


Future Fuels for Maersk

Best practice examples of meeting emission neutrality goals

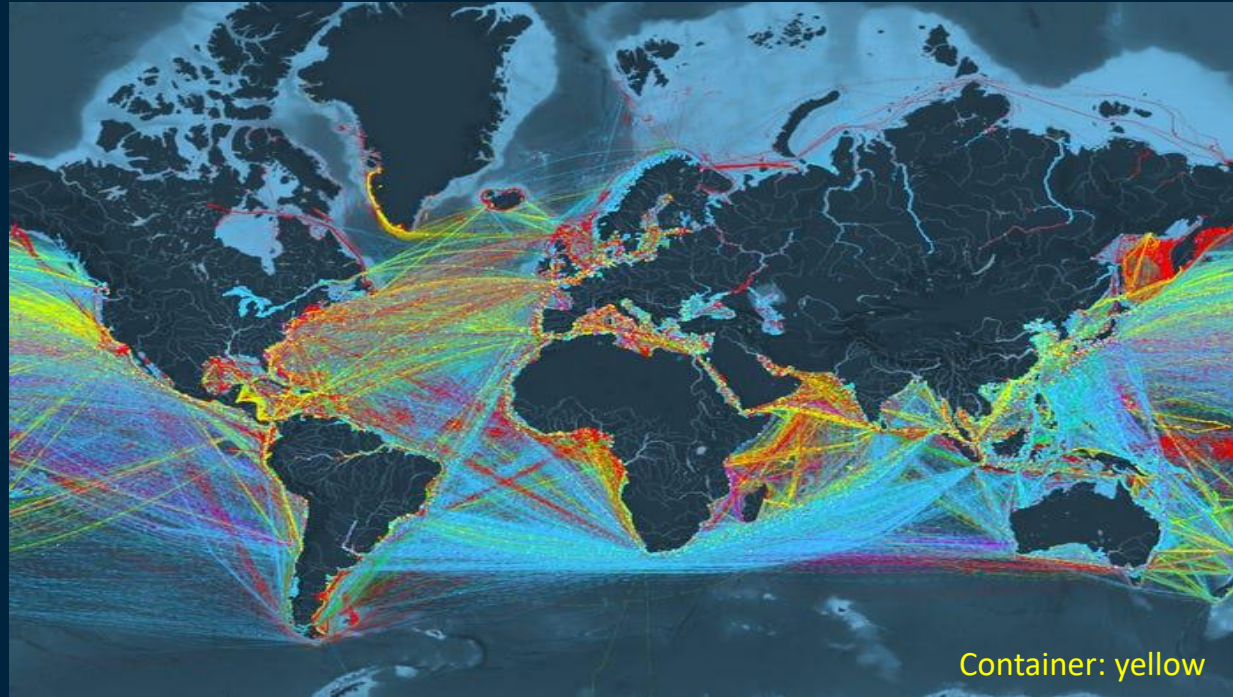
EUROPEAN CONFERENCE
5th FUTURE OF BIOFUELS
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The climate challenge in shipping is huge



[Kiln Interactive Map of Global Shipping \(businessinsider.com\)](https://www.businessinsider.com/kiln-interactive-map-of-global-shipping)

Maersk's fleet consumes **11 million tonnes of fuel oil per year** and emit **0.1%** of global GHG emissions

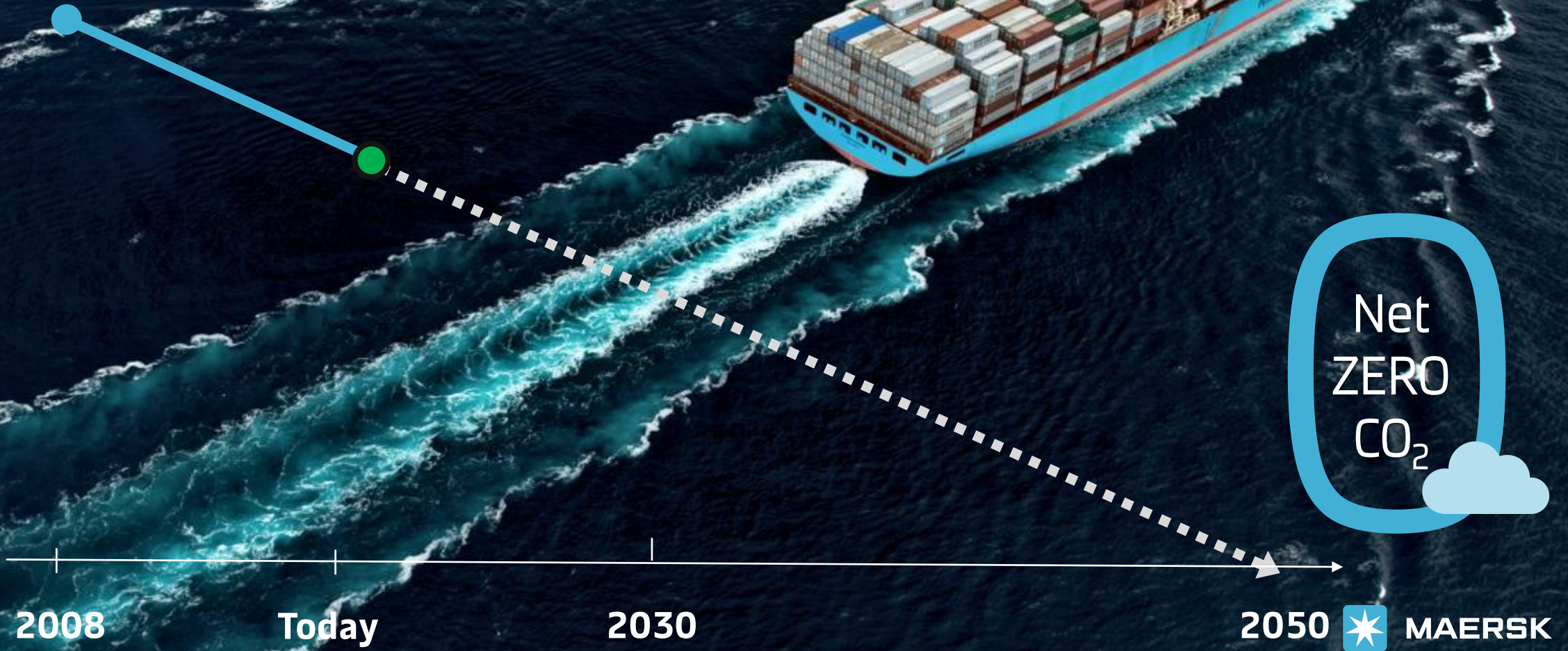


Equal to CO₂e emissions of Ireland (~33 mill tpa)



[Ireland CO2 Emissions - Worldometer \(worldometers.info\)](https://worldometers.info/ireland-co2-emissions/)

Our decarbonisation targets



Our decarbonisation targets

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

Terminals: ~70% absolute reduction of greenhouse gas emissions

Air: Min. 30% of cargo transported using Sustainable Aviation Fuels

Warehouses/depots: Min. 90% green operations

Our targets will be aligned with a **1.5°C pathway** as defined by SBTi for the maritime transport sector.

50%
Red. pr container transported
(2020 baseline)



35 - 50%
Absolut reductions
(depending on growth) - ocean only

Net
ZERO
CO₂

2008

Today

2030

2040

2050



MAERSK

Transition in 13 years ?!

Easter morning 1900: 5th Ave, New York City. Spot the automobile.



Source: US National Archives.

Easter morning 1913: 5th Ave, New York City. Spot the horse.



Source: George Grantham Bain Collection.

Transition of shipping has been done before

Decarbonisation of Maersk and shipping

GreenFuels
Environmentally Friendly Fuels

2040

2023



Diesel replaced by cheap heavy fuel oil

1950



Rapid transition to diesel from coal

1912

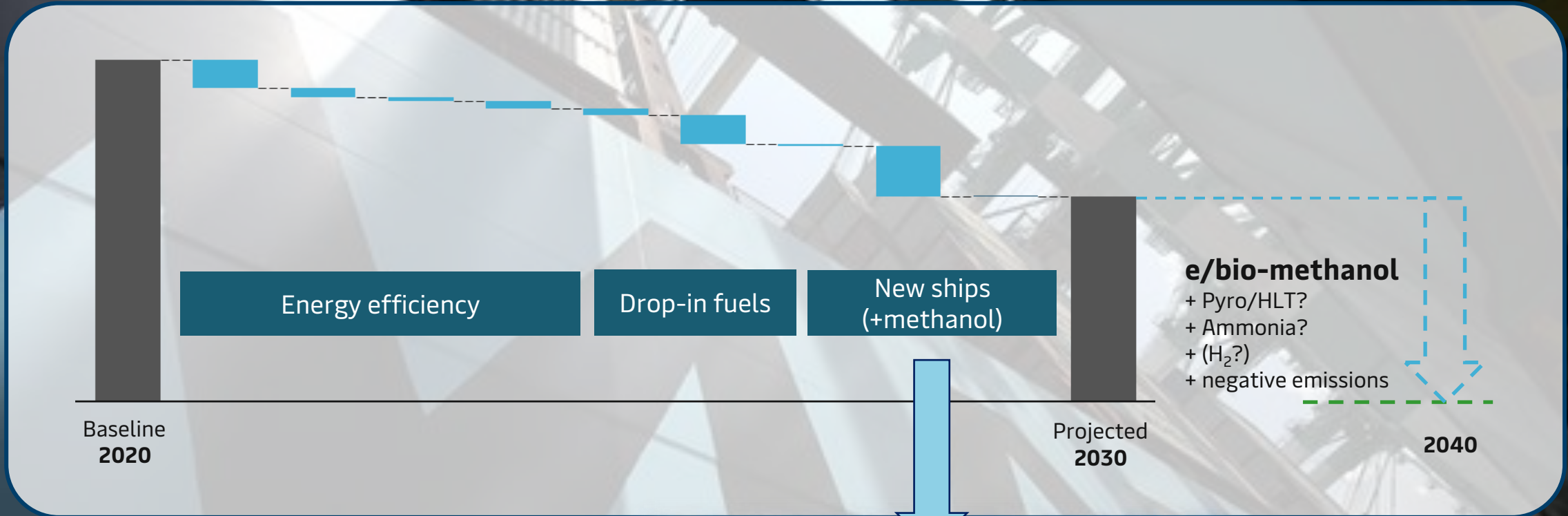


MS Selandia, Copenhagen, 1912

[MS Selandia was one of the world's first large transoceanic diesel-driven ships, and at her first appearance many people were confused because she was "smokeless"](#)

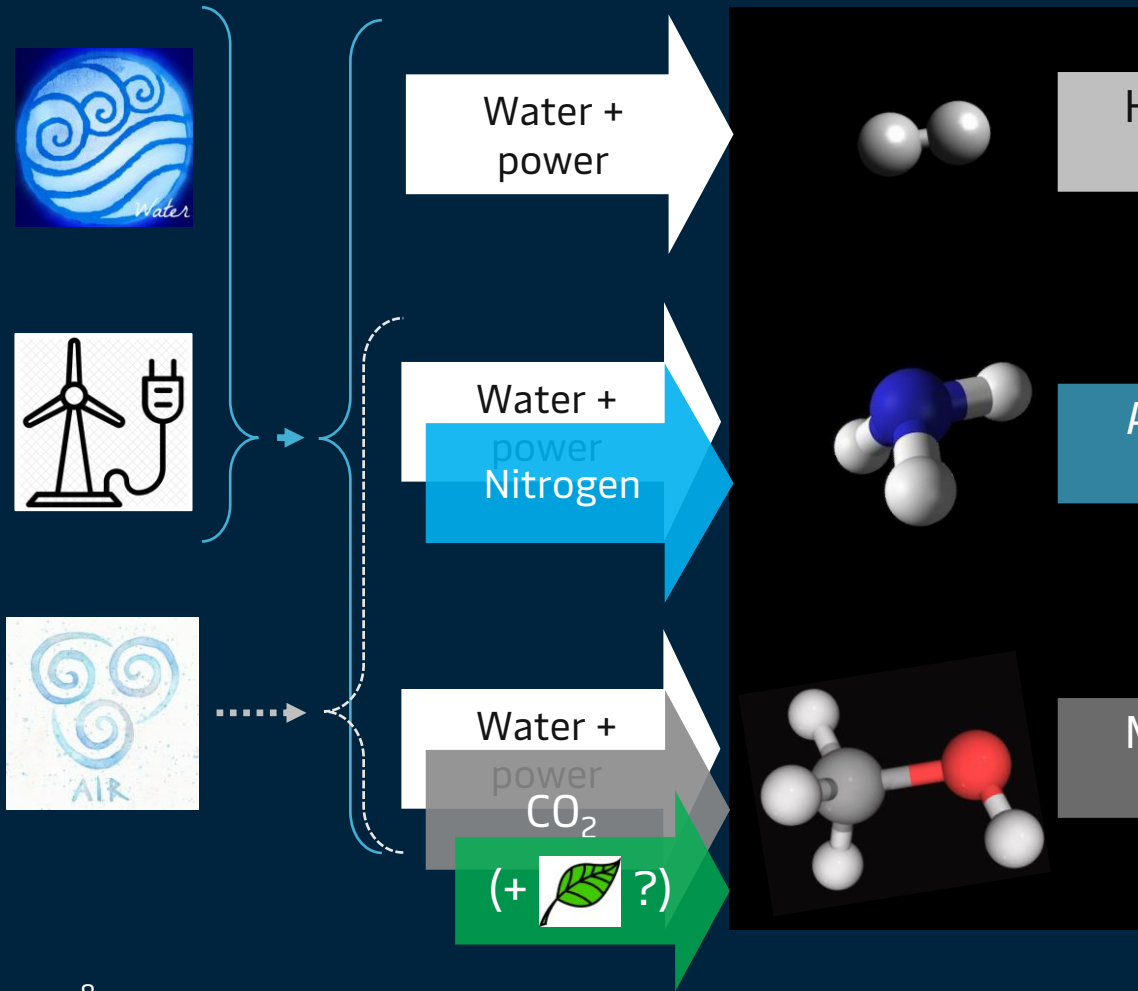


How do we intend to reach our longterm reduction targets?



25 dual fuel methanol ships ordered to date

Hydrogen-derived Future Fuels



Perfect fuel for fuel cells
No carbon dependency
No emissions (!?)
Difficult handling and safety
Onboard storage (!)

Poor fuel quality
Great scalability – no carbon
Unknown emissions
Safety (!)
Regulation (!)

OK fuel quality
Carbon dependency (!)
Low emissions (CO₂ must be balanced)
Handling is known
Proven onboard technology

Methanol is only real option today
Same fuel can be produced from biomass

Methanol ships – first of many delivered



[Milestone: Maersk launches methanol-powered feeder in bold move toward carbon neutrality - Offshore Energy \(offshore-energy.biz\)](#)



[Morten Bo Christiansen: The first-ever cargo ship powered by green fuel | TED Talk](#)

Worlds largest e-methanol plant

Renewable power; New 300 MW Solar PV
Hydrogen; 50 MW PEM electrolyzers
Biogenic CO₂; Trucked from nearby biogas facility
Product; 32,000 tonnes of e-methanol a year



[European Energy takes first step into large-scale commercial Power-to-X - European Energy](https://www.tvsyd.dk/aabenraa/det-groenneste-liv-er-i-aabenraa-her-ligger-landets-stoerste-solcellepark)

<https://www.tvsyd.dk/aabenraa/det-groenneste-liv-er-i-aabenraa-her-ligger-landets-stoerste-solcellepark>

New fuel-producing company: C2X


Bloomberg US

• Live Now Markets Economics Industries Tech AI Politics Wealth Pursuits Opinion Businessweek Equality

Green

Billionaire Maersk Family Forms Green Methanol Firm for Shipping

- C2X to produce 3 million tons of the alternative fuel by 2030
- Maersk alone is responsible for 0.1% of human CO2 emissions



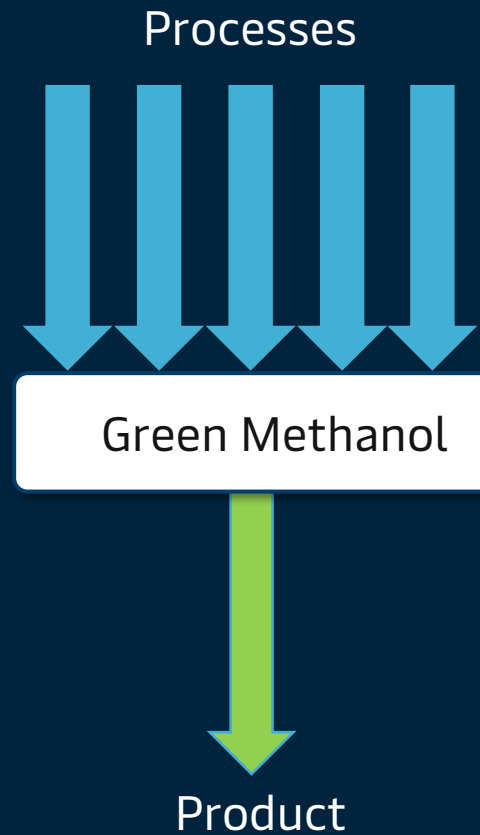
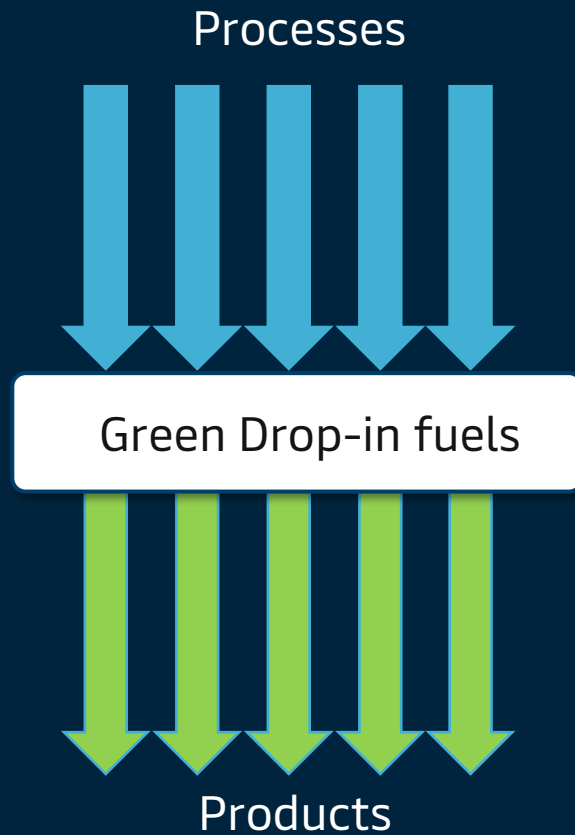
C2X

We accelerate the journey to a fossil-free future through large-scale green methanol production for multiple industries

[C2X \(c2xglobal.com\)](https://c2xglobal.com)

[Maersk Owner APMH to Make Green Methanol Shipping Fuel - Bloomberg](#)

Biooils vs methanol



Biodiesel?

Fatty Acid Methyl Esters, FAME

...Yes and No



biofuels
international

HVO pre-treatment
technologies for
biofuel industry

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AUG 10, 2021

Maersk hits choppy waters in quest for more UCO feedstock

A shortage of used cooking oil (UCO) has hit AP Moller Maersk's plans to forge ahead with its carbon neutral policies.

The Copenhagen-based carrier with its fleet of more than 700 vessels is shifting away from using fossil fuels to power its fleet.

Maersk uses biofuels in some of its vessels following requests from some of its clients. However, the demand for UCO has gone up because of high demand.

The company uses about 12 million tons of marine oil annually but is using more biofuel in its quest to become a greener carrier.

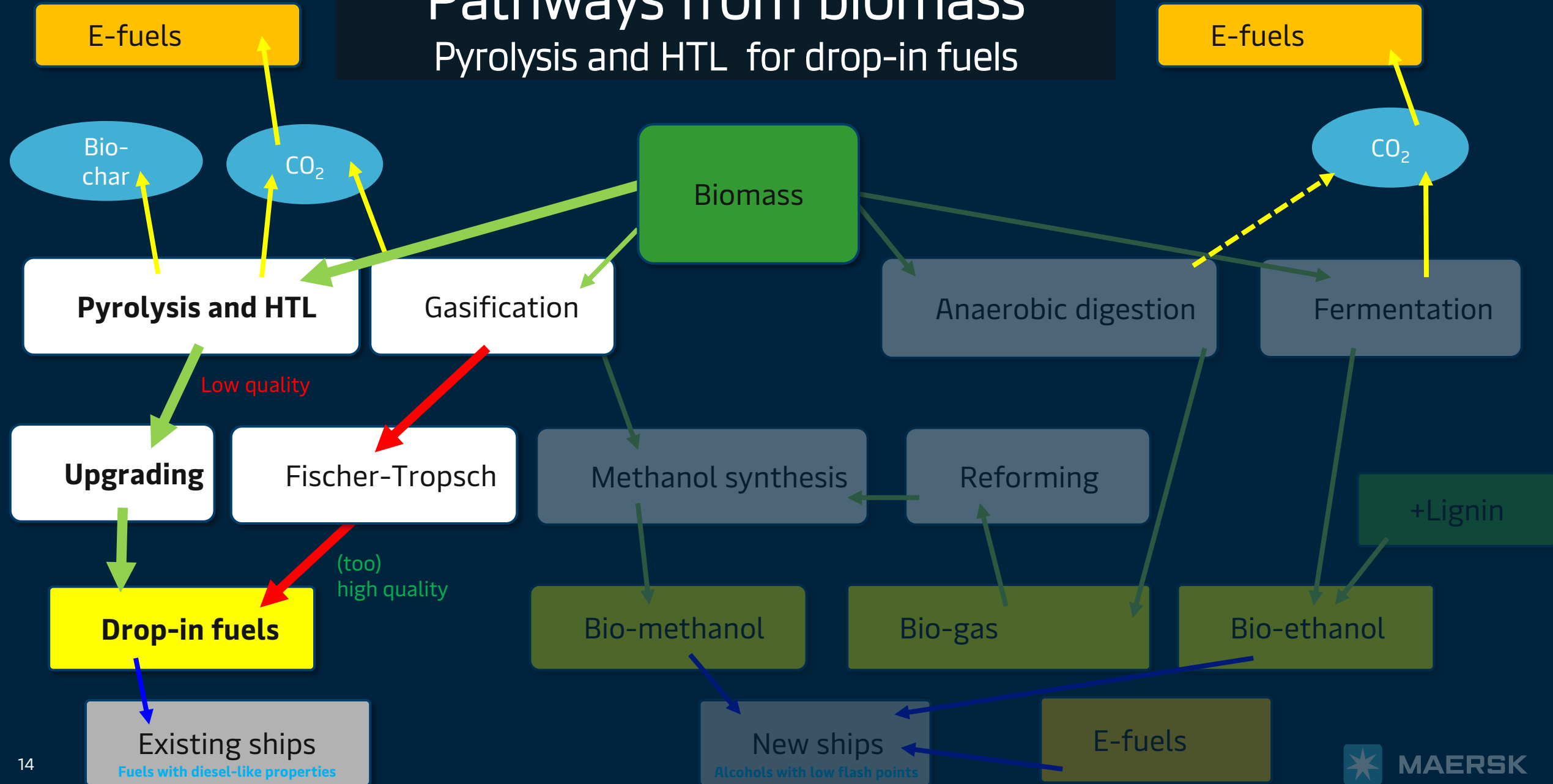
"The biofuel is sourced from used cooking oil, but the problem is that the world doesn't eat enough French fries," CEO Soren Skou told Bloomberg.



[Maersk hits choppy waters in quest for more UCO feedstock | Biofuels International Magazine \(biofuels-news.com\)](#)

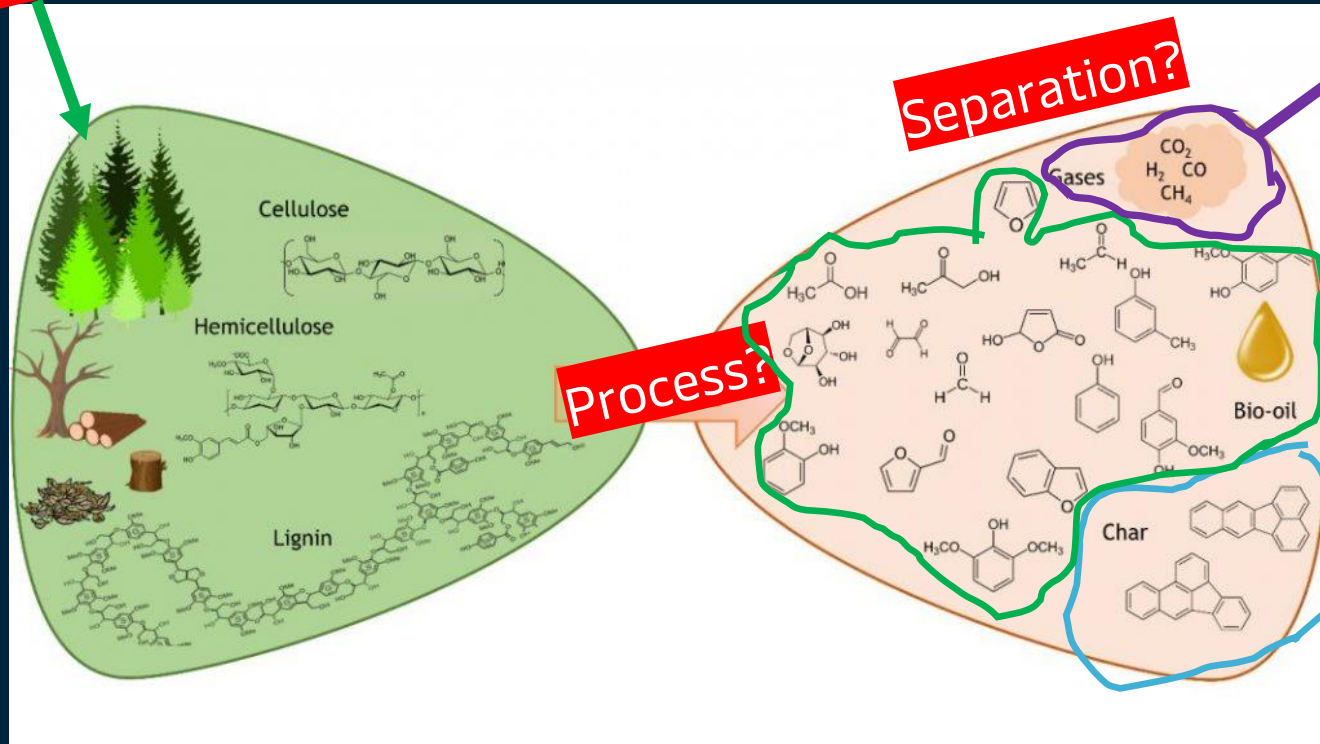
Pathways from biomass

Pyrolysis and HTL for drop-in fuels



Why is pyrolysis complicated?

Feedstocks?



Separation?

Value of gas?
(Hydrogen, CO_2 ,
heat...)

Upgrading
process?



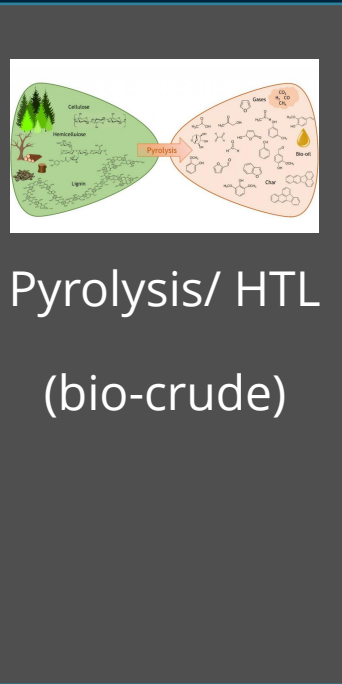
Value from biochar?
(products, carbon
sequestration...)

Thermal conversion

Biomass

Gasification (syngas)

Fischer-Tropsch



Catalytic conversion in condensed phase
Catalyst added
O removed as CO₂

Catalytic fast pyrolysis (in-situ CFP)
Catalyst added
O removed as CO₂

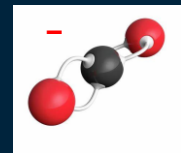
Co-processing in refinery hydro treater
Catalyst + H₂
O removed as H₂O

Dedicated hydrotreating of bio-crude
Catalyst + H₂
O removed as H₂O

Novel upgrading with alcohols (liquid batch process)
Low pressure alcohol

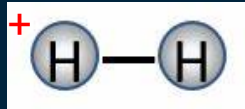
Solvolyis
High pressure alcohol

Catalytic hydrolysis (CHP)
High pressure H₂



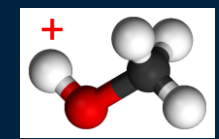
Low energy/hydrogen consumption

Low carbon-yield



High energy/hydrogen consumption

High carbon-yield



+ alcohol to form esters

+ hydrogen



Difficult oil quality

...is nothing new to Maersk

We are used to utilize poor quality oil!

- HFO: High viscosity, sulfur, impurities, aromatics, acidity, ...

Few hard requirements for new drop-in fuels:

- Flash point: Above 60°C
- Miscibility: Preferred fully miscible in HFO
- Stability: At least 9 months storage
- Pour point: Below 30°C

Testing fuels in Maersk

A specification is not enough

Typical test procedure:

- Results from biocrude developer or producer
- 1st sample: ISO 8217 test for first evaluation (~1 L oil needed)
- 2nd sample: Miscibility test for use with existing fuel types (~1 L)
- 3rd sample: In-house durability testing in 'injection rig' (~200 L)
- Engine testing on a vessel: >1000 tonnes (**100 tonnes** for B10 testing)

Viability status – Main parameters

- Sustainability
- Price levels (incl. outlook)
- Availability & scalability
- Safety
- Regulation
- Bunkering/infrastructure
- Ship CAPEX & OPEX
- Properties

Viability status – METHANOL

Sustainability

Regulation

Price levels (incl. outlook)

Bunkering/infrastructure

Availability & scalability

Ship CAPEX & OPEX

Safety

Properties

Viability status – biooils from pyrolysis and HTL

Sustainability

Regulation

Price levels (incl. outlook) () Bunkering/infrastructure

Availability & scalability () Ship CAPEX & OPEX

Safety

Properties

Challenges – for decarbonizing shipping fast enough

1. **Scaling production of affordable green methanol fast enough** (*short term*)

- Scaling renewable energy and H₂ production fast enough → subsidies & partnerships with suppliers
- Securing access to affordable biogenic CO₂ or DAC → accelerate clarification of e-ammonia as potential fuel

2. **Identifying** (and executing fast enough) **a fuel solution for decarbonising the existing fleet**

- Pyrolysis/HTL oils looks promising but at low TRL → work with technology developers on solution

3. **Having a continued increase in customers** being willing to pay premium (*long term*)

- We do see large growth in interest from customers, but to get all onboard → work closer with customers

4. **A regulatory level playing field** (*short/medium/long term*)

- Introducing a world wide carbon tax fast enough → work closer with regulatory actors



...so far the challenge is not the chicken
but rather to get enough eggs

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Thanks!

