Biofuels in the Transition of Maersk Can we use biomass and which biofuels should we produce?

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EUBCE 2022 - 30th European Biomass Conference and Exhibition MUSIC Workshop: Use of pyrolysis oil and other advanced biofuels to decarbonize maritime transport



In 2018, we committed to cutting CO₂ to net-zero



transported

Today

All future Maersk-owned newbuildings will be prepared to sail on carbon neutral fuels

2008

2030

2040



Net-

ZERO

CO2

The climate challenge in shipping is huge

- The maritime sector consumes <u>300 million tonnes of fuel oil per year</u>, and emits 3% of global GHG emissions.
- Maersk's 700+ container ships consume <u>11 million tonnes of fuel oil per year</u> and emit 0.1% of global GHG emissions
- But the technologies and solutions are there, we just need to 'get going'!



Who can use the limited biomass???

From Biofuture campaign: 28-287 EJ Biofuture Platform All Member Group Web Meeting

(ieabioenergyconference2021.org)

Total global biomass supply (primary energy) EJ/year



250 × Maersk energy consumption

Total global biomass supply in 2050!

 \approx



Average:

- How to start a green transition?

Who will build a ship for fuels that are not available?

Maersk Orders 12 Methanol-Powered Container Ships With Fuel-Saving Design (needs 500,000 tpa methanol)









Maersk secures green emethanol for the world's first container vessel operating on carbon neutral fuel



Maersk engages in strategic partnerships to scale green methanol production by 2025

E-methanol

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A.P. Moller - Maersk engages in strategic partnerships across the globe to scale green methanol production by 2025 | Press Release | News



Bio-methanol



Potential 1-molecule fuels

Technolog	y/fuel	Learnings sofar	Doable?
1. G ethanol		Food vs. Fuel issue.	No
2. G ethanol		Tech. has improved, but market price will remain high, depends of road-electr.	Perhaps
Higher alcoho	ls	Potential solution from e-fuel-process by Prometheus Fuels	Perhaps
Bio-methanol		Relatively mature (biogas & gasification), best overall feasibility profile	Yes, medterm
E-methanol		Depends on carbon capture (DAC, point-source) and renewable power	Yes, long-term
Bio-methane	(gas)	Most likely not scalable, slip issues (production & use)	No
E-methane	(gas)	Slip issues (use), high energy-loss in production vs. e-methanol	Νο
DME	(gas)	Potential use as pilot-fuel for methanol or as single-fuel	Joker
Hydrogen	(gas)	Potentially for short distance shipping	Joker
E-ammonia	(gas)	Uncertainty on safety issues, cheapest e-fuel, regional regulatory differences	Perhaps

new fuel + new ship



Potential drop-in bio-fuels

Fuel	Learnings sofar	Doable?		fuel
Biodiesel (FAME)	Feedstock limitations, regulatory concerns	Short-term		blending + existing
Renewable diesel (HVO)	Feedstock limitations, regulatory concerns	Short-term	J	ships
🔀 MAE	RSK Prices Book - Tracking Schedules Logistics solutions			
Home / Transpo	rtation Services			
Maor				
→ Get a qu	ote now → Share via email			



Potential drop-in bio-fuels

Fuel	Learnings sofar	Doable?	
Biodiesel (FAME)	Feedstock limitations, regulatory concerns	Short-term	
Renewable diesel (HVO)	Feedstock limitations, regulatory concerns	Short-term	
Pyrolysis/HTL fuels	Promising: Cheap, 2. G feedstock, drop-in fuel but need for upgrading	Medterm	
Jet-bottoms	Promising: 'Leftover' from SAF, high quality, price uncertain	Medterm	
Fischer-Tropsch	Heavy end of Fischer-Tropsch might be blend-in quality	Perhaps	
Alcohols-to-heavy oil	Promissing drop-in fuel if efficient conversion is developed ('alcohols-to-jet')	Perhaps	
Lignin-alcohols	Promising if lignin value remains low: cheap, drop-in for MeOH in ICE	Joker	

fuel blending + existing ships





New drop-in fuel production

Pyrolysis is simple – but also very complex







- Possible to handle most fuels on a ship

We are used to utilize poor quality oil!

➢ HFO: High viscosity, impurities, aromatics, acidity, ...

Few hard requirements for new drop-in fuels:

- Flash point: Above 60°C
- Stability: At least 9 months storage
 - Miscibility: Prefered fully miscible (or well-defined limitation).
- Pour point: Below 30°C



Why upgrading with hydrogen? Pros and cons

- → More hydrogen → more cost
- Hydrotreating of these oils is technically difficult!
- ÷ Low catalyst lifetime (?)
- ✓ More hydrogen →
 higher quality (or at all useable)
- ✓ More hydrogen → more energy per CO₂ emitted



E-fuels or bio-fuels ?

Green

methanol

Biomass

Hydrogen

(/power)

Hydrogen needed to produce methanol from $C_x H_y O_z$

<u>Bio-fuels</u>

Pro : cheaper, low power consumption for hydrogen (> 4 times lower) Con: needs biomass (!) + transporting this

<u>Ammonia /hydrogen</u> Pro: no carbon in, no carbon out! Con: Power consumption + safety + regulation + no solution ready (yet)

E-fuels Pro: no biomass, can be simple process Con: Biogenic CO₂ + power consumption



Minimum hydrogen needed [moles H₂ / moles C in feed]

Nonfossil CO₂



Summary - What are we looking for?

Maersk will need large amounts of green fuels

- If biomass is available and can be used this is our preferred feedstock
- If this is not the case: e-fuels will be the long-term solution

We can use a number of biofuels

- > For our new ships we can use methanol, ethanol, ligning/alcohols
- For the new ships we need green pilot fuels (~5 vol% of consumption)
- Fuels for blending into HFO are needed and might be produced from pyrolysis or hydrothermal liquifaction – most likely with an upgrade by mild hydrotreatment
- > We are open to new possibilities





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