

Alternative fuels for 2020

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Conventional hydrocarbon liquid fuels

- Marine distillates
 - Gas oil (<0.1% and <0.5% Sulphur)
 - Distillate diesel (<0.1% and <0.5% Sulphur)
- Marine residual blends
 - ULSFO (<0.1% Sulphur)
 - VLSFO (<0.5% Sulphur)
- These meet the rules on Flash point, Sulphur and meet ISO 8217 grade requirements (with some issues over test methods)

Distillates, ULSFO, VLSFO - is there anything else?

- A group of “low flash point” fuels.
 - Methane
 - LPG
 - Propane
 - Butane
 - Ethane
 - Methanol (including DME)
 - Ethanol
 - Ammonia
 - Low flash distillate diesel
- All of these have low flash point and do not comply with general SOLAS regulations.
- There are special rules for vessels using Methane

Are they realistic options

- Using new rules and special flag state exemptions some are in use now.
 - Methane (IGF code and IGC code)
 - Ethane (Flag state exemptions)
 - Methanol (Flag state exemptions)
- Propane, Butane, Ethanol and low flash distillate diesel will work with existing engine designs.
- IMO is considering adaptation of the IGF code to include regulations for those.

Don't forget Bio diesel

- Diesel made from bio components – Fatty Acid Methyl Esters (FAME)
 - Routinely used in automotive fuels
 - More expensive than hydrocarbon diesel
- A good fuel BUT
 - Poor oxidation stability – poor long term storage
 - Poor cold flow properties
 - It reacts with water – a problem in the marine environment.
- It is encouraged by governments to reduce CO₂ emissions.

Compare the energy cost.

Fuel	Specific energy MJ/kg	Energy density MJ/l (liq)	On board storage	Special engineering	Logistics infrastructure	Capital cost	Fuel cost MJ/\$ (excl deliv)
Ethanol	29.7	23.28	Atmos	Complex	Moderate	Moderate	43.6
Methanol	22.7	17.86	Atmos	Moderate	Moderate	Moderate	44.9
Ammonia	18.6	11.5	Pressure	Moderate	Moderate	Moderate	62
LFP diesel	45.3	37.18	Atmos	Moderate	Simple	Low	69.7
DMA	42.5	35.95	Atmos	Simple	Simple	Low	70.8
Butane	49.1	29.73	Pressure	Moderate	Complex	Moderate	88.6
Propane	49.6	29.45	Pressure	Moderate	Complex	Moderate	89.5
Ethane	51.8	28.23	Cryogenic	Complex	Complex	High	107.5
RMG380	39.9	39.6	Atmos	Simple	Simple	Low	114.1
Methane	53.6	23.53	Cryogenic	Complex	Complex	High	211.0

LNG – Liquid Natural Gas

- Principal constituent is Methane
- Stored as a cryogenic liquid (-162 °C at atmospheric pressure up to – 130 °C at 10 bar pressure)
- Low flash point
- 55 years of marine experience
- Excellent fuel – potentially cheap
- In use on non gas carriers since 2002

Methane in use now on non LNG carriers



Kvitbjørn



a – Methane dual fuel



Ternfjord – Methane dual fuel

Latest news (Feb 2018)

- Carnival building 9 LNG fueled cruise liners
- TOTE complete 1st of 4 retrofit conversions to LNG
- 1st LNG fueled Supramax Bulk Carrier delivered
- 5 LNG fueled PSV find employment
- Boil Off CNG storage solution for Schulte LNG bunker vessels.
- 3 separate classes of LNG fueled oil tankers ordered.
- MOL building 18,500 m³ LNG bunker barge.
- This is just a selection of February announcements!

And - (March 2018)

- Yokohama-Kawasaki study LNG bunkering hub in Tokyo bay
- Wartsila to integrate VOC system with fuel supply on dual fueled tankers
- Vale receives new VLOC with LNG capability
- SIEM building 2 LNG fueled car carriers for Volkswagen
- Construction starts on Shell/Halter marine LNG ATB bunker vessel
- Construction starts on LNG ROPax vessel “Honfleur”
- Launch of first of 5 LNG hybrid ferries for Norway

LPG – Liquid Petroleum Gas

- Ethane
- Propane
- Butane
- Stored under cryogenic, fully/semi refrigerated or pressurised conditions depending on size and gas.
- 45 years marine experience in storage – but new to propulsion fuel.
- Exmar has just committed two VLGC's to LPG fuel (delivery 2020)
- Ethane is new as a ships fuel and at present only used on Ethane carriers.

LPG



Ethane Crystal - Ethane

Methanol – DME - Ethanol

- Alcohol fuels
- Low flash and mild corrosive
- 40 years marine experience in storage
- New to propulsion fuels (2 years)
- Relatively high price
- Low energy density
- DME is Di Methyl Ether, made from Biomass, Methanol or Natural Gas

Methanol



Taranaki sun



Stena Germanica

Other energy sources

- Solar
 - In use to provide on board electrical power.
- Wind
 - In use to supplement propulsion power
- Fuel cell
 - In use to provide on board electrical power
- Ammonia
 - Has been used in road transport and farm machinery in the past.

Other fuels and energy sources



Nichioh Maru – Solar assist



Viking Lady – Fuel cell assist



E-ship 1 – Wind assist

Low Flash Point Diesel

- Automotive gas oil
- Represents the major proportion of distillate diesel sold worldwide (over 90% of market demand)
- Flash point dependent on national regulation – EU min 55 °C, USA min 52 °C, Brazil min 38 °C.
- Has good cold flow properties, excellent fuel but may contain up to 7% bio component (FAME) which is “Hydrophilic” which is not ideal in a marine environment.

And?

- Because of the relatively low percentage of marine demand, marine distillate is a special product.
- In 2021 the marine percentage may be as high as 15% - BUT it will retreat to below 8% by late 2020's
- There is an ongoing risk of contamination in storage (flash point, FAME, etc.)
- This leads to industry pressure to use “automotive” specifications at sea.