Electrofuels for maritime transportation

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Electrofuels IEA Workshop

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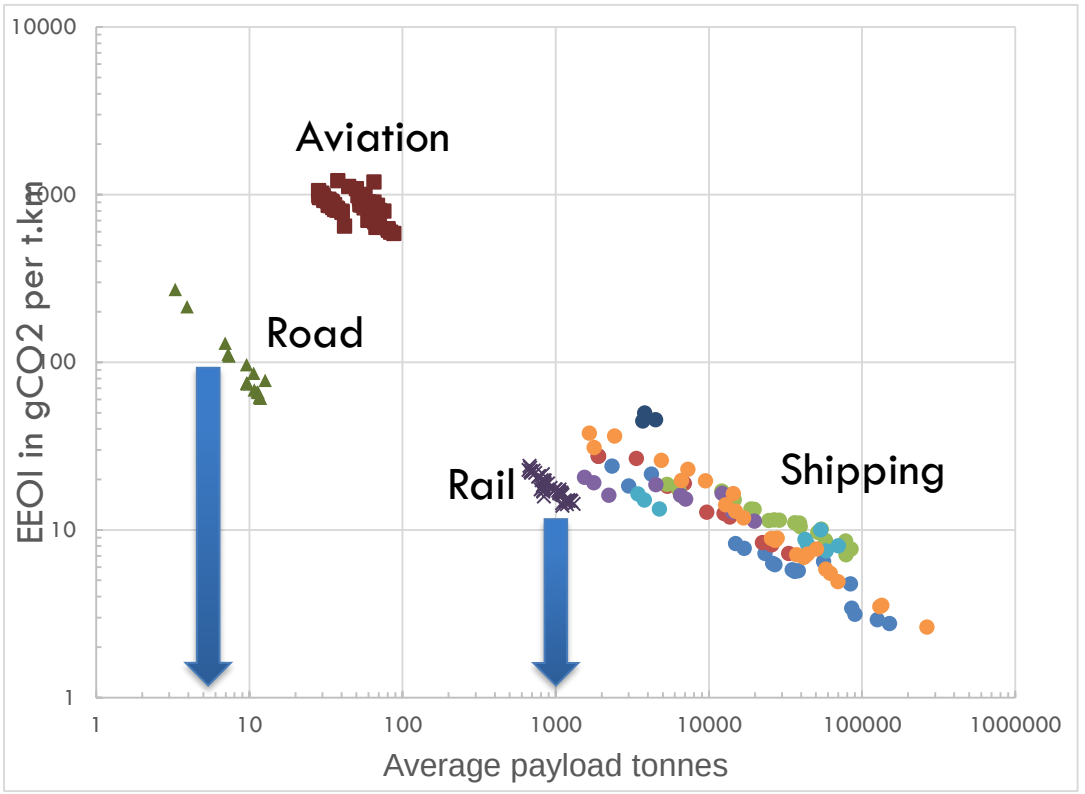
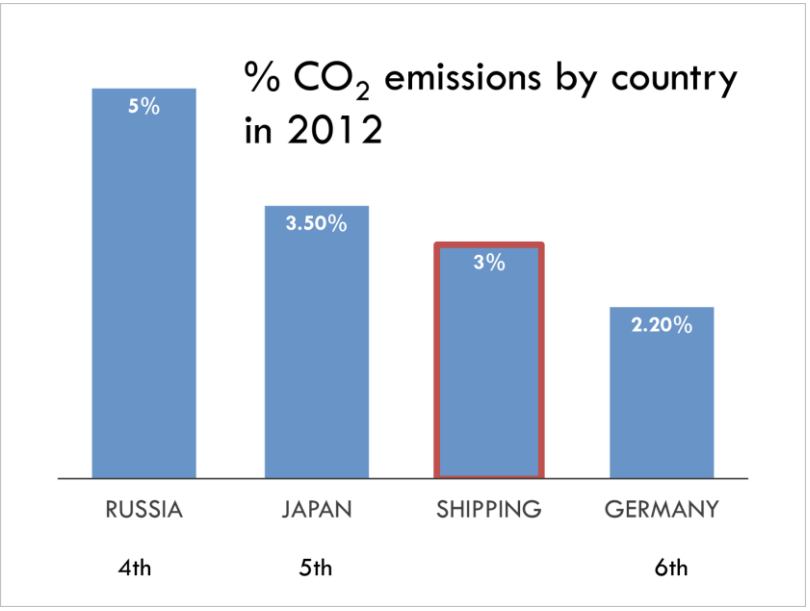
Maritime consultancy delivering applied solutions for a carbon constrained future

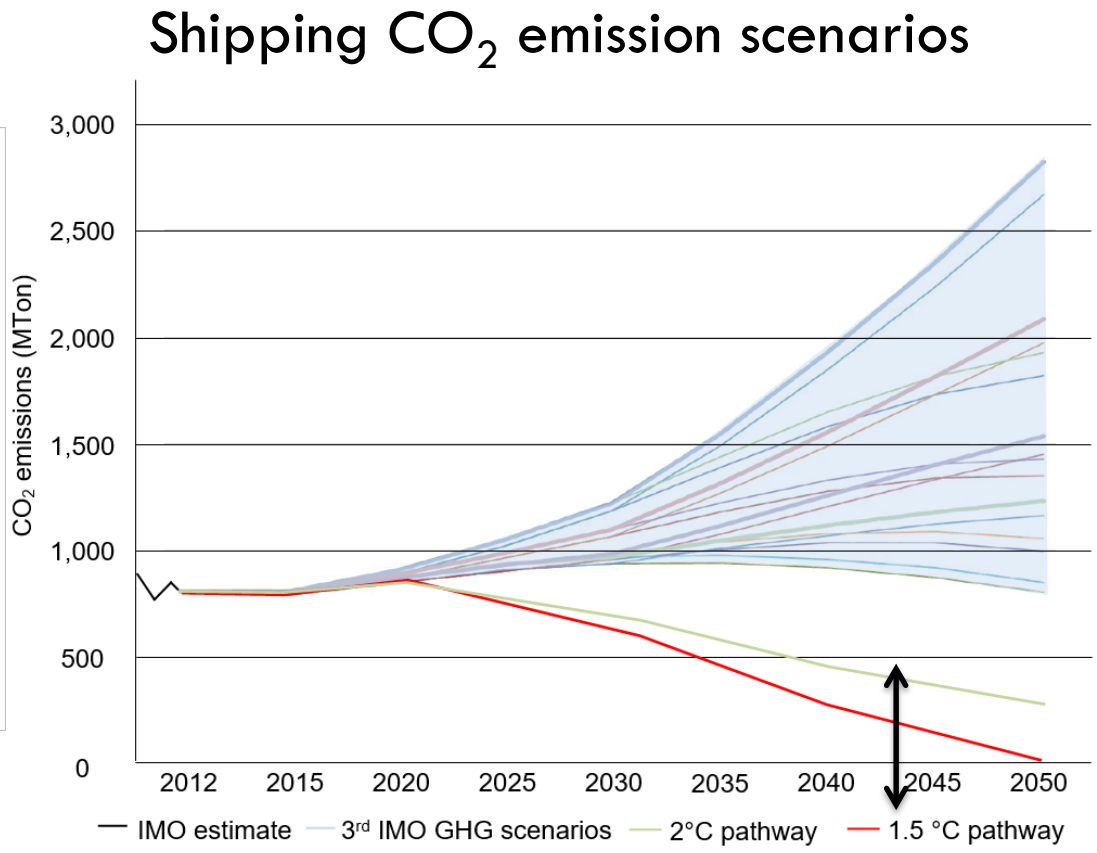
Shipping, the 'greenest' mode of transport?



Source: MEPC 68 Inf. 24

Shipping could reach 10-15% of the total CO_2 emissions in 2050





IMO signs intent to reduce emissions to at least 50% of 2008 levels by 2050

The initial IMO GHG strategy

.1 ***carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships***

to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;

.2 ***carbon intensity of international shipping to decline***

to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and

.3 ***GHG emissions from international shipping to peak and decline***

to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision as a point on a pathway of CO_2 emissions reduction consistent with the Paris Agreement temperature goals.

Source: IMO MEPC 72

A range of potential operational and technical interventions

Operational

Speed – "slow steaming"

Technical

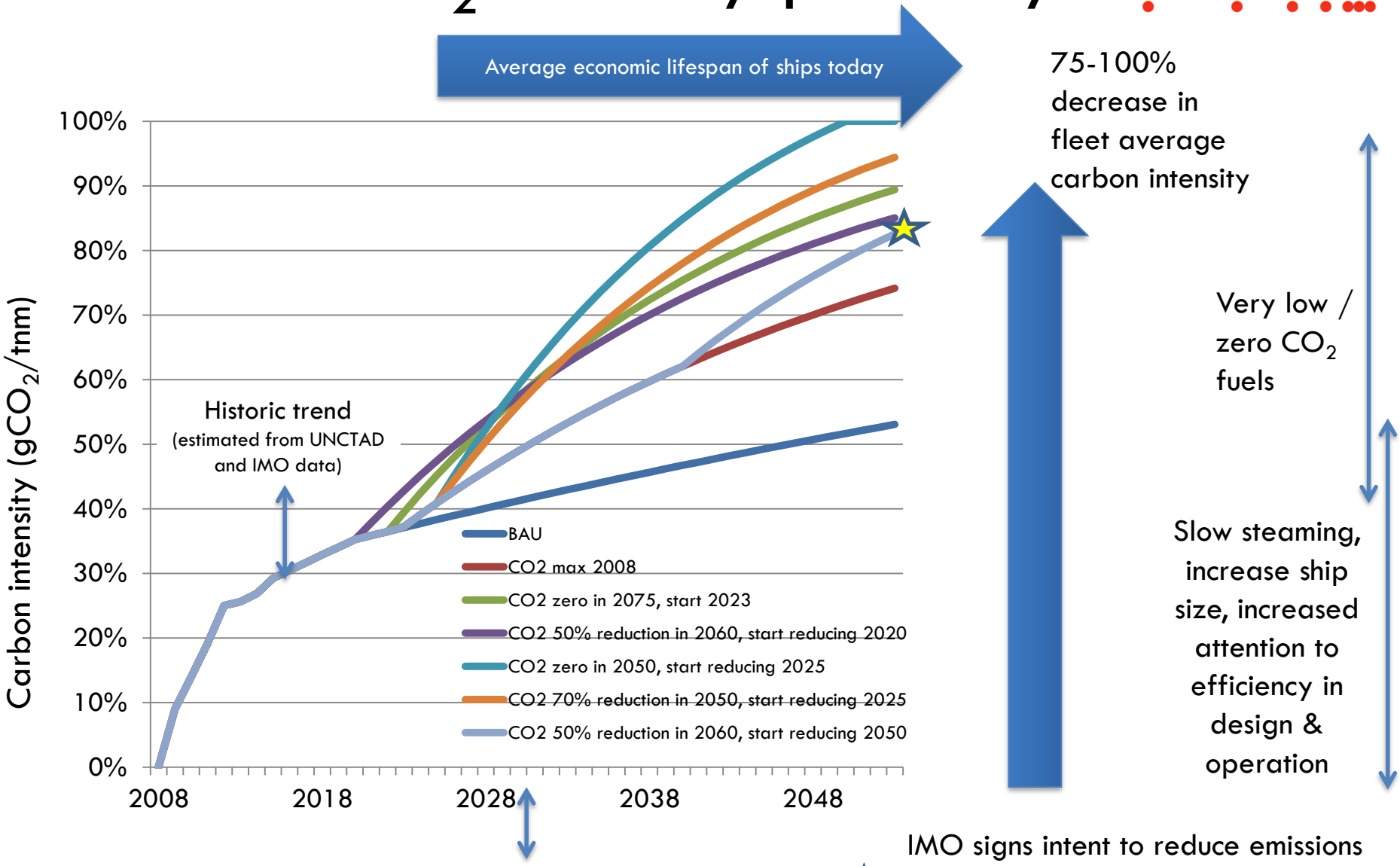
Energy efficiency technologies

- Rudder Bulb
- Preswirl Stator Duct
- Trim and Draught Optimisation
- Vane Wheels
- Contra-rotating Propeller
- Tip Loaded Propeller
- Stern Flaps
- Biocide Hull Coating
- Foul Release Hull Coating
- Steam WHR
- Organic Rankine Cycle WHR
- Engine Tuning
- Engine Derating
- Common Rail
- Autopilot Upgrade
- Air lubrification
- Wind assistance

Engines and fuels

- 2 /4 strokes
- Fuel cells
- Electric motor
- Gas turbine
- LNG/BioLNG
- Biofuels/ Bio-methanol
- Hydrogen
- Ammonia
- Batteries/Electricity

Estimated CO_2 intensity pathways

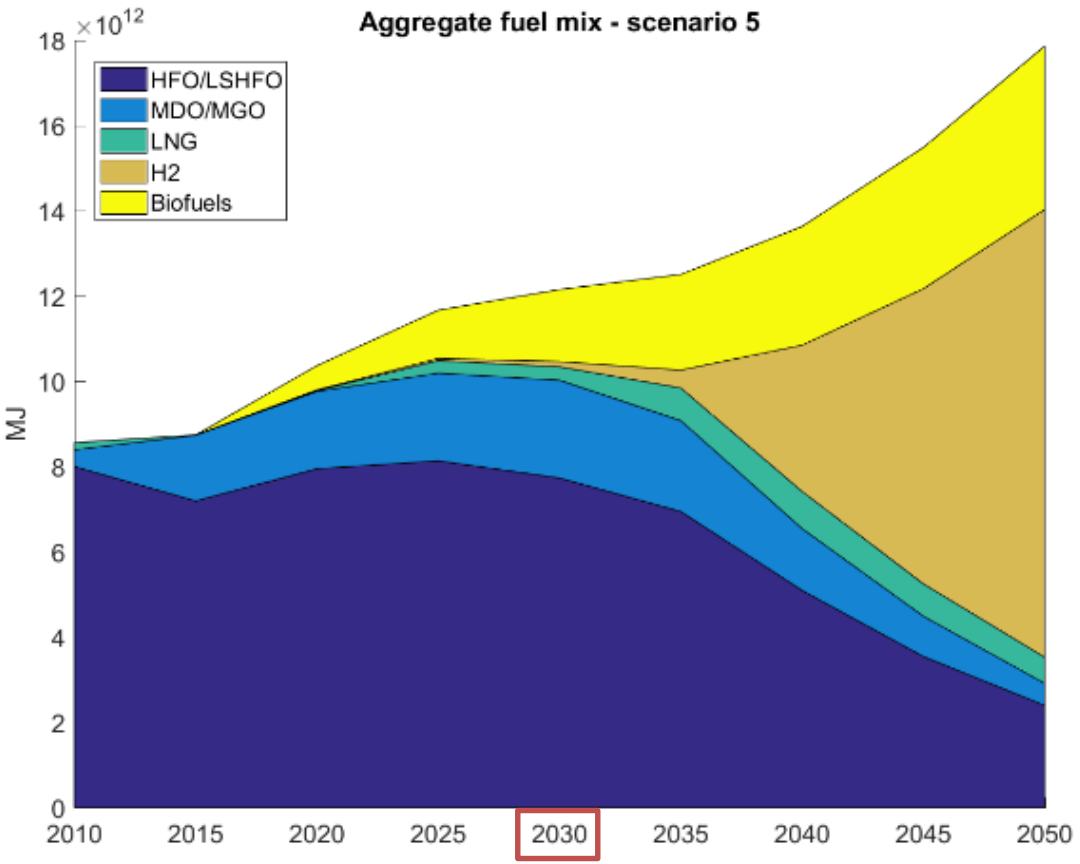


Fuel mix for a 2 degree compatible pathway

-The fuel mix progresses beyond FO/MDO with a gradual increase of biofuel used in blends

-LNG is taking up and then progressively, a quantity of Hydrogen.

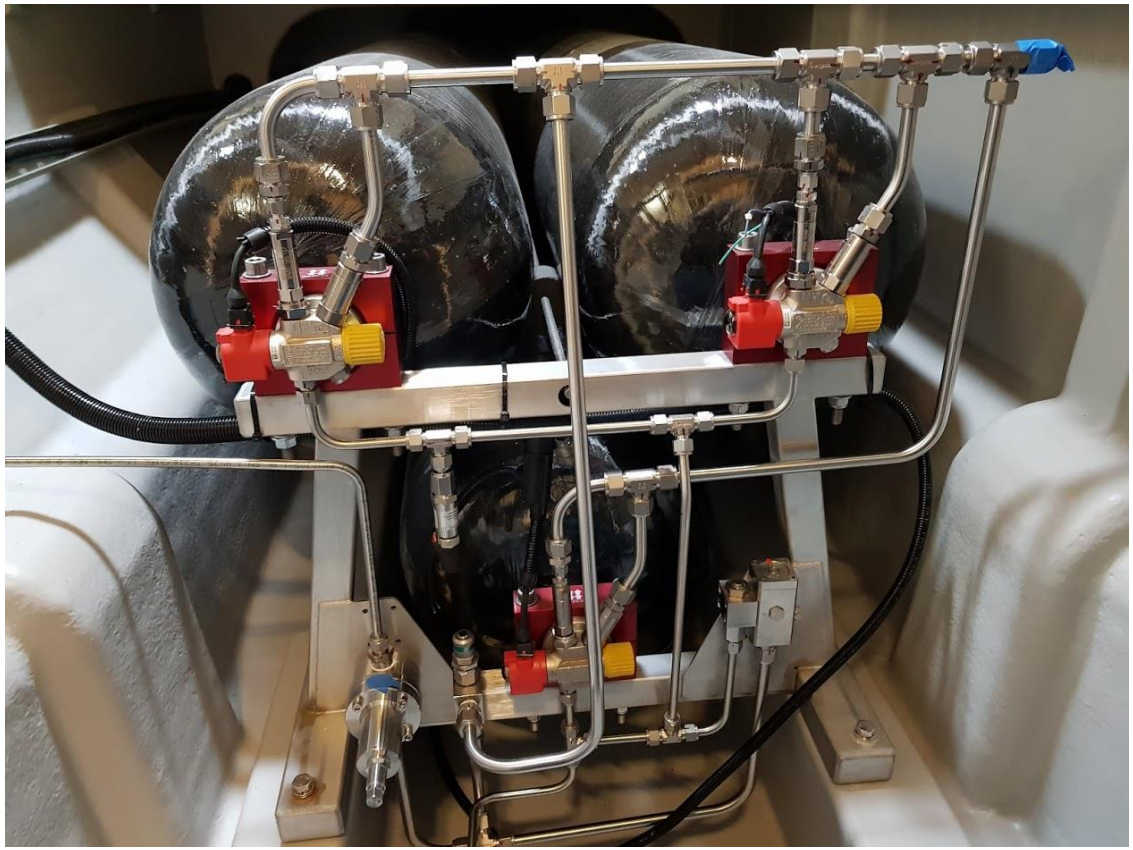
-Hydrogen is used as a proxy for renewable fuels generally (so this could include renewable methanol and ammonia).



Shell and ITM 10MW Electrolyser - online from 2020

"The Rhineland 10 MW system will be the largest PEM electrolyser in the world. It represents the maturing of PEM technology for large scale, industrial applications." Graham Cooley CEO ITM

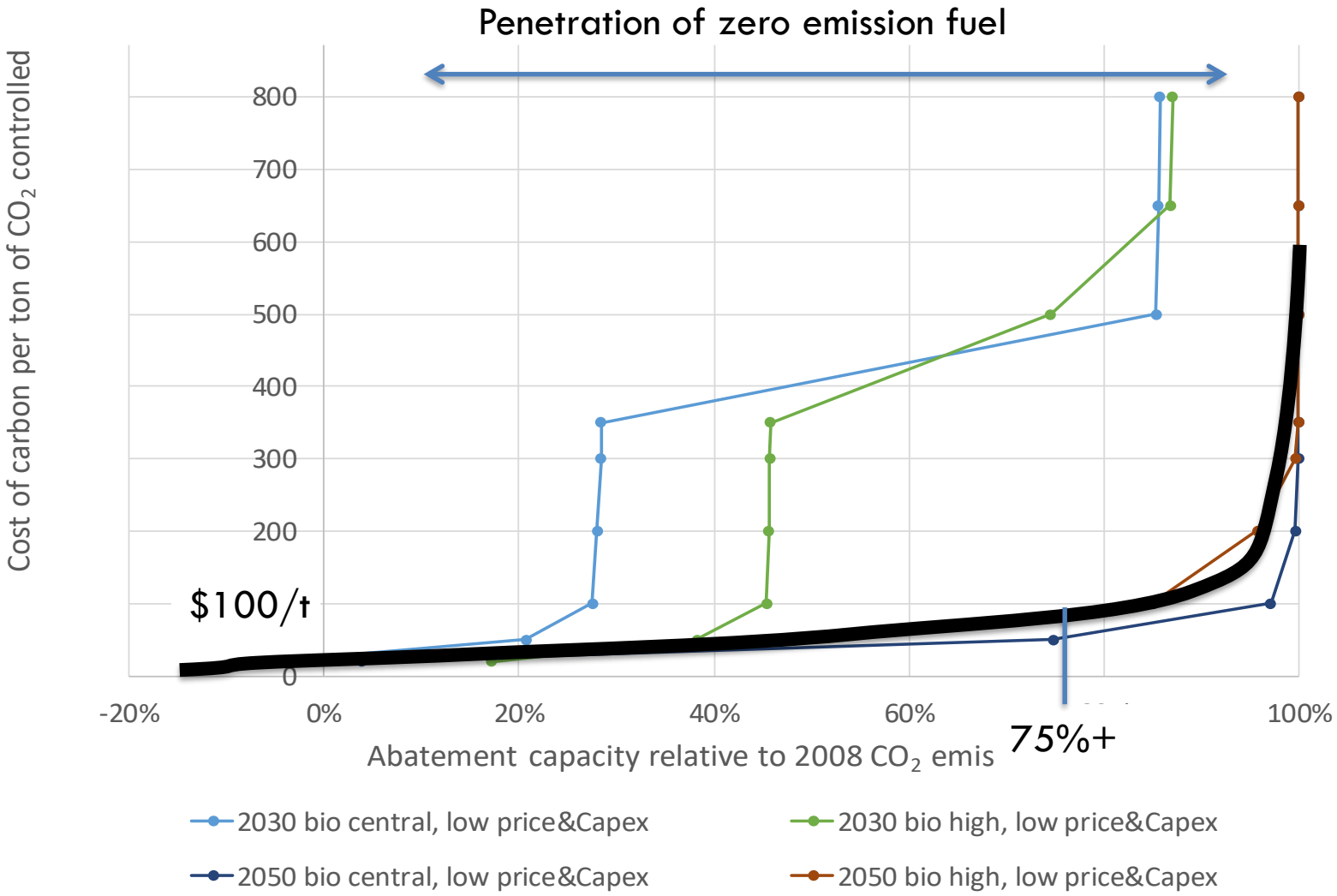
Hydroville



The price of renewable electricity drives the price of renewable marine fuel

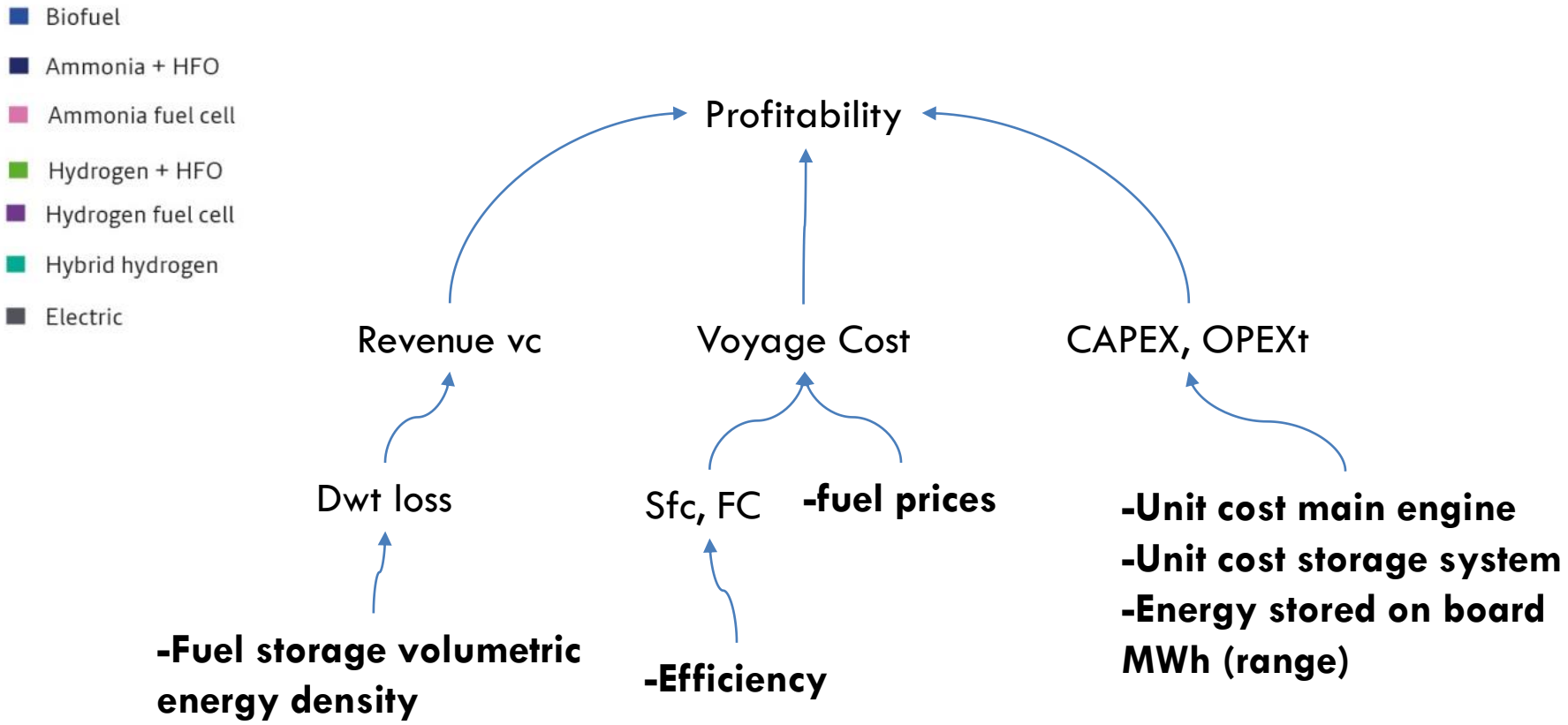
Electricity price ($/MWh)	Hyrdogen price ($/t)	Energy quivalent HFO/MDO price ($/t)
$60/MWh	$3000/t	$945/t
$30/MWh	$1700/t	$540/t

Low renewable fuel price



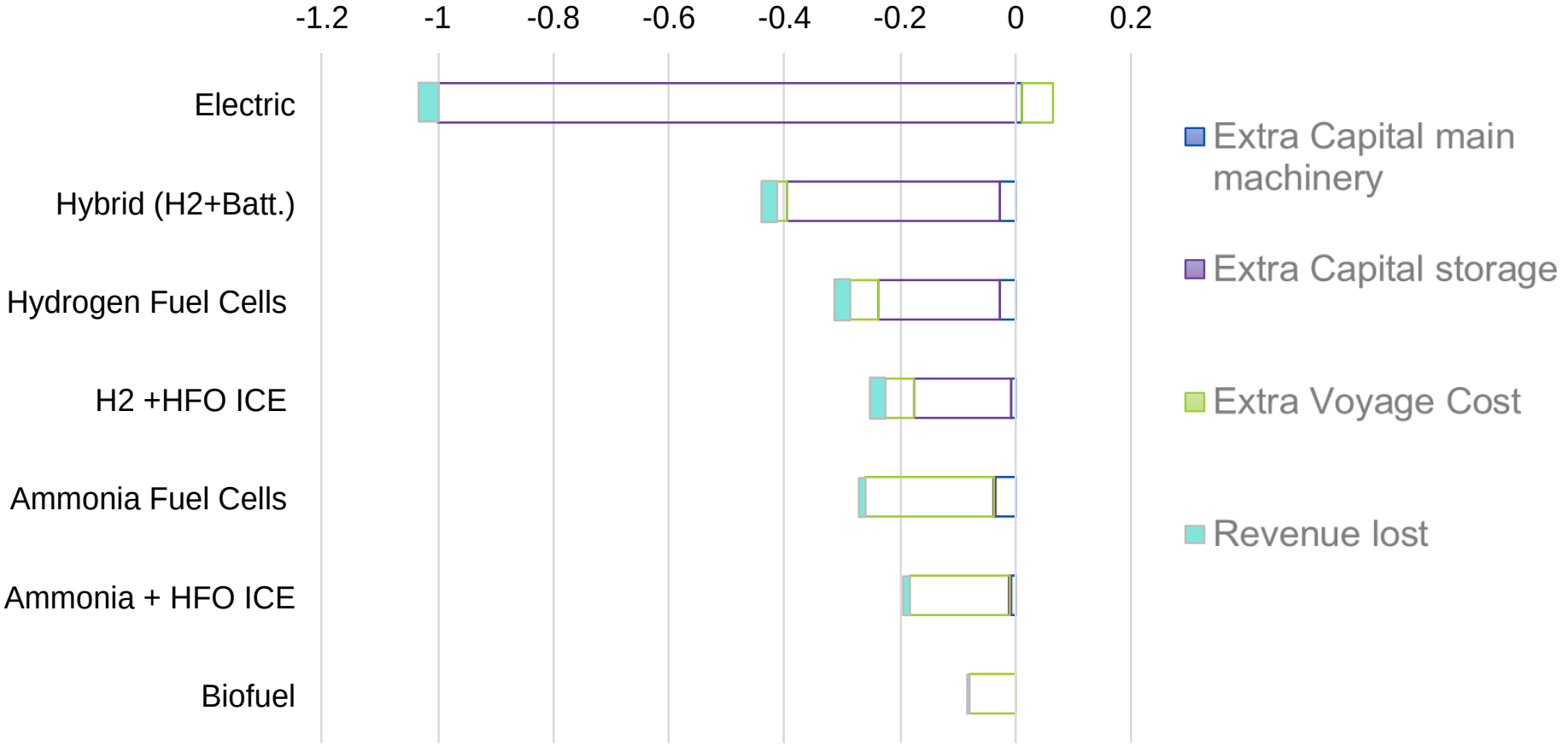
ISWG 3-3

An economic evaluation of Zero Emissions Vessels



Cost changes

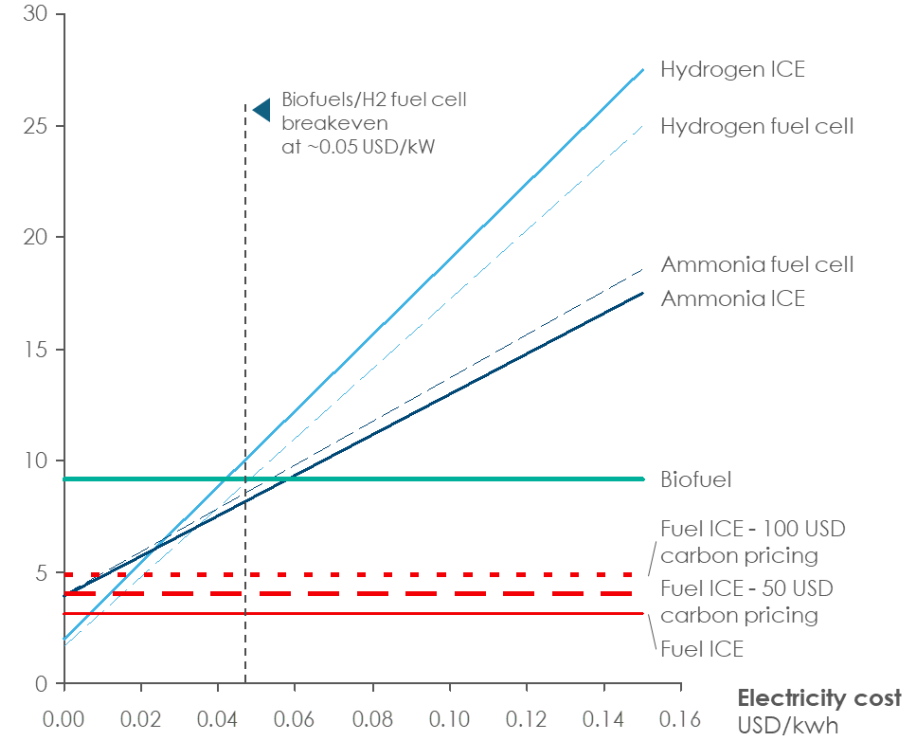
How costs change relative to a conventional ship (9000TEU container)



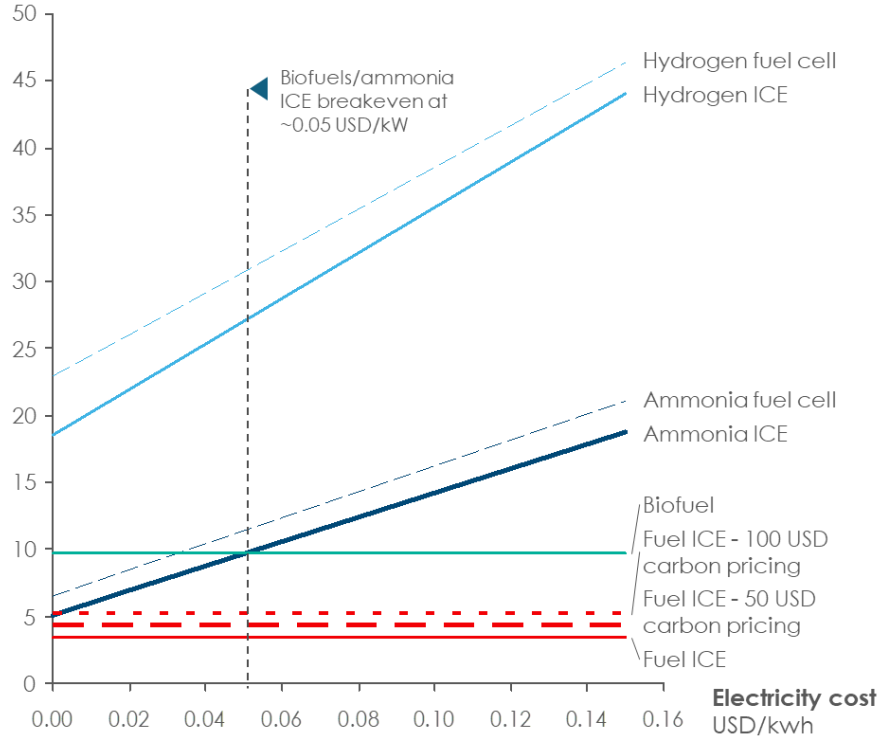
Green Ammonia would be competitive vs. biofuels if electricity is below 0.05 USD/kwh

Zoom on bulk carriers cost – sensitivity on electricity cost

Voyage cost – 2030
Million USD

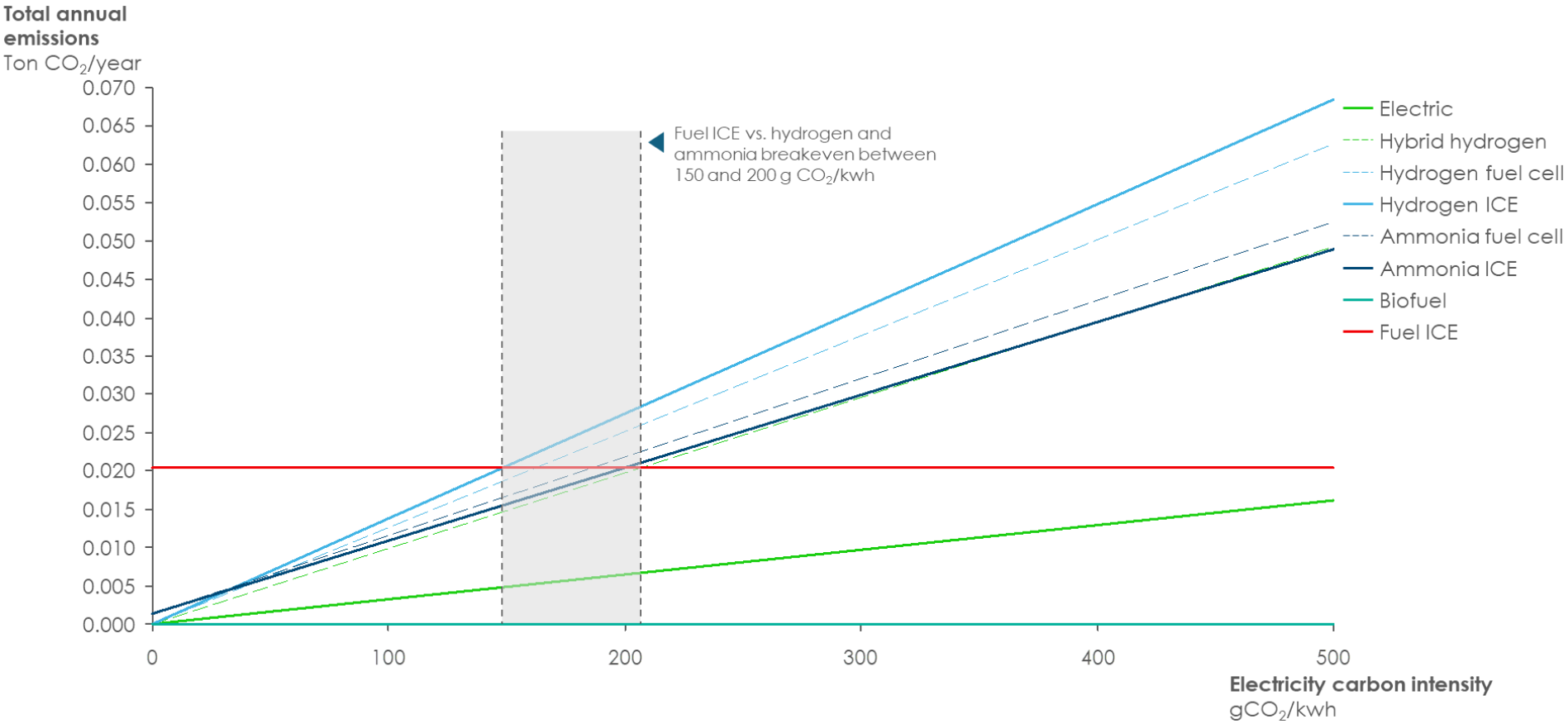


Total cost – 2030
Million USD



SOURCE: Lloyd's Register & UMAS, 2017. Zero-Emission vessels 2030, ETC PMO analysis.

Hydrogen and ammonia emit less than HFO if the carbon intensity of electricity is below 200 gCO2/kwh



SOURCE: Lloyd's Register & UMAS, 2017. Zero-Emission vessels 2030, ETC PMO analysis.

Conclusions and further research

- Narrow down the options with the associated pathways for implementation and adoption
- Understanding of how the shipping industry could cooperate with the energy sector, trying to find overlaps with other sectors needs of storage and demand management requirements.
- How the development of the candidate future marines fuels infrastructure would need to be coordinated with the growth and development of a compatible fleet.
- Newbuilds only, or newbuilds and retrofits? One winner for all ship types?
- Role of existing, interim and transition technologies

Thank you

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UMAS

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