MAN and Wartsila engines

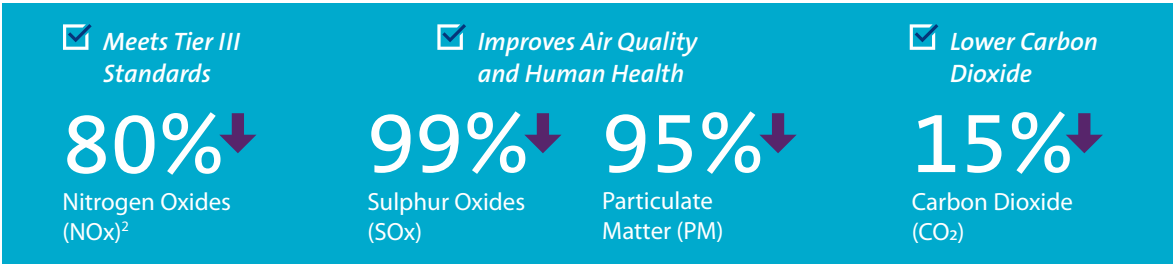


Cost-competitive with other lower-carbon, low sulphur fuels without the need for expensive modifications to engines, onboard storage or bunkering infrastructure

LOW EMISSION



Reduces emissions: As a clean-burning fuel, methanol supports the maritime industry to meet new International Maritime Organization (IMO) environmental regulations that require ships to decrease emissions of SOx, particulate matter, CO2 and NOx. Today, methanol is estimated as the fourth most significant marine fuel used and is growing.¹



Source: Stena Lines, MAN
Combustion emission reductions when compared to heavy fuel oil

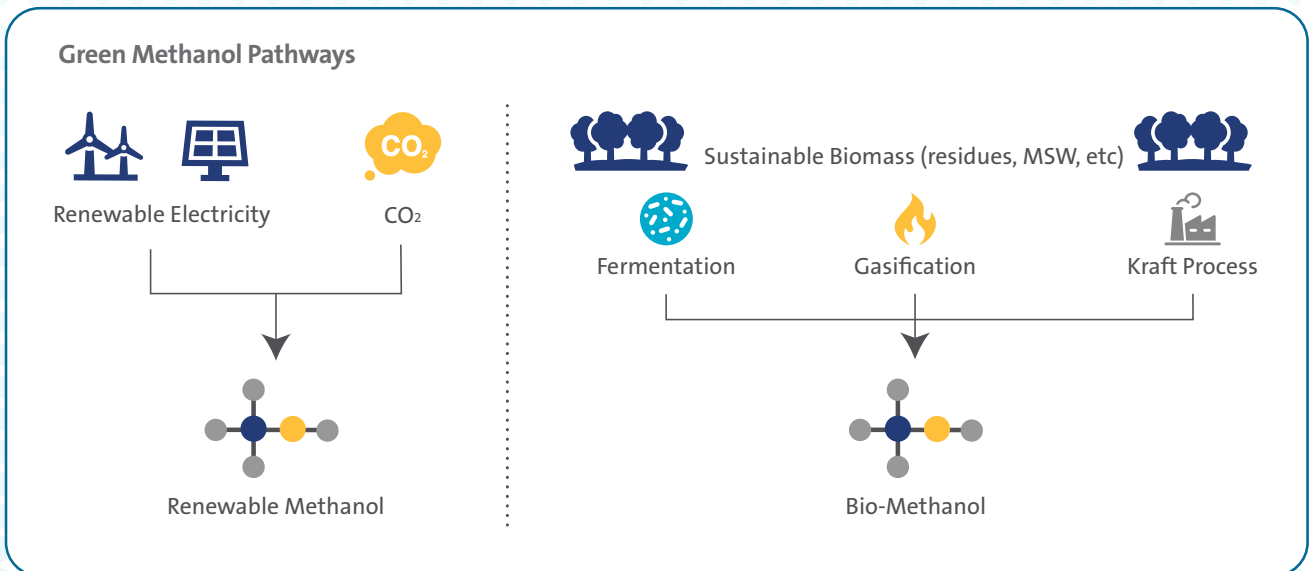
FUTURE PROOFED



Pathway to decarbonization: Green methanol can be produced from renewable sources such as biomass and recycled carbon dioxide³ reducing CO2 emissions by up to 95% and offering a future-proofed fuel that provides a clear pathway to future emissions compliance, including IMO's 2030 and 2050 decarbonization goals.

Renewable and bio-methanol are compatible with current methanol dual-fuel engine technology, without future investment or compatibility issues.

Bio-methanol is one of the most promising carbon neutral fuels for the long-term in a decarbonization scenario.⁴



¹ <https://safety4sea.com/wp-content/uploads/2020/08/MEPC-75-7-15-Fourth-IMO-GHG-Study-2020-Final-report-Secretariat.pdf>

² Tier III NOx compliance achieved using water blending

³ <https://www.methanol.org/renewable-methanol/>

⁴ DNV GL Maritime Forecast to 2050 - September 2020

SAFE



Long history of safe handling: For over 100 years, methanol has been shipped globally, and handled safely in a variety of energy applications. Handling low flashpoint fuels is well proven.



Biodegradable: Methanol is biodegradable and, if spilled in water, quickly and completely dilutes to non-toxic levels. It is non-toxic to aquatic life resulting in lower environmental effects and impacts on marine life than an equivalent oil spill.



Risk classification: In November 2020, the IMO approved guidelines for the safety of ships using methanol as fuel, as a precursor to the development of a chapter on methanol in the **International Code of Safety for Ships using Gases or Other Low-flashpoint Fuels (IGF Code)**.



Proven culture of safety: Leading shipping companies such as Stena, Westfal-Larsen, Waterfront Shipping, Mitsui O.S.K. Lines, NYK Line, IINO LINES, and and Marinvest/Skagerack Invest have selected methanol as a marine fuel.

Waterfront Shipping, a subsidiary of Methanex, is a recognized industry leader for supporting a strong culture of safety onboard its vessels. Its crews have developed and receive regular safety and response training to allow the safe operation of its methanol dual-fuel vessels.

COST-COMPETITIVE



Economical: Methanol is cost-competitive, on an energy equivalent basis, with other low sulphur fuels such as marine gas oil (MGO). Its use as a marine fuel provides shippers and port facilities with an affordable, low emission option for compliance with tightening emission requirements. Methanol also offers improved fuel efficiency over conventional fuels.



Flexible, future-proofed fuel: To hedge the risk of fuel price volatility, shipping companies may choose to diversify their fuel mix to operate on flex-fuel methanol/diesel engines. This enables vessel owners to have the choice of using the lowest cost fuel while meeting increasingly stringent air pollution regulations.



Low installation cost: As a liquid fuel, methanol does not require expensive cryogenic equipment and is more economical to convert to and operate compared with other fuels that require cooling or pressurization. Methanol provides a compelling return on capital and quick paybacks.



Tier III NOx Compliance: Methanol fueled engines can achieve Tier III NOx compliance through blending water with methanol. This avoids the need to install expensive exhaust after-treatment equipment and reduces operating costs.



Low infrastructure costs: As a liquid fuel, storage for methanol is similar to established diesel infrastructure. If methanol storage is not available at a particular port, only minor modifications are needed for storage and bunkering infrastructure to enable methanol marine fueling.

“We are very enthusiastic about methanol’s possibilities and it has the potential to be the maritime fuel of the future.”

Carl-Johan Hagman, CEO Stena Line

“Maersk considers methanol one of the best positioned fuels to reach net zero emissions.”

Søren Toft, Maersk COO

“The technology for handling methanol is well developed and offers a safe dual-fuel solution for low-flashpoint liquid fuels.”

Patrik Mossberg, Chairman, Marininvest/Skagerack Invest



“We have found methanol to be one of the best alternative fuels due to its wide availability, the use of existing infrastructure, and the simplicity of the engine.”

Rolf Westfal-Larsen Jr, CEO, Westfal-Larsen Management



GLOBALLY AVAILABLE



Globally available: Methanol is one of the top chemical commodities shipped around the world and is available in almost 90 of the top 100 ports worldwide. Unlike some alternative fuels, it is readily available through existing global terminal infrastructure and is well positioned to supply the global marine industry.



Bunkering infrastructure: Established diesel tanks can be used to store methanol with only minor modification needed resulting in easy and cost-competitive supply of methanol to new locations, at low cost. As a liquid fuel, there is minimal incremental cost to adopt methanol using existing bunkering infrastructure.



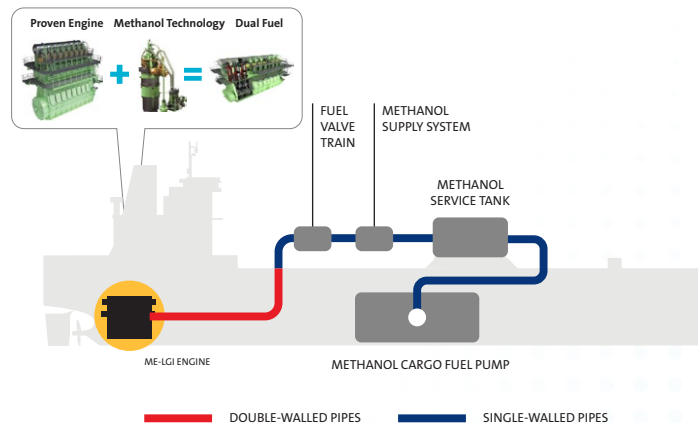
“The main challenge is not at sea, but on land.”

Søren Toft, Maersk COO

2ND GENERATION METHANOL DUAL-FUEL TECHNOLOGY



Simple engine modification: MAN’s methanol dual-fuel engines are built on the foundation of a traditional diesel engine and require minor modifications at a modest incremental cost. The engine is a standard and well-proven two-stroke MAN ME-B engine with the Liquid Gas Injection (LGI) methanol component as an ‘add-on feature’. Similarly, Wärtsilä has developed a four-stroke methanol compatible engine with a ballast tank conversion and a high pressurized delivery system on a standard engine.



Simple fuel supply system: Existing fuel storage tank and vessel designs can be used for methanol with minor modifications without the need for cryogenic or pressurized storage and supply equipment.



Growing investment into methanol vessel technology: Engine manufacturers, including MAN and Wärtsilä have developed efficient methanol dual-fuel engines. Other engine manufacturers and stakeholders have also advanced projects to commercialize methanol as a marine fuel. These include:

- the MethaShip project in Germany, which was focused on methanol powered cruise ships and ferries.
- several projects focused on the smaller marine engine market including the EU-supported Leanships and Fastwater projects, and the SUMMETH and GreenPilot projects in Sweden.
- in China, Methanex is working with the Ministry of Transport and other stakeholders to develop a methanol fuel pilot and to support the development of marine fuel standards locally.



Higher energy density: Methanol has a higher energy content relative to other alternate, low emission fuels such as ammonia or hydrogen. As a result, it is better suited to a wider range of vessel types, longer voyages and less frequent bunkering.

PROVEN THROUGH EXPERIENCE



MAN Energy Solutions



Waterfront Shipping Company Limited
A Responsible Care® Company

Waterfront Shipping - world's largest methanol fueled ocean tanker fleet: In 2013, Waterfront Shipping signed agreements with its partners to build seven new 50,000 deadweight tonne vessels with MAN's methanol dual-fuel engines. Since then, Waterfront Shipping has continued to invest in its fleet adding four more vessels in 2019, and ordering eight more for delivery in between 2021 and 2023, all powered by the new, second-generation, low emission, MAN dual-fuel engines.



World's first methanol powered ferry: Stena Germanica has been operating in the Baltic Sea since 2015, using Wärtsilä four-stroke engines. By running on methanol as its main fuel, the ferry reduces emissions compared to traditional marine fuel.



Proman Shipping and Stena Bulk announce ventures: Proman Shipping AG and Stena Bulk AB Joint Venture announced a commitment to building three methanol ready 49,900 deadweight tonne vessels for launch in 2022.



MAERSK

Renewable methanol production for marine: Methanol is one of the best positioned marine fuels. In 2020, a consortium including Maersk, the world's largest container line, announced plans to develop an industrial-scale production facility to produce renewable methanol for maritime transport and other e-fuels that will be fully scaled up by 2030.



Green Marine Partner

Methanex is proud to be a partner of Green Marine, a voluntary environmental certification program for the North American marine industry. Green Marine is a rigorous, transparent and inclusive initiative that addresses key environmental issues and ensures participants are taking concrete actions to reduce their environmental footprint. To learn more, visit green-marine.org



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