Challenges and new perspectives for the maritime industry

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HYDROGEN & ELECTRIFICATION IN SHIPPING

Energy for ship propulsion

→ Using what we have “free of charge”----- how far does this bring us?

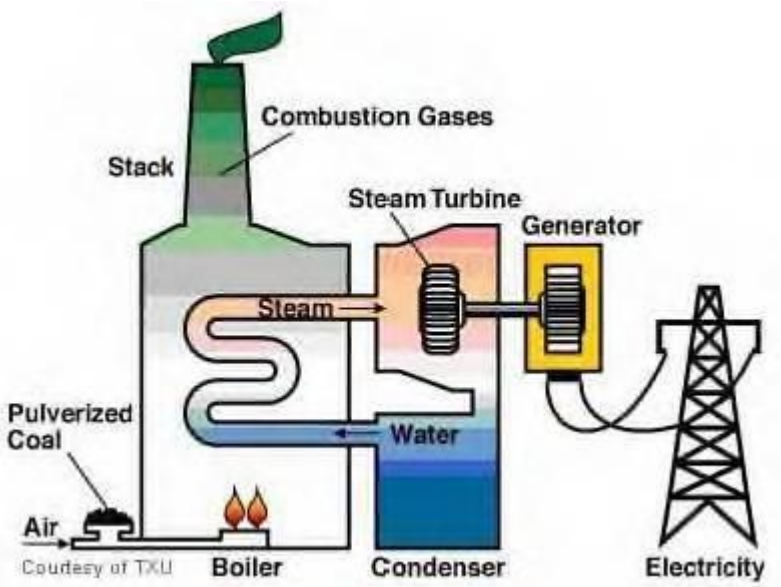
- 5% to 30….50%?

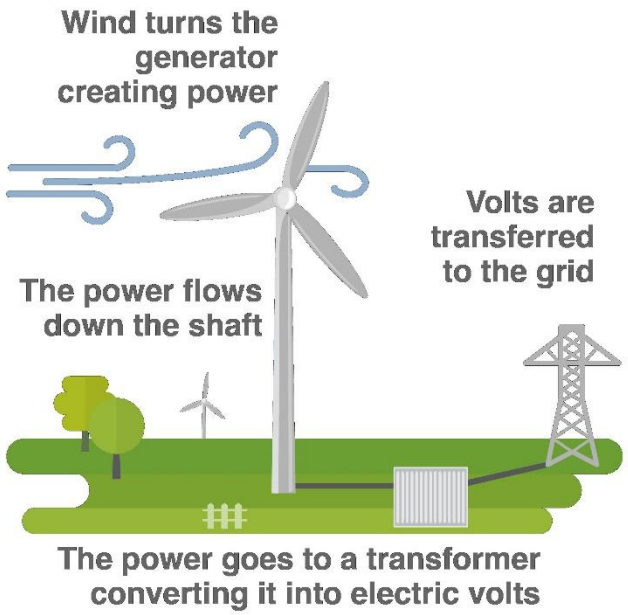
Depending on application and vessel segment!

- “storage” not a topic….but the availability

Converting energy –“THE” building block of industrialization

→ Going from fossil source to renewable is the challenge of the 21 century





NC SUSTAINABLE ENERGY ASSOCIATION

- keep it simple

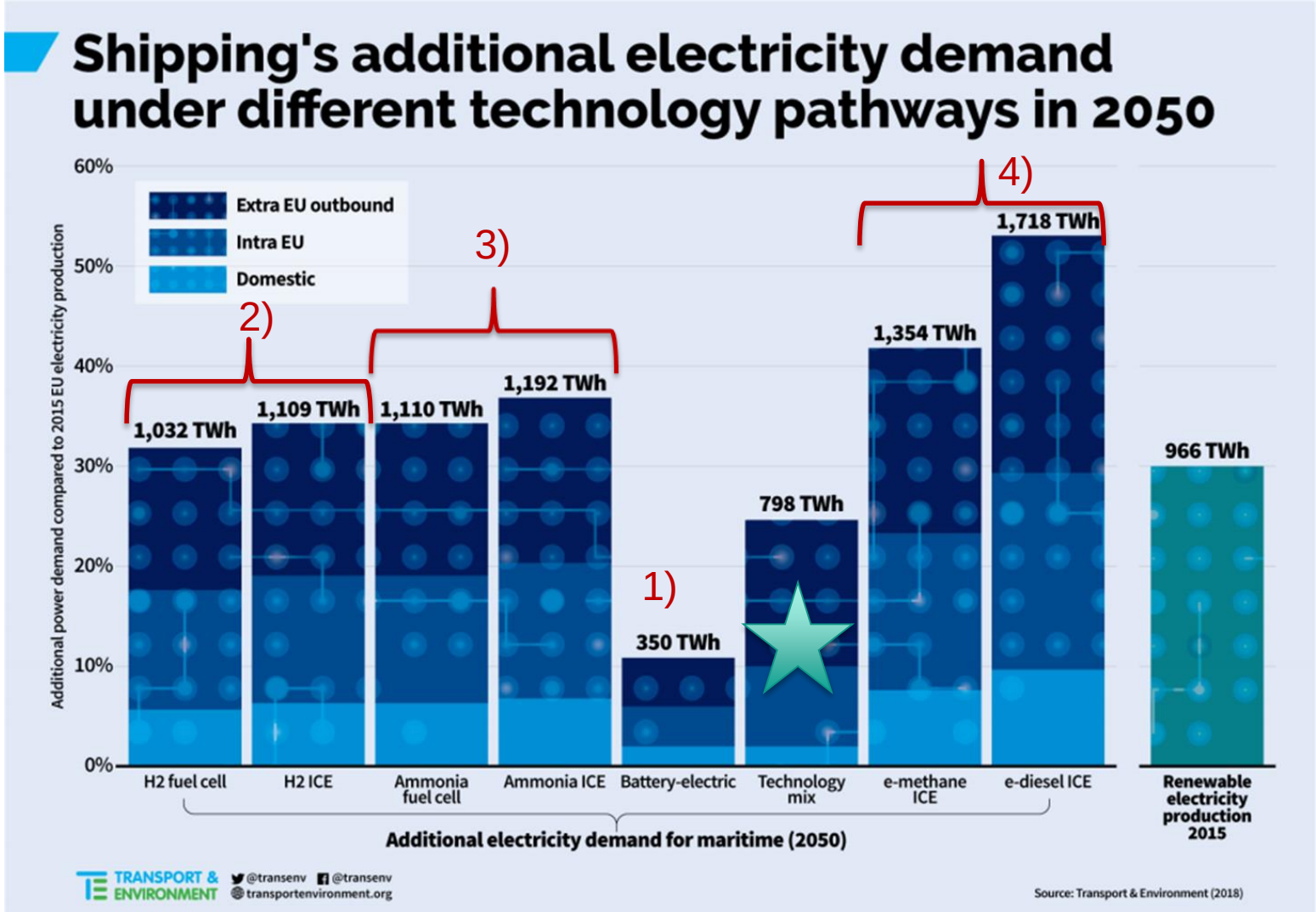
Electricity is highest value energy:

- highest conversion efficiency
  - for kinematic energy
  - Heat/cool etc.

but electricity is:
- …hard to store
- …difficult/expensive to transport

…if shipping in the EU could use electricity

→ it would reduce primary energy need BIG SCALE!



1) Electricity has the lowest possible energy demand for well to wake:

- lower then fossil fuels
- zero emission on the ship

2) H2 is second best!

- but 3x as much electricity needed for production
- hard to store and transport

3) NH3 next in line

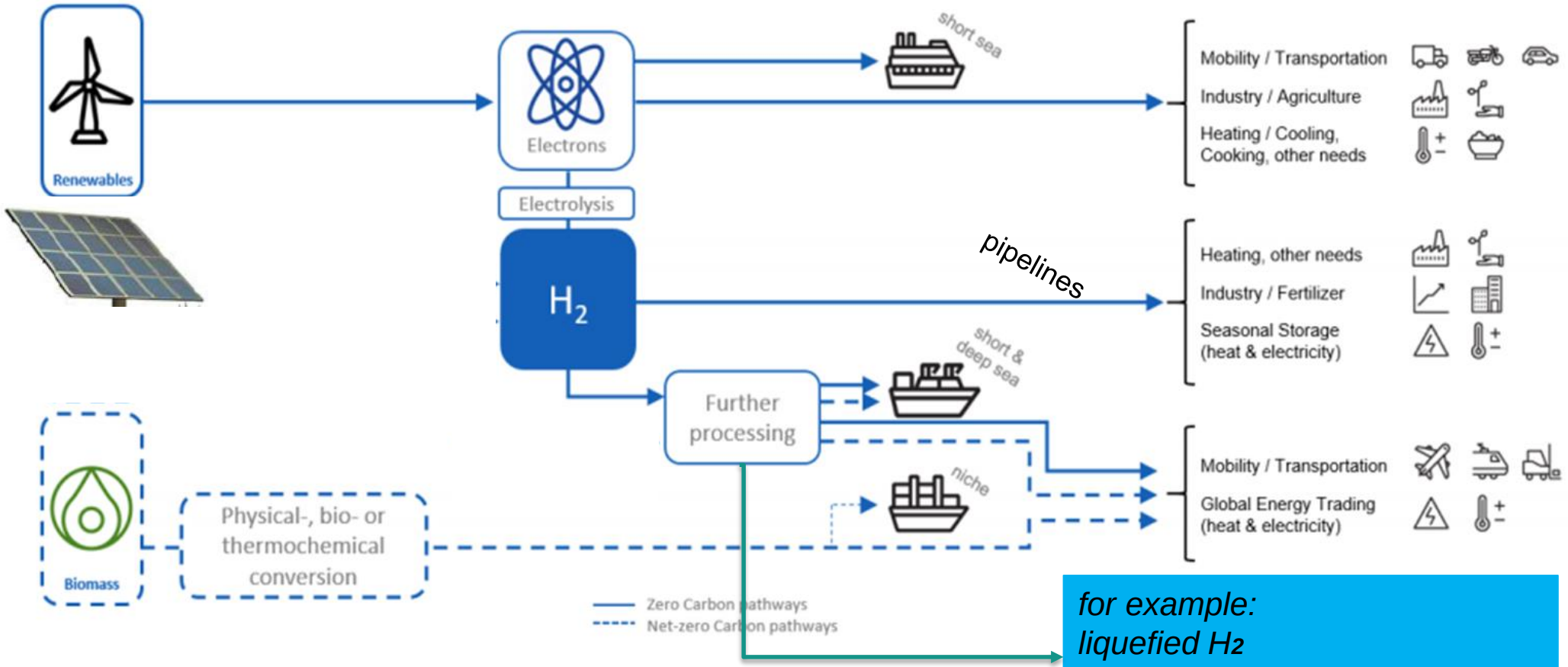
- better to store and transport
- no drop in capabilities

4) E-fuels (liquid and gaseous)

- Less efficiency (4x e-need)
- ..but drop in capabilities with existing supply chains and ship propulsion solutions

Carriers for renewable electric energy

Direct use of electricity always most efficient balance



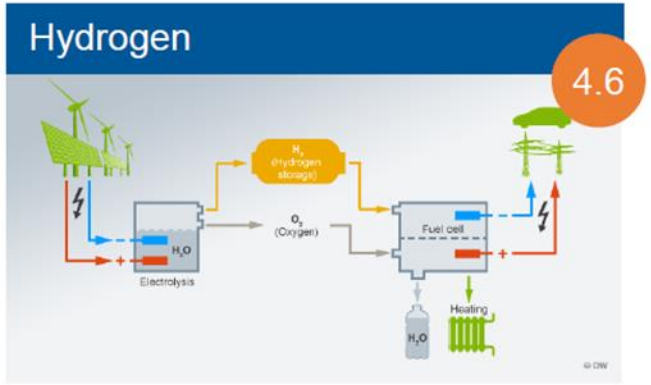
for example:
liquefied H_2
Ammonia
Methanol
E-fuels (liquid "Diesel" and CH_4)

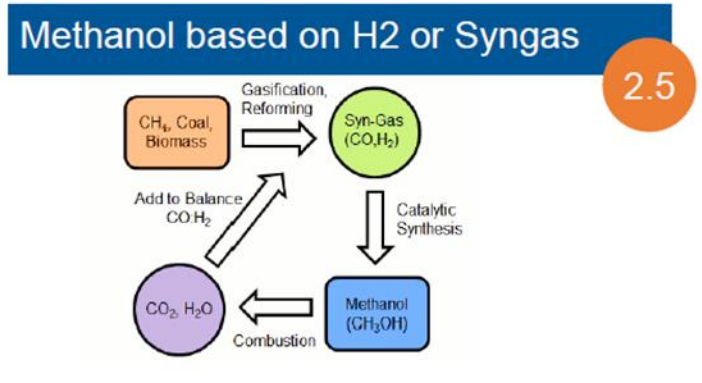
Increasing energy intensity

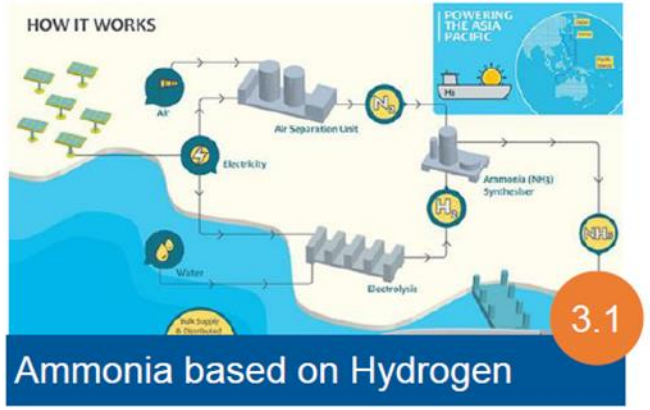
(Source: ABB, 2020)

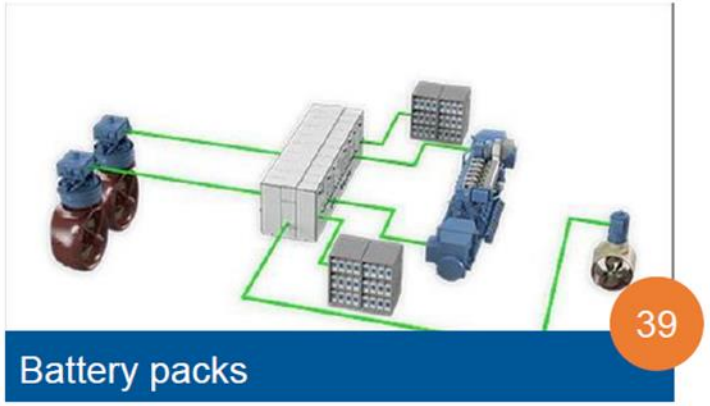
Understanding storage density of energy

the problem for high power applications







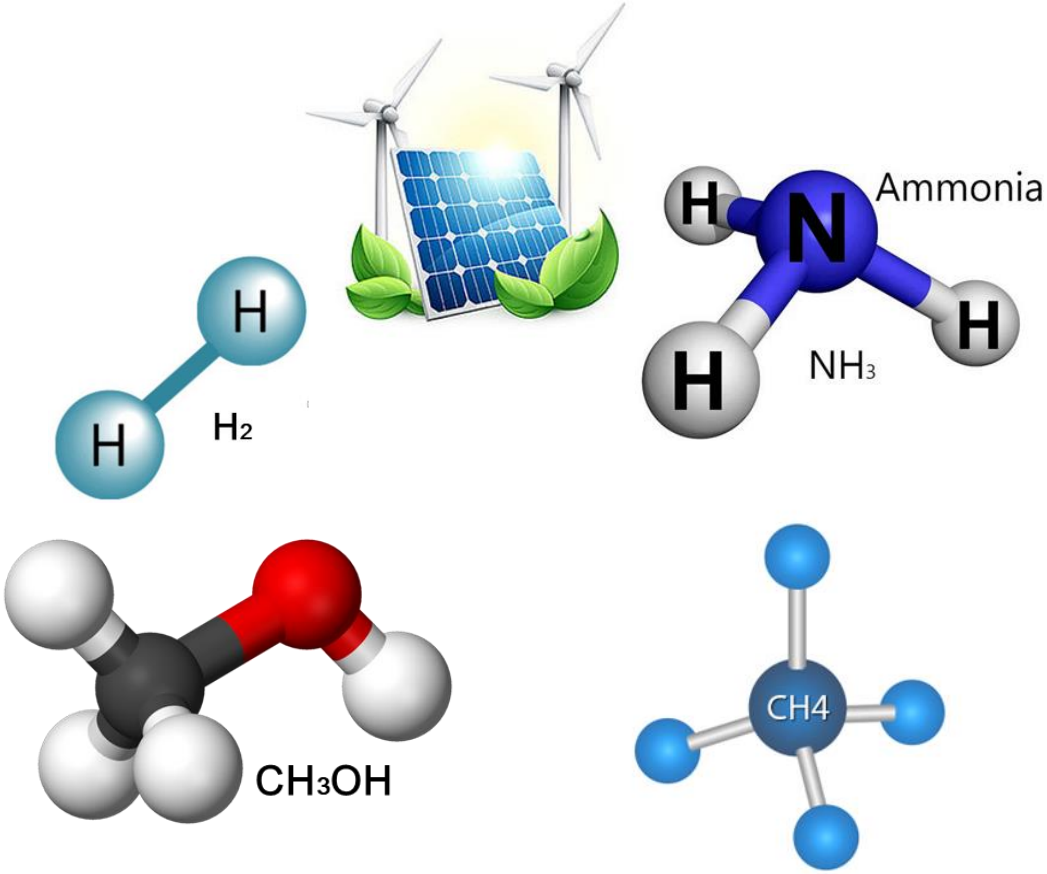


Different fuels for different applications

→ Electrify as much as possible short sea shipping

→ Hydrogen as fuel in limited niches where batteries are not applicable anymore

→ Use hydrogen carriers (Ammonia, Methanol, e-fuels) for deep sea applications



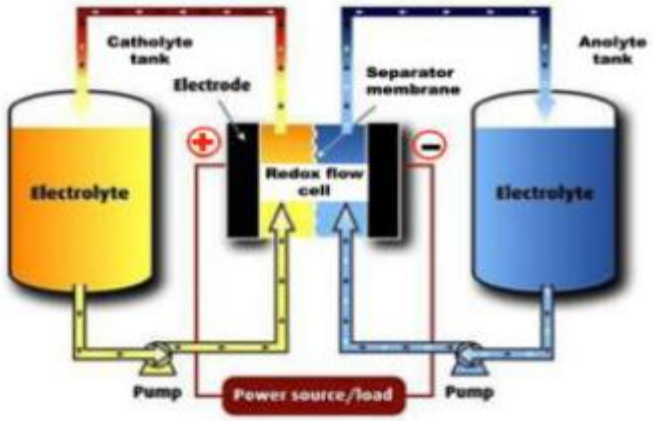
- H_2 problematic to store and transport in bulk
- Ammonia “sexy” as no carbon in exhaust but toxic and no proven energy converters available; technology not ready yet for ship fuel application
- Methanol easy to store, efficient to produce and transport; CO2 in the production process needs to be sourced from biological sources to achieve carbon neutrality; proven energy converters available; no drop in capabilities
- E-fuels have lowest production efficiency; supply chains are available; drop in capable; the only fuels which can be used by todays existing tonnage

Hydrogen & Electrification

→ Proven technology available for ship propulsion

→ Further innovation for electric storage expected

→ Scaling of fuel cell technology in the make



as fuel

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