

Methanol plotting a course to low carbon pathways

Sustainable Shipping Technology Forum

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Graz, September 26, 2019

Methanol is simplest of alcohols

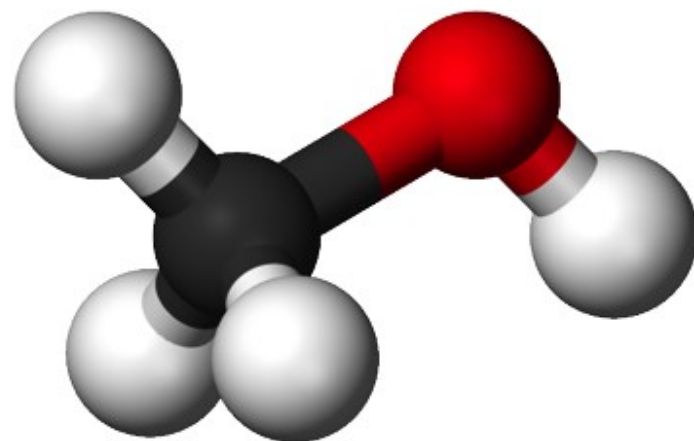
- Simple molecule rich in hydrogen, with only a single carbon bond
- Clear and colorless liquid at room temperature and ambient pressure
- Also known as “wood alcohol,” methanol can be produced from a wide range of feedstocks

Formula: CH_3OH

Density: $0,792 \text{ g.cm}^{-3}$

Molar mass: $32,04 \text{ g mol}^{-1}$

Appearance: colourless liquid



Increasing use as a marine fuel

COMBUSTION ENGINE



9x **+2x**

1x

1x

chemical
tankers

ROPAX
ferry

Pilot
boat

MOL, WL,
Marinvest

Stena Line

Swedish
Maritime
Admin.

2 stroke
MAN

4 stroke
Wärtsila

high speed
Scania,
Volvo, a.o.

new build

retrofit

'retrofit'

FUEL CELL



2x

1x

Tourist
boat

Ferry

Innogy,
Konstanz
Uni

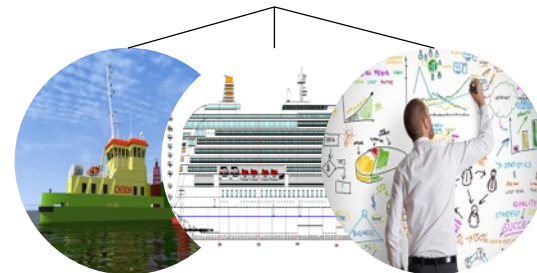
Viking Line

Serenergy fuel cell stacks

retrofit

retrofit

PROJECT and R&D



Cruise ships, fishing boat,
barge, dredge, a.o.

Billion Miles, Summeth/Martec,
HyMeth Ship, Lean Ships,
Methaship, GMM, a.o.

SI hybrid, dual fuel, etc.

new build & retrofit

Toward a low carbon shipping industry

Potential future propulsions solution should ideally be:

SUSTAINABLE



SCALEABLE

STOREABLE

Methanol...

- is plentiful, available globally
- can be made 100% renewable
- runs well in existing engine technology and has potential for further optimization
- complies with increasingly stringent emission reduction regulations
- requires only minor modifications to current bunkering infrastructure
- is biodegradable!
- safe handling can rely on long history and experience in shipping and industry
- cost are relatively modest and drop as experience mounts
- shows slight regional price variation





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FURTHER INFORMATION

A global industry association

- First formed in 1989, the Methanol Institute (MI) serves as the trade association for the global methanol industry.
- MI represents the world's leading methanol producers, distributors and technology companies from offices around the world



MI provides value to its members by:

- Ensuring safe handling of methanol and its derivatives
- Promoting methanol growth by furthering methanol as an essential chemical commodity and an emerging source of clean and renewable energy
- Influencing global regulatory and public policy initiatives that impact the methanol industry

2019 members

Tier 1



Tier 2



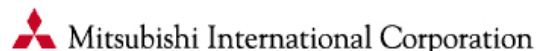
قطر فUEL ADDITIVES COMPANY LIMITED
Qatar Fuel Additives Company Limited



Tier 3



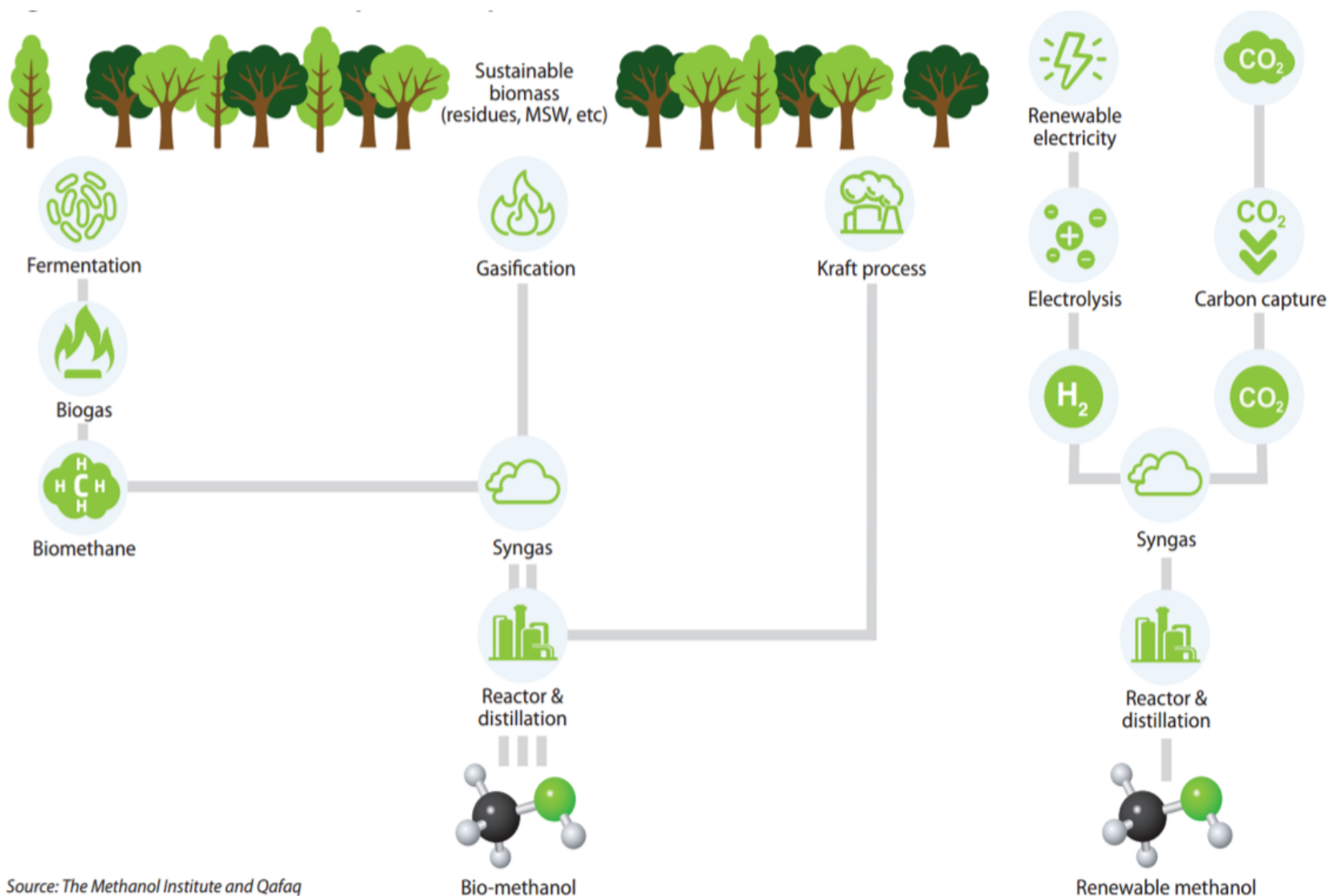
Ecofuel



Tier 4



Low carbon pathways exist



Source: The Methanol Institute and Qafaq

Reduces tail pipe emissions

SO_x [a]

99% <

NO_x [a]

60% <

Particulate matter [a]

95% <

CO₂ (TtW) [b]

17% <

[a] Source: Stena Line

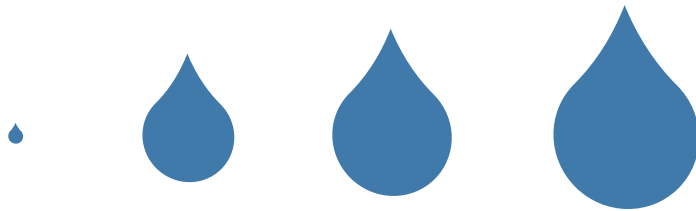
[b] Source: Ford, CO₂ benchmark compared to gasoline

Assumptions:

same mileage, impact due to stoichiometry and heating value

Putting things in perspective

LC50 - Lethal dosis fish



Gasoline ^[1]
8,2 mg/l

Methane ^[2]
49,9 mg/l

Diesel ^[3]
65 mg/l

Heavy Fuel Oil ^[4]
79 mg/l

Methanol ^[5]
15.400 mg/l

Sources:

^[1] Petrobras/Statoil ASA, Safety Data Sheet, ECHA registration dossier Gasoline

^[2] ECHA, European Chemicals Agency, registration dossier Methane

^[3] ECHA, European Chemical Agency, registration dossier Diesel

^[4] GKG/ A/S Dansk Shell, Safety Data Sheet

^[5] ECHA, European Chemical Agency, registration dossier Methanol

Options to scale and reduce carbon



Fossil

Bio-methane



MSW

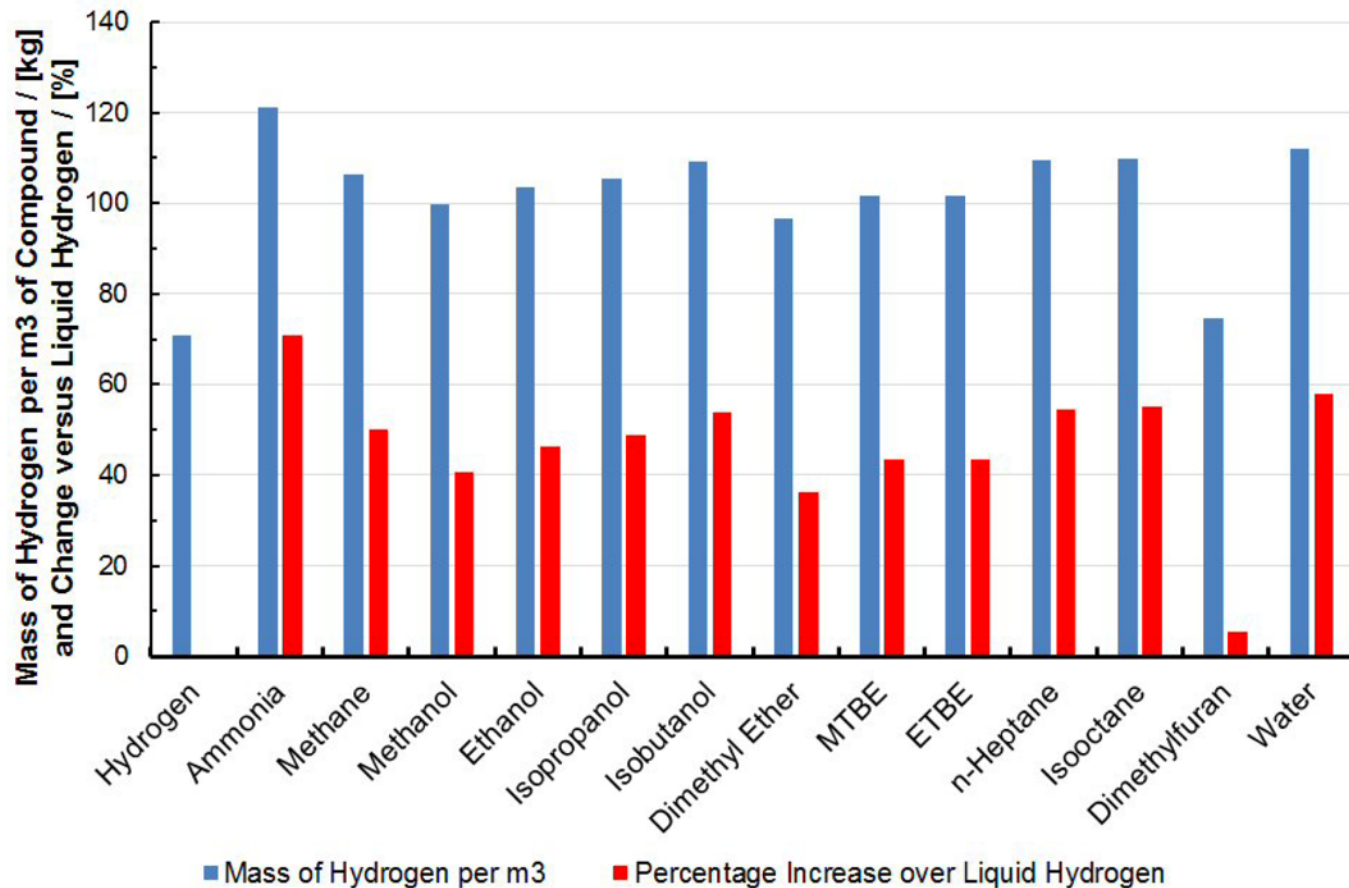


PtX

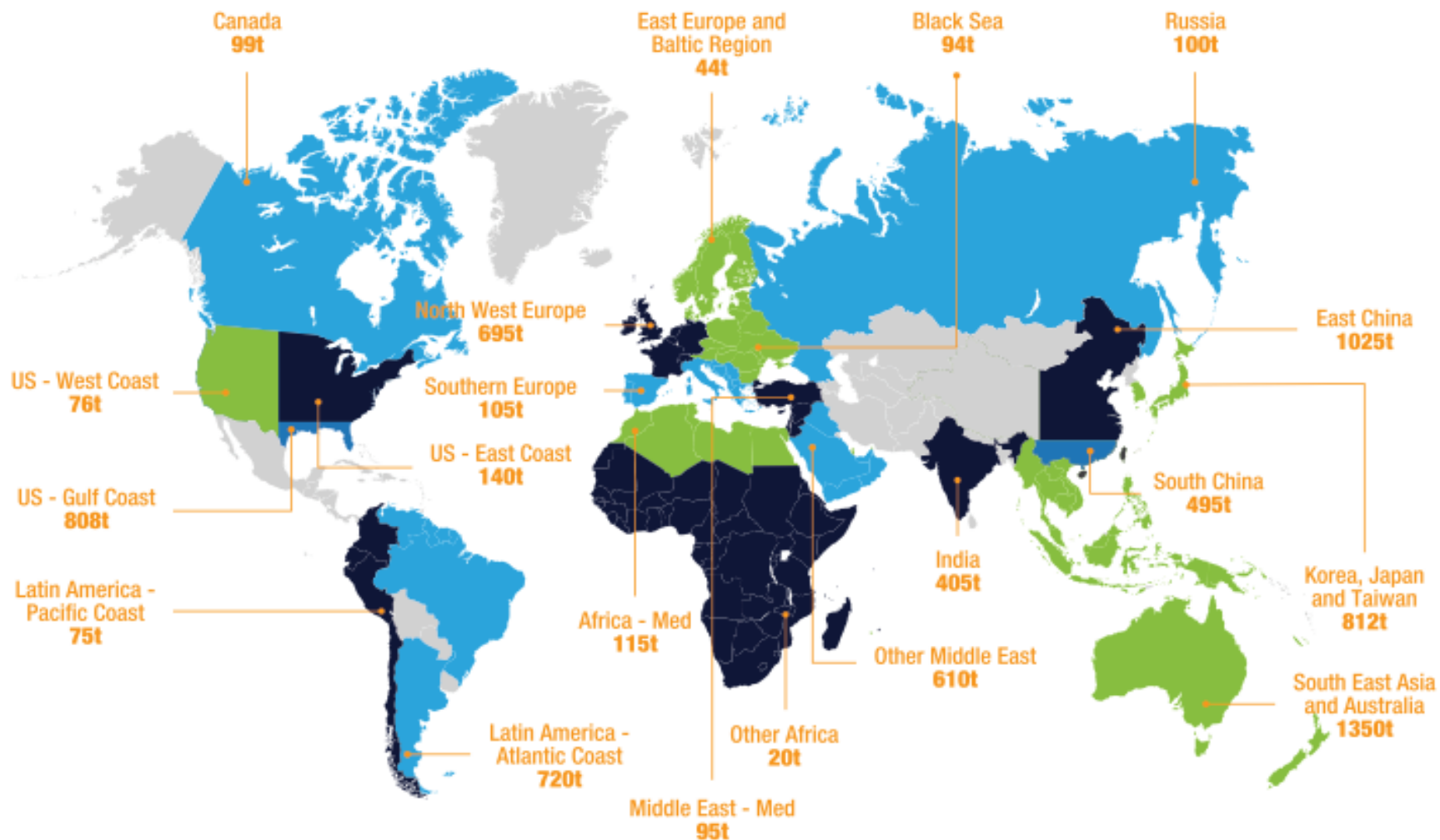


Methanol is a great energy carrier

H₂: very bad at storing H₂



Available around the world



Methanol storage capacity estimates (thousand tons)