Decarbonising Maersk - ASAP

... status, learnings and challenges

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Why the ‘ASAP’?

– because it is no longer a matter of avoiding climate change – is it about reducing the catastrophic impacts!

Our decarbonisation targets

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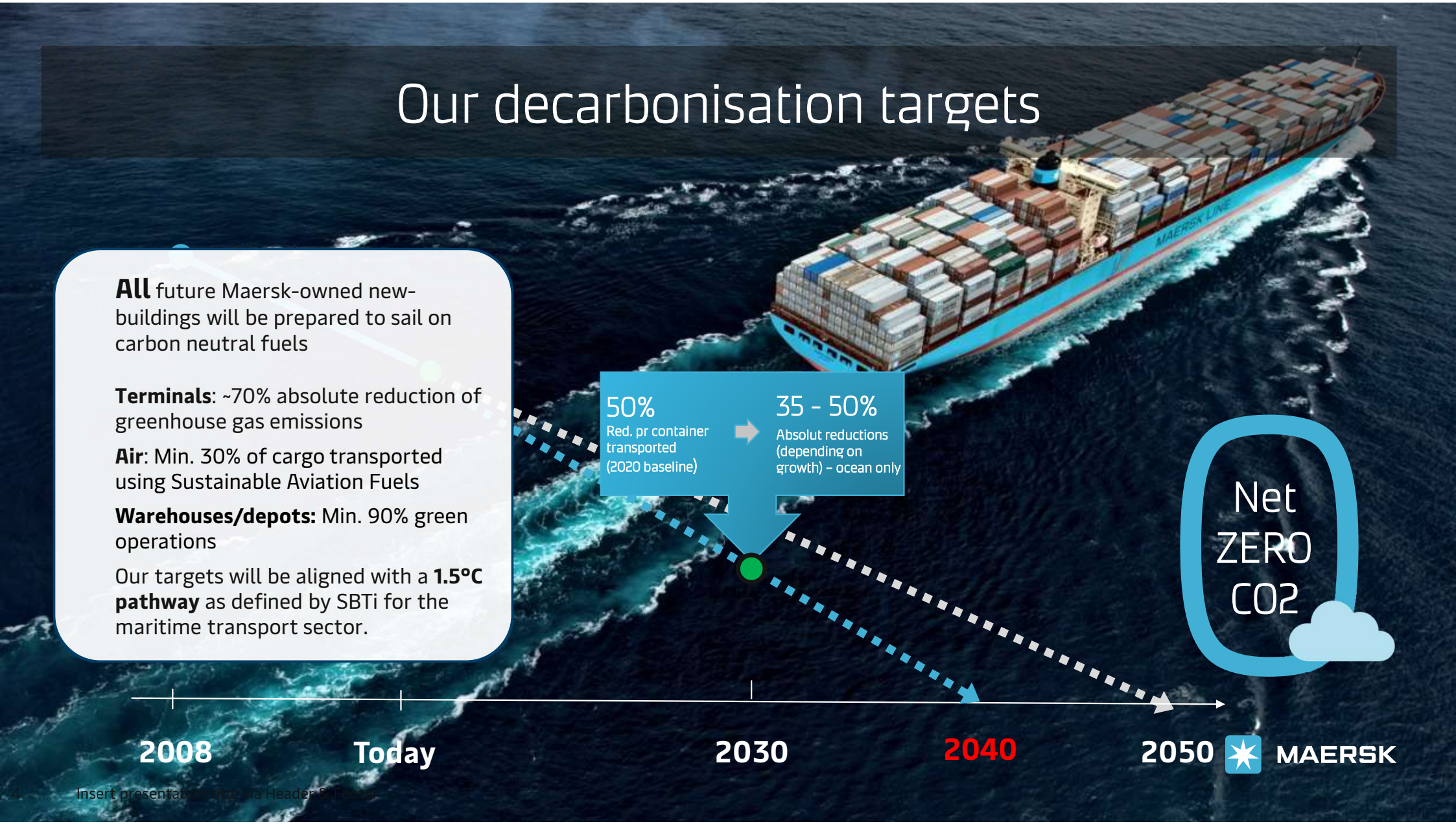

All future Maersk-owned new-buildings will be prepared to sail on carbon neutral fuels

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.

How do we intend to reach our ocean goals – towards 2030?

A suite of initiatives will all help in decarbonisíng ocean, such as:

- Network design
- Network execution
- Efficient operations
- Chartering the right vessels
- New innovations on ships
- Port productivity/turn time

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Why is it we like green methanol so much?

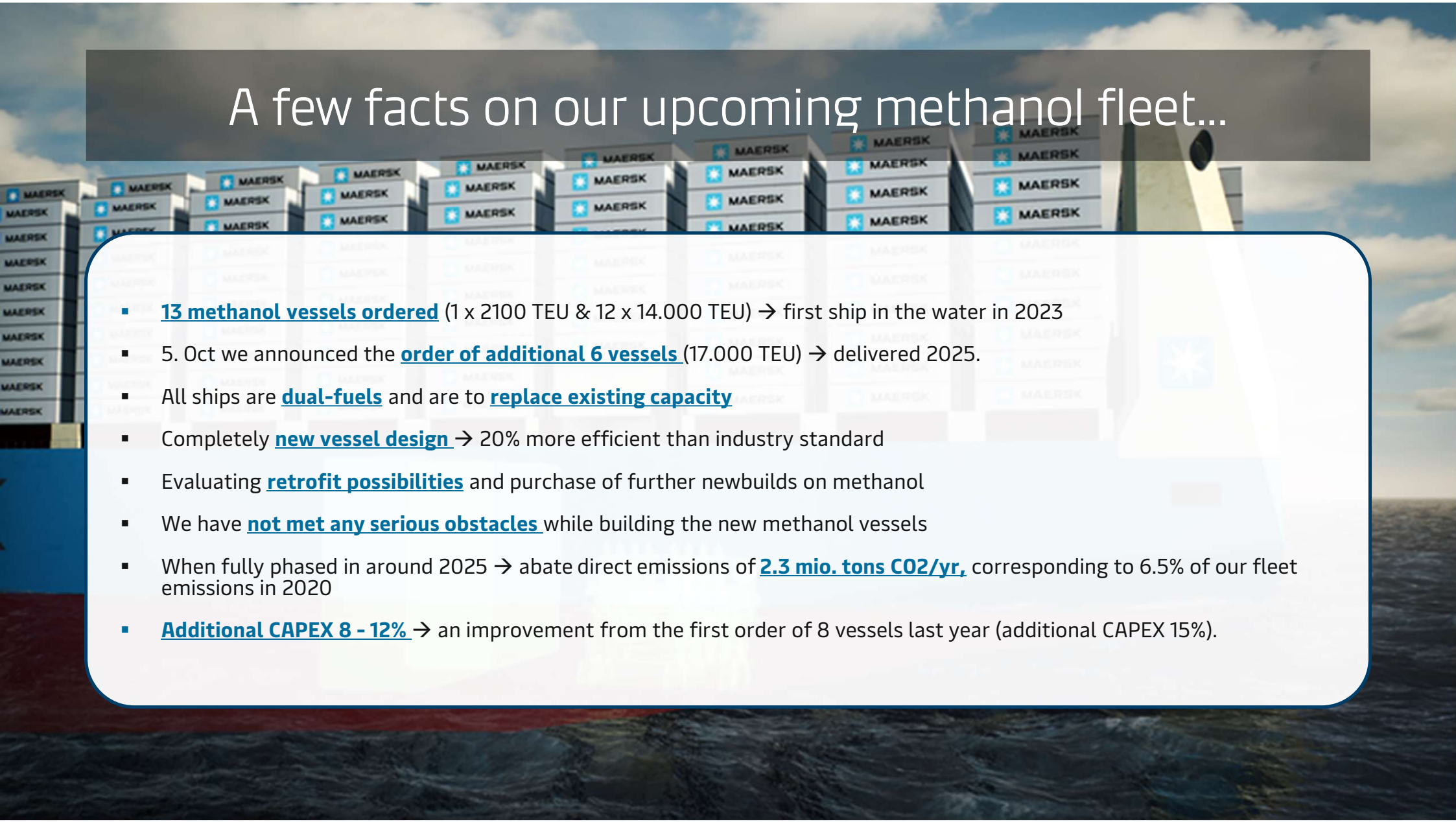
After 3 years of continuous evaluation of other potential carbon neutral fuels (bio/e-methane, 2. g ethanol, etc.) → **green methanol continues to come out with the best overall feasibility profile!**

- **Mature engine** technology
- **Low toxicity** towards humans and environment
- **Easy handling** onboard
- **Easy storage** (we can put it 'wherever there is room')
- High energy density → only **double tank size**.
- Multiple **mature production** pathways – incl. **bio- and e-pathways**

- One of (if not the) **cheapest method** to convert biomass residues to liquid fuel
- **Simple fuel** (vs. bio-oils that are complex)
- **Regulation in place**
- **Suitable for fuel cells** as well (i.e. future proof)
- (if **2. g ethanol** becomes available at acceptable market prices, it can be a drop in fuel for the methanol ships)

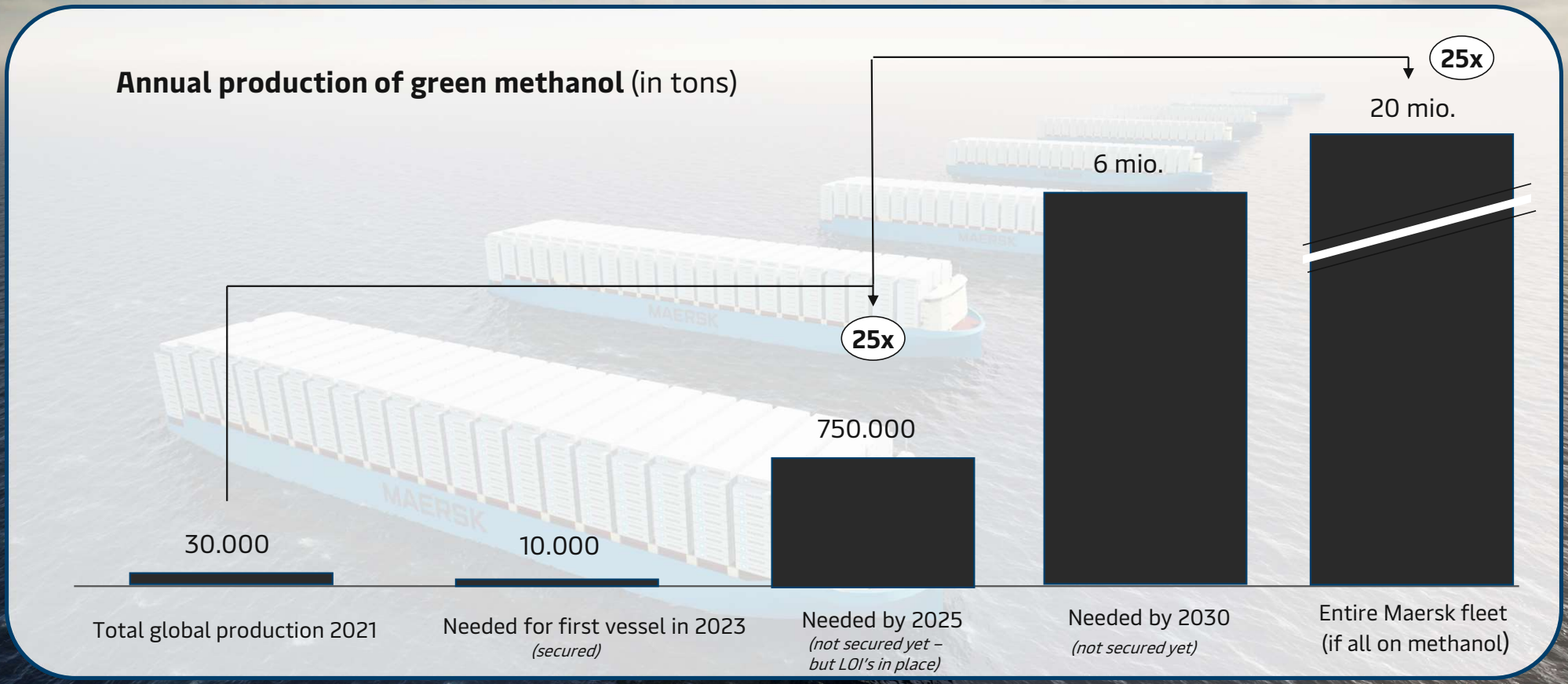
.. and the cost/price level seems reasonable!

A few facts on our upcoming methanol fleet…



- **13 methanol vessels ordered** (1 x 2100 TEU & 12 x 14.000 TEU) → first ship in the water in 2023
- 5. Oct we announced the **order of additional 6 vessels** (17.000 TEU) → delivered 2025.
- All ships are **dual-fuels** and are to **replace existing capacity**
- Completely **new vessel design** → 20% more efficient than industry standard
- Evaluating **retrofit possibilities** and purchase of further newbuilds on methanol
- We have **not met any serious obstacles** while building the new methanol vessels
- When fully phased in around 2025 → abate direct emissions of **2.3 mio. tons CO2/yr,** corresponding to 6.5% of our fleet emissions in 2020
- **Additional CAPEX 8 - 12%** → an improvement from the first order of 8 vessels last year (additional CAPEX 15%).

It will be quite a leap to get to scale green methanol
– but it can be done



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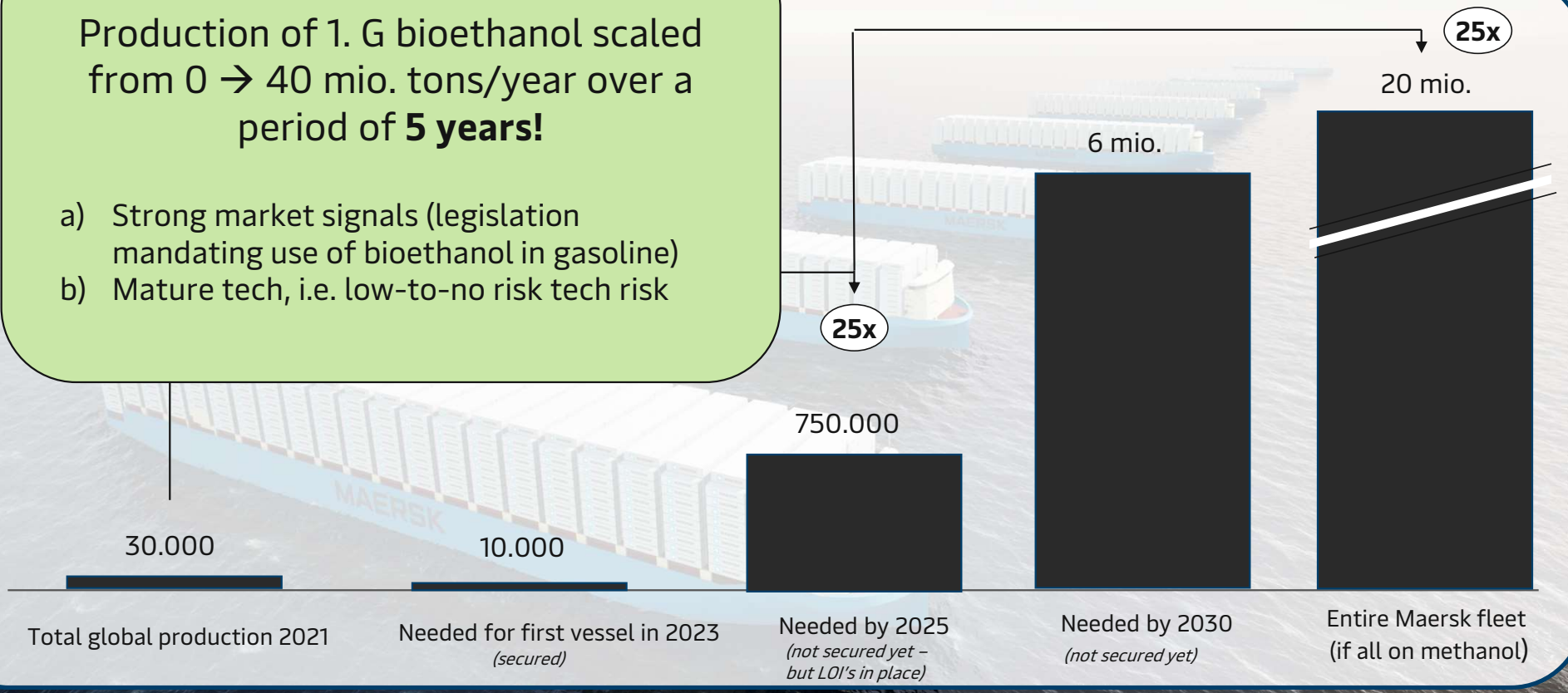
– but it can be done

Production of 1. G bioethanol scaled from 0 → 40 mio. tons/year over a period of **5 years!**

a) Strong market signals (legislation mandating use of bioethanol in gasoline)
b) Mature tech, i.e. low-to-no risk tech risk



Our new partnerships on methanol supply

- broad range of companies and geographies, e-methanol and bio-methanol

Ørsted

- 300,000 ton/year
- First delivery in 2025
- North America

CIMC ENRIC 中集安瑞科

- 50,000 ton/year.
- First delivery in 2024
- China

PROMAN

- 200,000 ton/year
- First delivery in 2025
- North America

EUROPEAN ENERGY

- 2-300,000 ton/year
- First delivery in 2025/2026
- North & South America

Green Technology Bank

- 50,000 ton/year
- First delivery in 2024
- China

WASTEFUEL

- 30,000 ton/year
- First delivery in 2024
- South America

(EUROPEAN ENERGY + REintegrate)

- 15,000 ton/year
- First delivery in 2023
- Kassø, Southern Jutland

DEBO Energy

- 200,000 ton/year
- First delivery in 2024
- China

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Is there enough affordable CO2 and H2 to have e-methanol as a longterm solution?

Biogenic CO2

- Studies shows **current availability of (point source) biogenic CO2 in the range of 1.4 bio. tons/year** – increasing to 3.8 bio. tons/year in 2050
- Main sources being bioethanol production, biogas production, paper mills – lowest capture cost at 13 USD/ton CO2.

Yes, there seems to be enough – not only for Maersk, but shipping as a whole

DAC

- Studies show that **is seems likely that DAC can scale** – it is a known technology and we see a major push in this area
- Price range now: 300 – 600 USD/t
  Price range 2030: 175 – 200 USD/t

It seems likely that DAC will scale, bringing prices down to around 175-200 USD/ton alreday in 2030

H2/ren. power

- **This is a challenge!**
- Blue H2 is not considered, but..

There will be enough green H2 in the future – the question is when will there be enough at attractive price?

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DAC

H2/ren. power

a challenge!

2 is not considered,

<u>All-e-fuels:</u> Maersk would need 7 × DK power consumption as renewable power

<u>All-Bio:</u> 200 × Maersk would use all sustainable feedstock!

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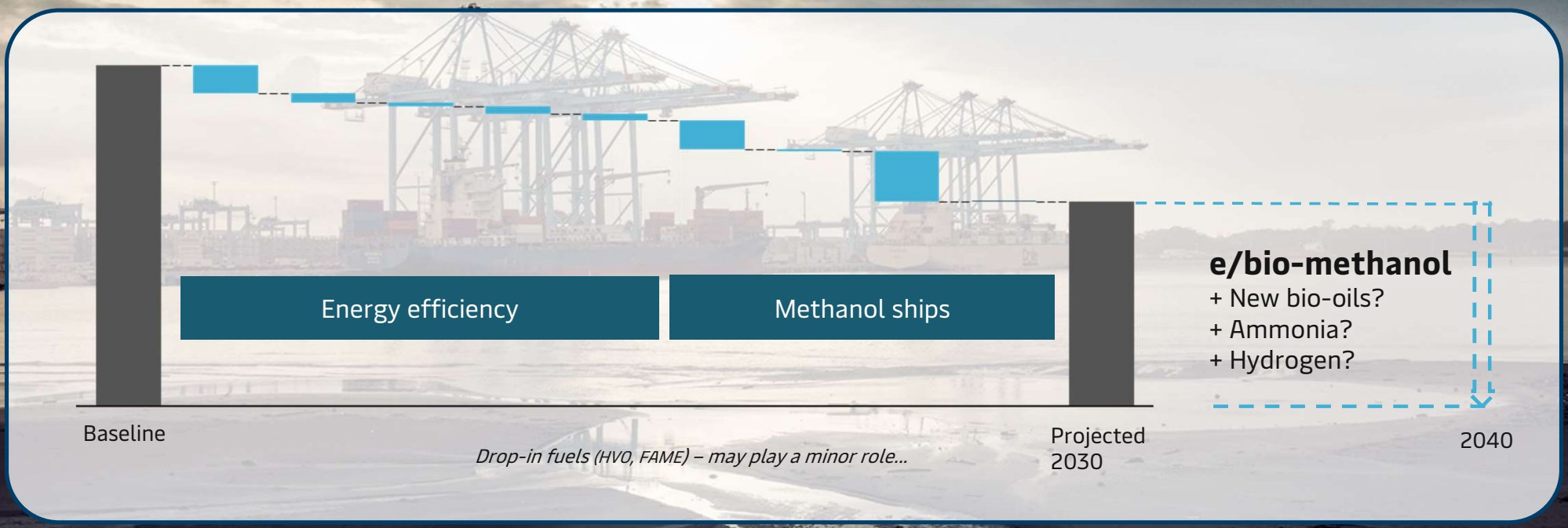
How do we intend to reach our ocean goals – longterm?



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New bio-oils could be a future fuel…

Definition of 'new bio-oils'?	A carbon neutral fuel that **can be used as a fuel in our existing fleet** without altering the ships engine or fuel system (too much) (either pure or blended x % into HFO).
Why are we interested?	They **could represent a cheaper way of decarbonising our exisiting fleet** (than retrofitting to methanol).
The most promising types?	**Pyrolysis and HTL oils** (cheap convertion method, feedstock agnostic, 'crappy oil' quality that with minor upgrading probably is 'good enough')
Maersk's current activities	**We test a variety of different pyrolysis/HTL oils** for usability (acidity, stability, miscibility, etc.)

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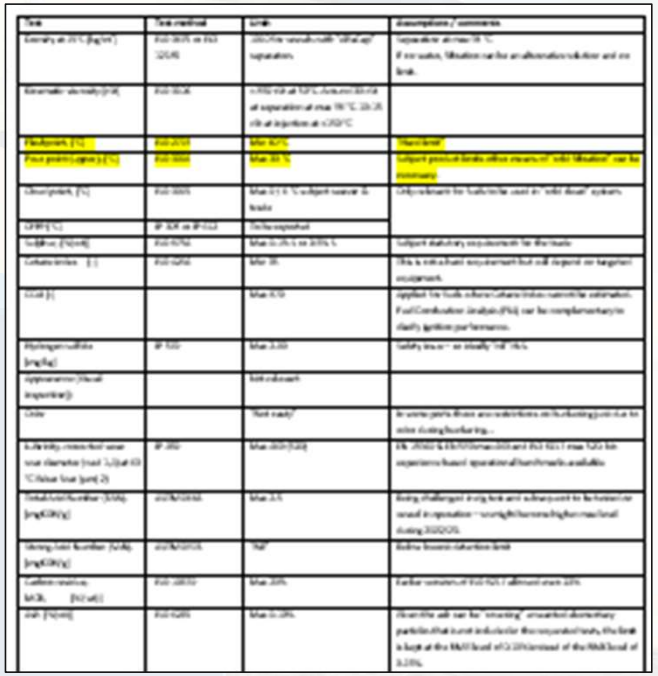
Our requirements towards a ‘new bio-oils’

- We are used to run on ‘poor quality oils’

A **few hard requirements:**

- Flash point (above 60˚C)
- Stability: at least 9+ months storage
- Miscibility: prefered fully miscible (or else min XX%).
- Pour point: below 30°C



Our current spec for ‘new drop in fuels’ (relaxed from 8217)

What are Maersk's thoughts on ammonia as fuel?

- It is still on '**the perhaps list**'
- We are engaged in **multiple projects** with external partners to explore:
    1. Ship design and bunker vessel design studies for various geographies
       (can we do bunkering in the opening? Can we do bunkering while we do cargo operations at cargo terminals, how ready are ports?, etc.)
    2. Safe handling of ammonia as a fuel
       (should people wear full PPE?, what is required regarding crew training, etc.)
    3. Green ammonia sourcing options
- Awaiting a **full LCA of e-ammonia** & analysis **reg. spills in the environment**
- Earliest possible commercial order of an ammonia engine is in 2025

What are Maersk's thoughts on hydrogen as fuel?

- **Why?**
  - The fewer convertion steps the better + no carbon + high energy denisity pr. weight
- **Challenges?**
  - Storage → we need 5-15 times the tank size
  - Safety → small molecule, impossible to contain completely
  - Environment → GWP of H2 may have been underestimated (appr. 20-40 (20 yr. Horizone)
- **What are we doing?**
  - Feasibility for smaller vessels
  - Cost levels in different scenarios (liq H2 on par with e-methanol!)

Maersk principles for fuel sourcing
- under continous development

Feedstock & Energy

- ✓ **Only biogenic feedstocks** for biofuels
- ✓ **Only waste and residues as feedstock**
- ✓ No first generation feedstocks (corn, soy, rapeseed, palm, etc)
- ✓ **No feedstocks (1st and 2nd gen) related to palm oil industry**
- ✓ Only **biogenic CO2 point sources for e-fuels (or DAC)**
- ✓ Electricity for e-fuels must be **renewable and additional**

Certification

- ✓ All fuel must be certified by a **3rd party certification** body to safeguard sustainability and for documenting GHG footprint of the fuel
- ✓ Maersk **recognise ISCC and RSB** certification
- ✓ **GHG savings must meet EU minimum** thresholds relative to fossil fuels

Other issues

- ✓ We assess feedstock risks and indirect emissions **(iLUC)**
- ✓ We use **consequential LCA** to assess the consequences and indirect effects of our fuel sourcing

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The biggest challenges – for us

1. **Scaling production of green methanol fast enough *(short term)***
    1. Scaling ren. el & green H2 production fast enough → work closer with suppliers
2. **Having a continued increase in customers being willing to pay premium *(long term)***
    1. We do see exponential growth but we have 70.000 customers → work closer with customers
3. **A regulatory level playing field *(short/medium/long term)***
    1. Introducing a world wide carbon tax fast enough → work closer with regulatory actors

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Carbon neutrality will not come for free

– but the impact on consumer prices are marginal

Estimated average cost increase to attain full carbon neutrality

Automotive
USD 35,000 car

Electronics
USD 400 phone

Fashion
USD 50 jeans

Source: BCG, the Boston Consulting Group

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Thanks!

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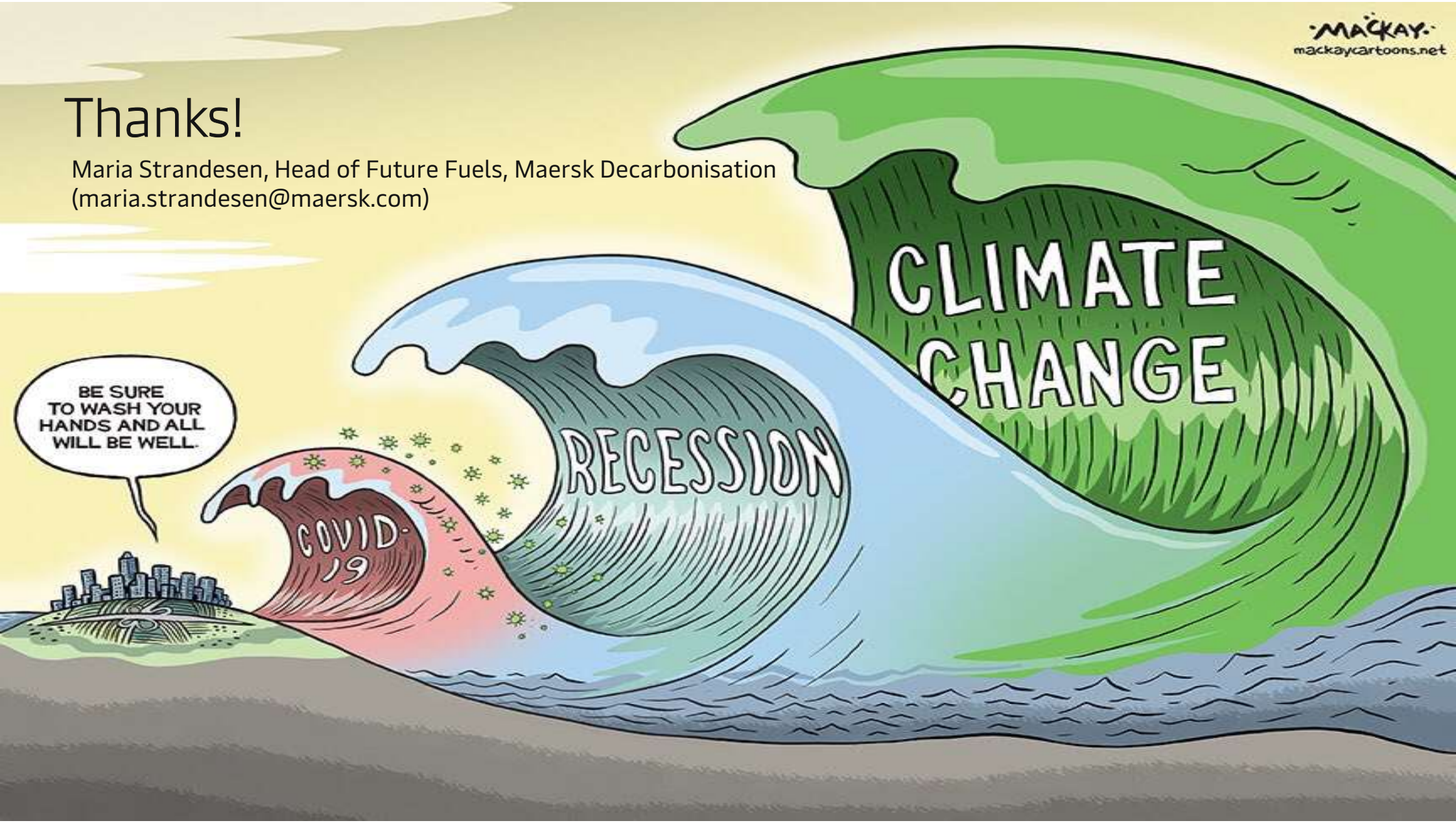
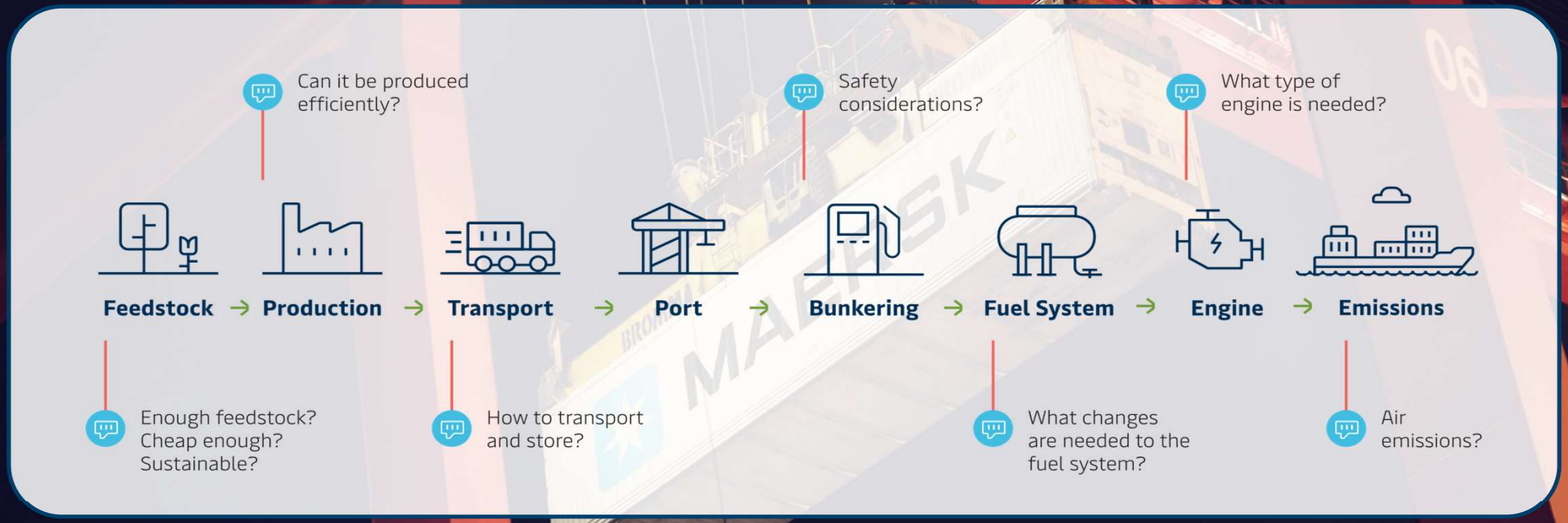


New fuels are not enough
- we need to build a new ecosystem



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