Decarbonising Maersk

Need for new fuels to reduce emissions from our fleet

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How do we intend to reach our reduction targets – longterm

Energy efficiency  Drop-in fuels  New ships (+methanol)

Baseline 2020  Projected 2030  2040

e/bio-methanol
+ Pyro/HLT?
+ Ammonia?
+ (H2?)
+ negative emissions

25 dual fuel methanol ships ordered to date
Hydrogen-derived Future Fuels

Water + power

Hydrogen as fuel?

Water + power
Nitrogen

Ammonia as fuel?

Water + power
CO₂

Methanol as fuel?

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

Only real option today

(other options: e-methane, e-DME, e-diesel, e-ethanol, …)
To back a future fuel we need ‘acceptable feasibility’ within these areas....

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

- Sustainability
- Price levels (incl. outlook)
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To power a fleet of today’s size, APMM needs 20+ million tons of green methanol or ammonia; significant green energy requirement.

- **Green fuel requirement (‘000 tons)**
  - 2023: 10
  - 2025: ~500
  - 2030: ~5-6,000
  - 2040: +20,000

- **Requirements to deliver**
  - 20+ m. tons... of green methanol or ammonia
  - ~30 GW... of electrolyzer capacity
  - 80 – 100 GW... of wind/solar capacity
  - USD 100 bn. ... of capital investments

... and all of this is only for Maersk based on what we know today.
Viability status – PYRO/HTL

- ✔ Sustainability
- ✔ Price levels (incl. outlook)
- ✔ Safety

- ✔ Regulation
- ✔ Bunkering/infrastructure
- ✔ Properties

- ? Availability & scalability
- ? Ship CAPEX & OPEX
Status and challenges – pyro/HTL

- **Pro’s:**
  - Scalable (feedstock agnostic), cheap, blending in HFO, potential use as pilot fuel for methanol ships, less competition, negative emissions.

- **Cons’s:**
  - Crude pyro/HTL oils most likely to poor quality, i.e. slight upgrading is needed, not fully mature technology.

- **CHALLENGE:**
  - What combi of pyro/HTL process and upgrading gives the cheapest pyro-oil just about good enough to blend into HFO at x%?
  - How can we scale pyro/HTL oils fast enough?
Challenges – for decarbonizing shipping fast enough

1. **Scaling** production of affordable green methanol fast enough *(short term)*
   - Scaling ren. el & green H2 production fast enough → subsidies & partnerships with suppliers
   - Securing access to affordable biogenic CO2 or DAC → accelerate clarification of e-ammonia as pot. fuel

2. **Identifying** (and executing fast enough) a fuel solution for decarbonising the existing fleet
   - Pyrolysis/HTL oils looks promising but low TRL → work closer with developers

3. **Having a continued increase in customers** being willing to pay premium *(long term)*
   - We do see exponential 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
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

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable power</td>
<td>New 300 MW Solar PV</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>50 MW PEM electrolyzers</td>
</tr>
<tr>
<td>Biogenic CO₂</td>
<td>Trucked from nearby biogas facility</td>
</tr>
<tr>
<td>Product</td>
<td>32,000 tonnes of e-methanol a year</td>
</tr>
</tbody>
</table>

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-har-ligger-landets-stoerste-solcellepark

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New fuel-producing company: C2X

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

Thanks!

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