

Methanol -

An Ultra Clean Marine Fuel Solution



A RESPONSIBLE CARE® COMPANY

Connecticut Maritime Association - Shipping 2017

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Agenda

- 1) Methanex Corporation
- 2) Methanol Marine Fuel
 - Attributes
 - Business Case
 - Technology
- 3) Case Studies: Methanol Marine Fuel in Use Today



Methanex

The world's largest producer and supplier of methanol to major international markets



Methanol for Marine

Methanol is an innovative alternative fuel solution with many benefits



- Low emissions
- Fuel flexibility
- Cost competitive
- Wide availability
- Innovative technology
- In use today

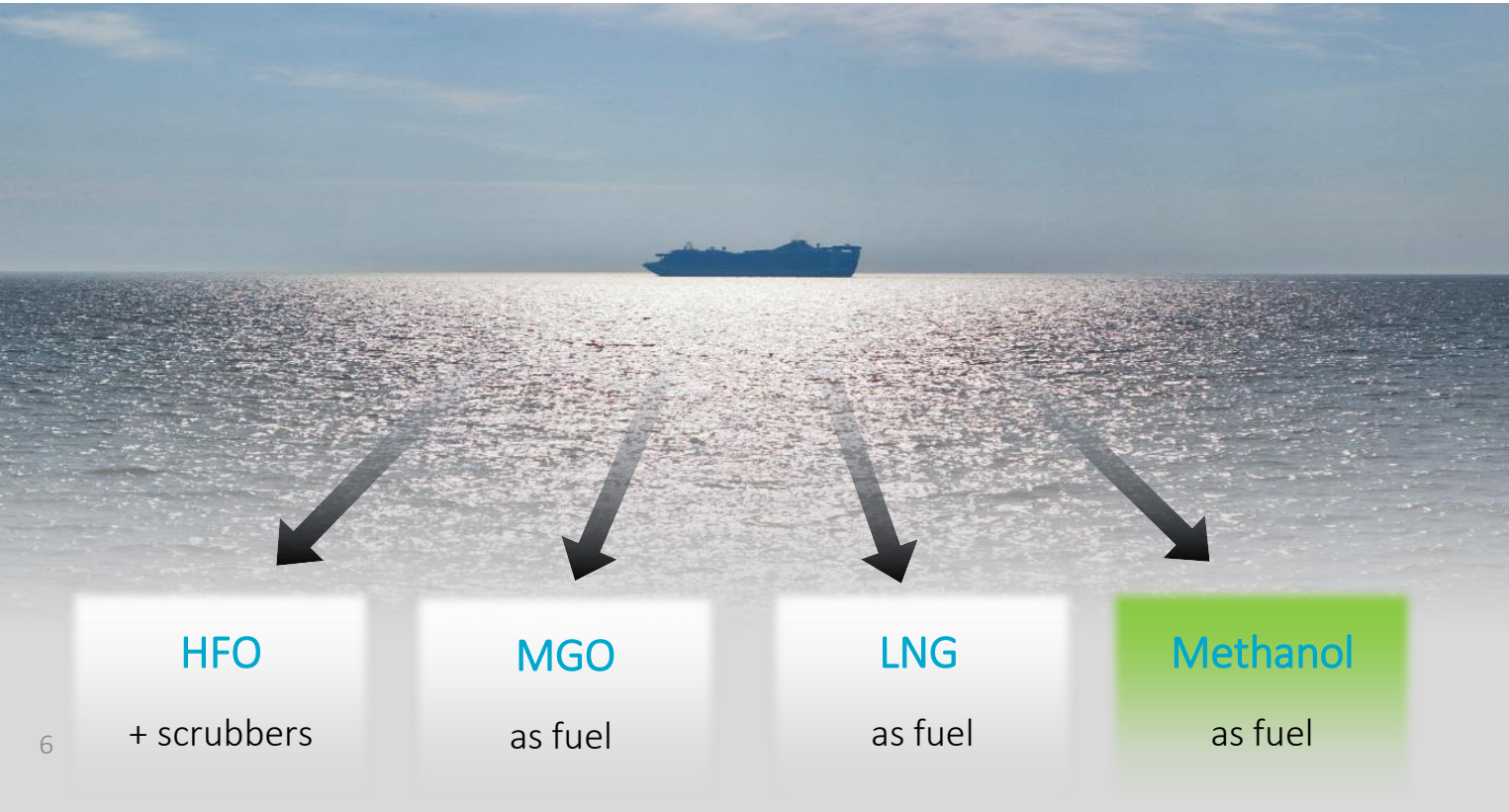
Emissions Reductions

Methanol is among the lowest emission fuels for marine engines



Fuel Flexibility

Methanol fuel enables shippers to operate cost effectively and diversify fuel options



Cost Competitiveness: Fuel

Methanol is an economically viable alternative marine fuel over the cycle

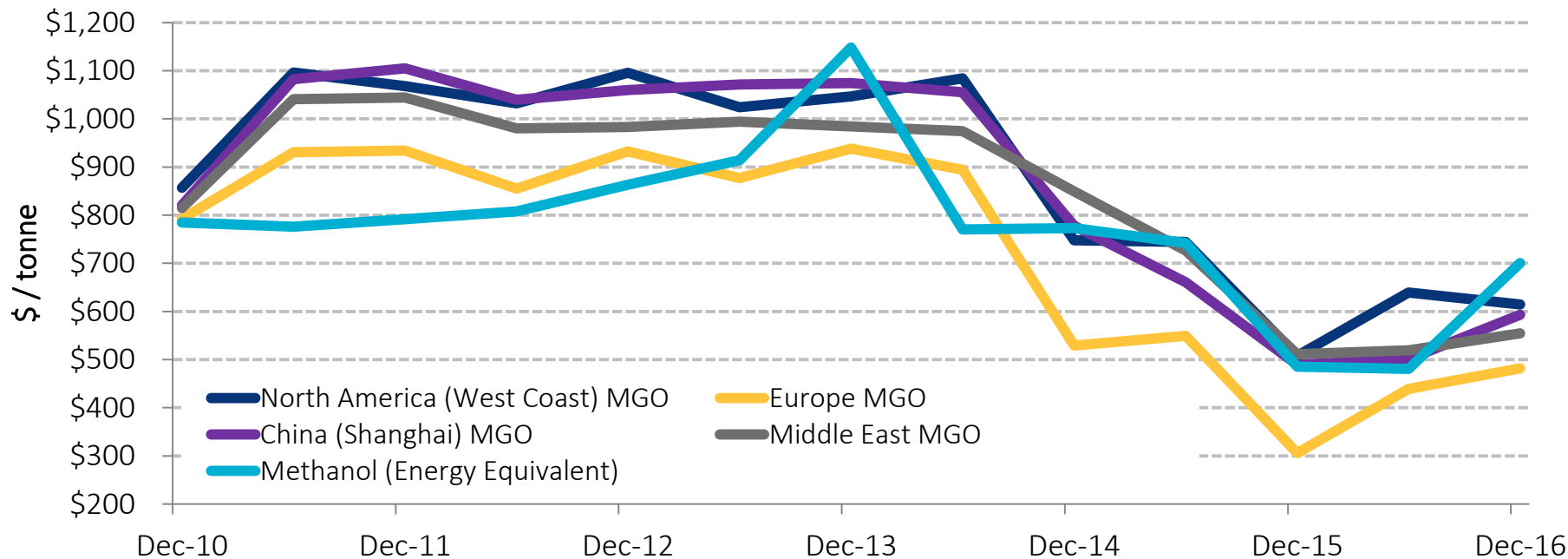


Chart source: Platts and IHS Chemical

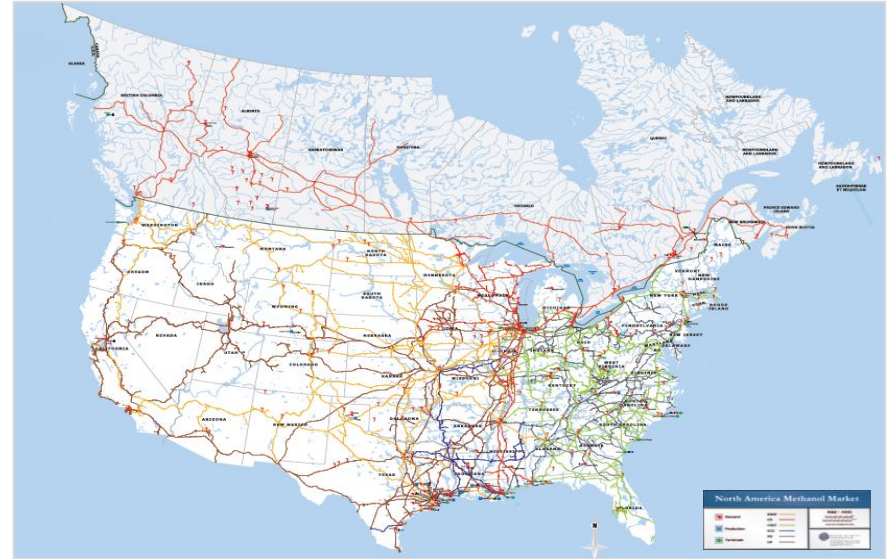
- MGO N.A. WC: Average of Los Angeles, San Francisco, Portland, Seattle and Vancouver; MGO Europe: Average of Rotterdam, Antwerp, Hamburg; MGO Middle East: Average of Fujairah, Kuwait, Khor Faakan
- Methanol: Average of USGC, China and Europe spot prices; adjusted to energy equivalent of MGO (2.16 factor)

Wide Availability & Low Infrastructure Costs

Methanol infrastructure already in place and well positioned to reliably supply the global marine industry



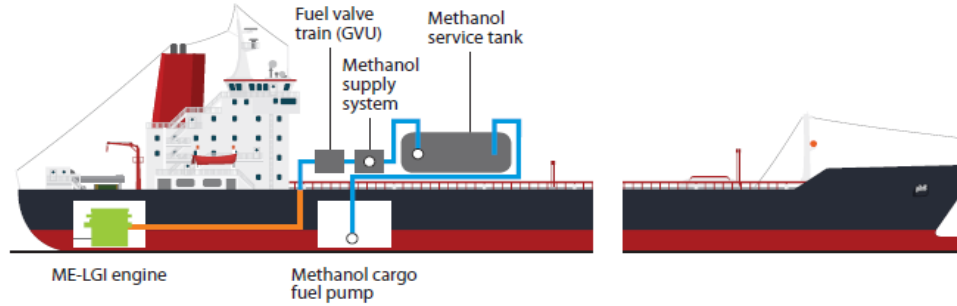
Methanol global terminal locations based on available information; not a complete list



- Red flags/circles represent existing methanol supply locations; lines represent rail networks

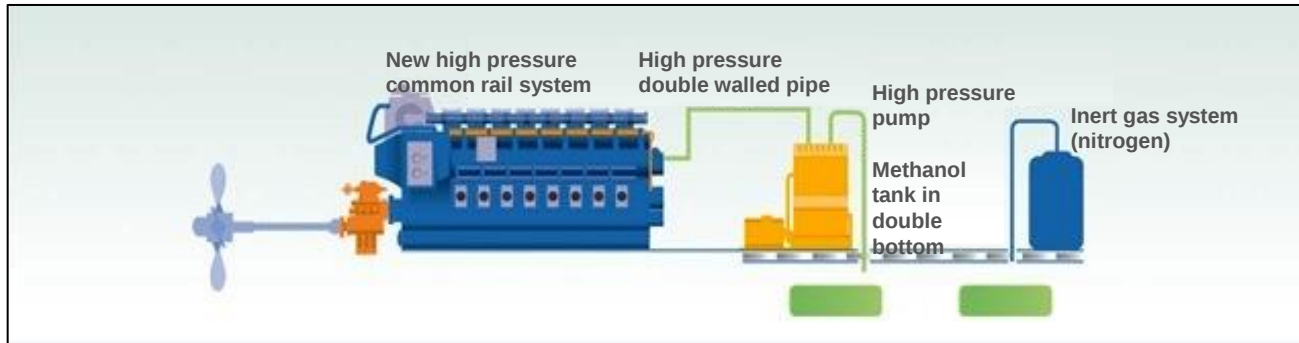
Innovative technology

Methanol has minor modification requirements and modest incremental cost



■ Double-walled pipes
■ Single-walled pipes

Source: MAN, 2015b



Source: Stena Line



Methanol in Use Today: Stena Germanica Ferry

The world's first methanol-fuelled ferry



- Stena Germanica ferry converted to run on methanol in 2015
- Gothenburg to Kiel
- Powered by four Wärtsilä 4-stroke engines
- Fuel switching (Methanol or MGO) is fast, simple and reliable. No loss in engine speed or output
- Efficiency improvements (i.e. 1-2%) versus bunkers

Methanol in Use Today: Waterfront Shipping Tankers

The world's first methanol-fuelled tankers



Cajun Sun



Mari Jone



Taranaki Sun



Leikanger



Mari Boyle



Lindanger



Manchac Sun

Medium Range Fleet 50,000 DWT
Methanol Dual Fuel Engine Class

- Commercial-ready technology
- In 2016, Waterfront Shipping launched seven vessels with methanol dual-fuel MAN ME-LGI 2-stroke engines
- Multiple ship owners



Shipping Company Limited
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Positive reception on methanol from marine industry



"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



"We have found 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



"Investing in technology that encourages the use of a fuel like methanol that significantly reduces emissions is a step forward for both our company and the shipping industry"

-- Akio Mitsuta, Senior Managing Executive Officer, Mitsui O.S.K. Lines, Ltd.

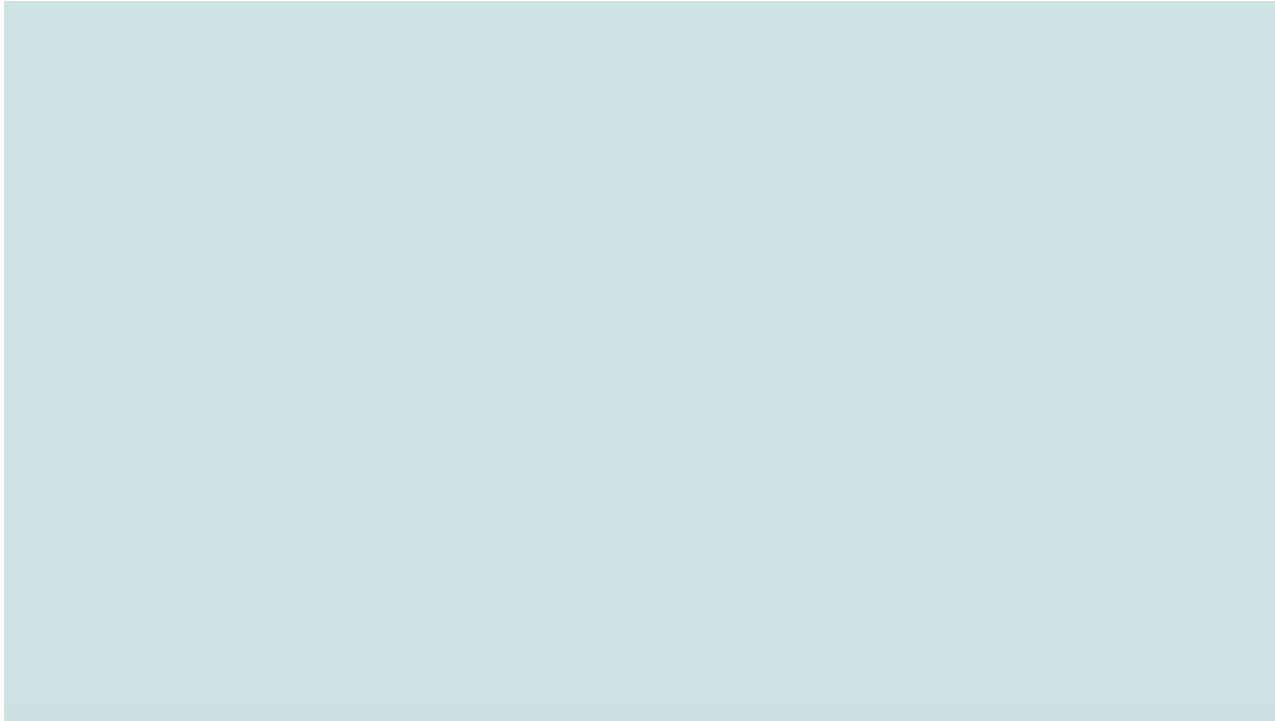


"We have found methanol to be one of the best alternative fuels due to its wide availability, the use of existing infrastructure, and the simplicity of the engine design and ship technology"

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

Conclusion

Methanol – an innovative alternative fuel of today and the future



Thank you!

- For more information on methanol marine fuels & supply -

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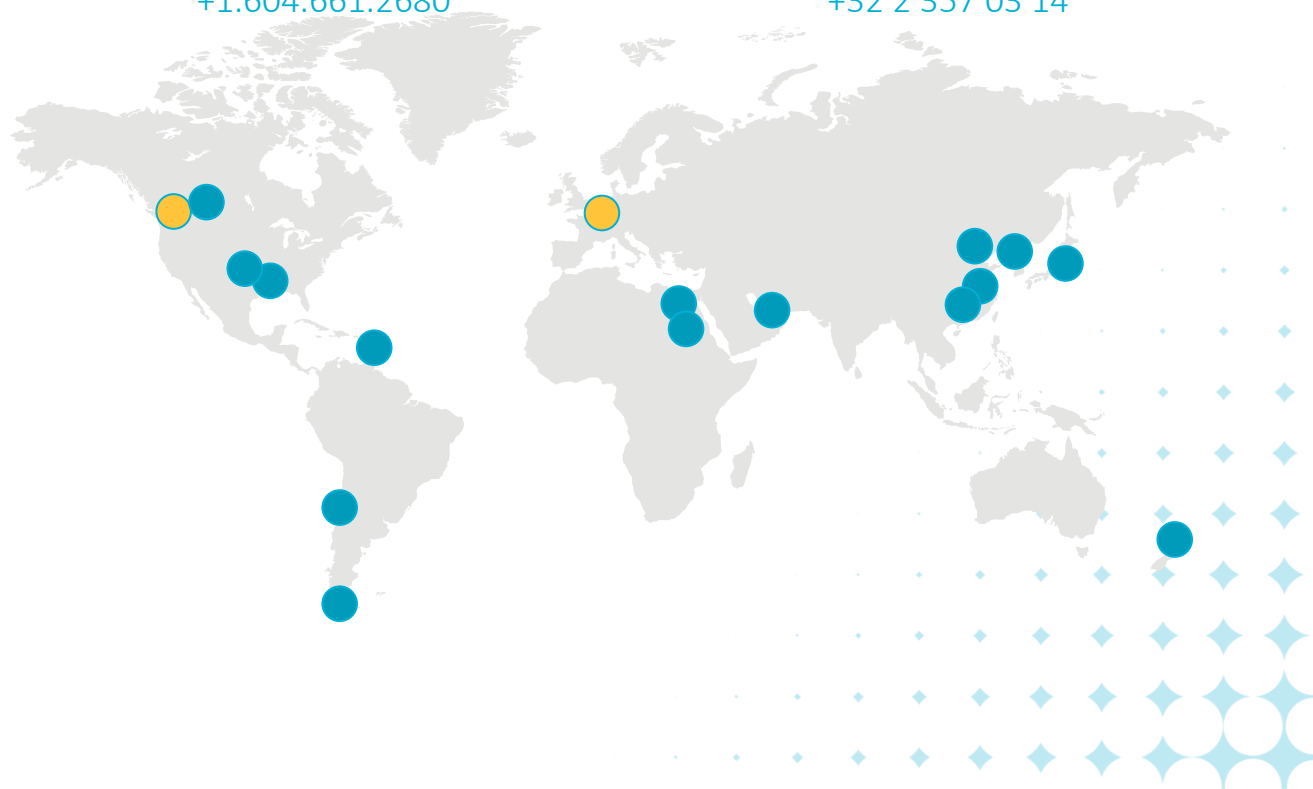
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Appendix

Methanol

An essential ingredient of modern life

- Essential ingredient used in countless industrial and consumer products
- Can be made from renewable sources
- **Energy/Fuel applications represent the fastest growing demand segment for methanol**
 - Clean-burning, biodegradable vehicle fuel
 - Emerging power source
 - Innovative marine fuel of today and the future

Methanol can be found in products that we use every day:

Roof panels
Adhesives
Lumber

Paint
Insulation
Carpeting
Synthetic fibres
Plastics
Particle boards

Refrigerants

Sportswear
Fleece fabrics

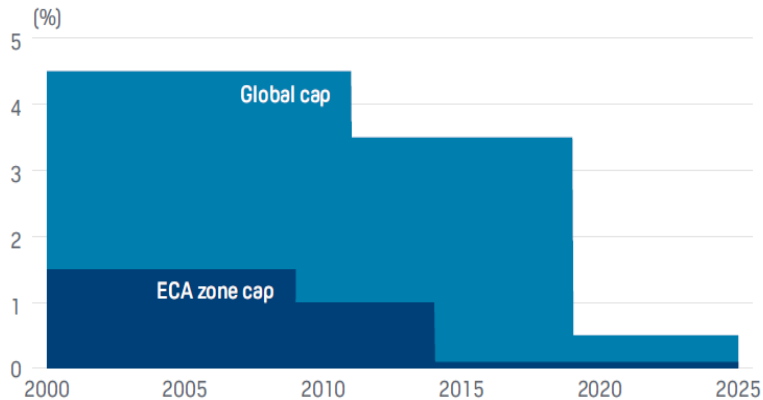
Safety glass laminate
Windshield washer fluid
Solvents
Upholstery

Transportation fuel

Environmental Regulations for Lower Marine Fuel Emissions

SO_x, NO_x Emission Control Areas (ECA's); Global SO_x in 2020

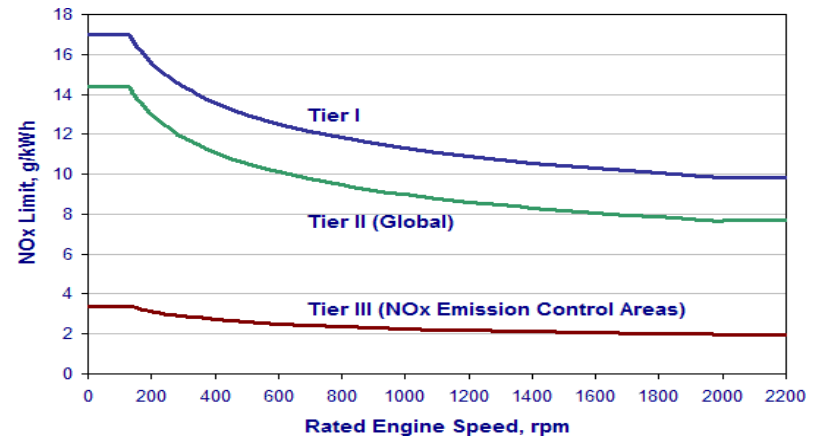
IMO Sulphur Limits – Marpol Annex VI



Source: IMO

- IMO limits SO_x content of fuel to 0.1% in ECAs. Global sulphur cap of 0.5% (from current 3.5%) to come into effect in 2020.

IMO Nitrogen Oxides Limits – Marpol Annex VI



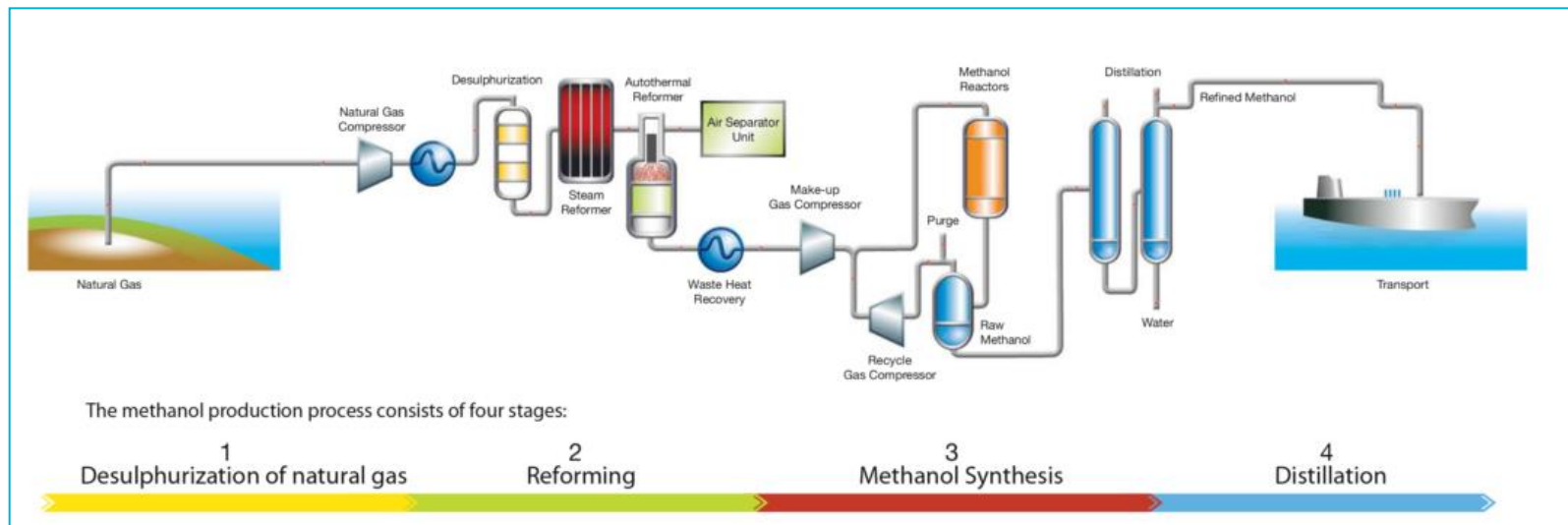
Source: IMO

- Tier III NO_x limits effective in North America in 2016 and North and Baltic Seas effective 2021 (newbuilds only)

Emissions Reduction

- Methanol (CH_3OH) with one carbon atom is a lower carbon content fuel for Energy Efficiency Design Index (EEDI)
- Methanol is typically made from natural gas, but can also be made from renewables and significantly reduce CO_2 emissions

Methanol Production



Methanol - Environment, Health and Safety

Methanol is a clear, colourless liquid that quickly and naturally biodegrades

- More environmentally benign than conventional marine fuels (i.e. HFO and MGO)
- Long history of methanol safe handling
- Industry standards established for the safe handling of methanol and other low flashpoint fuels



Methanol in Use Today: R&D/Projects

R&D / Other Commercialization Projects

Large Engine Market (i.e. cruise ships and ferries)

- Funded by German government to support further commercialization work for new methanol cruise ships and ro-pax* ferries



Small Engine Market (i.e. tug and barge)

- LeanShips: Sponsored by the EU to support commercialization of the smaller engine market
- GreenPilot: Co-funded by Swedish Maritime & Transport Administrations & Methanol Institute to support commercialization of the smaller engine market



China Market

- China Classification Society (CCS) methanol for marine fuel guidelines under development
- Ministry of Agriculture methanol marine fuel pilot project



Customer Testimonial – Mitsui O.S.K. Lines, Ltd.

“Investing in technology that encourages the use of a fuel like methanol that significantly reduces emissions is a step forward for both our company and the shipping industry”

“Investing in technology that encourages the use of a fuel like methanol that significantly reduces emissions is a step forward for both our company and the shipping industry. This is the reason we were very pleased to partner with Waterfront Shipping and others to have three of our vessels -- Cajun Sun, Taranaki Sun and Manchac Sun-- built with the first of its kind MAN dual-fuel technology. We are continually working to upgrade our methanol transport services, leveraging experiences to meet a range of customer needs while proactively introducing technologies that reduce the shipping industry’s environmental impact.”

-- Akio Mitsuta, Senior Managing Executive Officer, Mitsui O.S.K. Lines, Ltd.



Taranaki Sun Vessel, Mitsui O.S.K. Lines, Ltd., 2016

Customer Testimonial - Marininvest/Sakagerack Invest

“We have found the technology for handling methanol is well developed and offers a safe dual-fuel solution for low-flashpoint liquid fuels”

“We are proud to invest and have two of our JV vessels, Mari Jone and Mari Boyle, built with the first-of-its kind MAN B&W ME-LGI two-stroke dual-fuel engine. Our overall focus in the development of the dual-fuel system concept has been safety and engine reliability. We have found the technology for handling methanol is well developed and offers a safe dual-fuel solution for low-flashpoint liquid fuels. Safety measures include all methanol fuel equipment and distribution systems double-walled and ventilated with dry air, ensuring there is no direct contact with methanol and safe for operators and engineers. Any operational switch between methanol and other fuels is seamless and records a slightly better efficiency compared to conventional HFO-burning engines. Our vessels have regularly been running on methanol and we foresee this continuing going forward.”

-- Patrik Mossberg, Chairman, Marininvest/Skagerack Invest



Mari Jone Vessel, Marininvest/Sakagerack Invest, 2016

Customer Testimonial - Westfal-Larsen Management

"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 design and ship technology"

"As we were evaluating our investment in this technology and having the Leikanger and Lindanger built with an engine that can run on a fuel such as methanol, it was important that we assessed its adaptability and use. Now with our vessels in operation and in the waters, 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 design and ship technology. Methanol shares similar characteristics with other marine fuels with respect to storage and handling and can even be bunkered by trucks if required. As methanol is a much cleaner and less viscous fuel than HFO or MGO, lower noise and vibrations have been observed when running on methanol. Using methanol as a marine fuel is a feasible and practical solution that supports the shipping industry and regulatory requirements. With the recent announcement by IMO for a global 0.5% sulfur cap for vessels worldwide effective 2020, methanol will soon be one of the very few fuel alternatives to MGO that can be utilized by existing modern vessels after relatively minor and cost effective retro-fit modifications compared to for instance LNG."

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



Lindanger Vessel, Westfal-Larsen Management, 2016

Customer Testimonial – Stena Line

"We are very enthusiastic about methanol's possibilities and it has the potential to be the maritime fuel of the future"

"Our aim has always been to apply innovation to increase the benefits for our passengers and society in general. We constantly review the use of different types of fuel for the future. And now to be the world's first owner of a ship with methanol-drive, is a big step towards sustainable transport. We are very enthusiastic about methanol's possibilities and it has the potential to be the maritime fuel of the future. We want to pursue change and development in the shipping sector and, with the Stena Germanica, our environmental impact will be completely different to what the industry has seen before."

-- Carl-Johan Hagman, CEO, Stena Line



Stena Germanica, Stena Line, 2016