Perspectives for zero-carbon fuels

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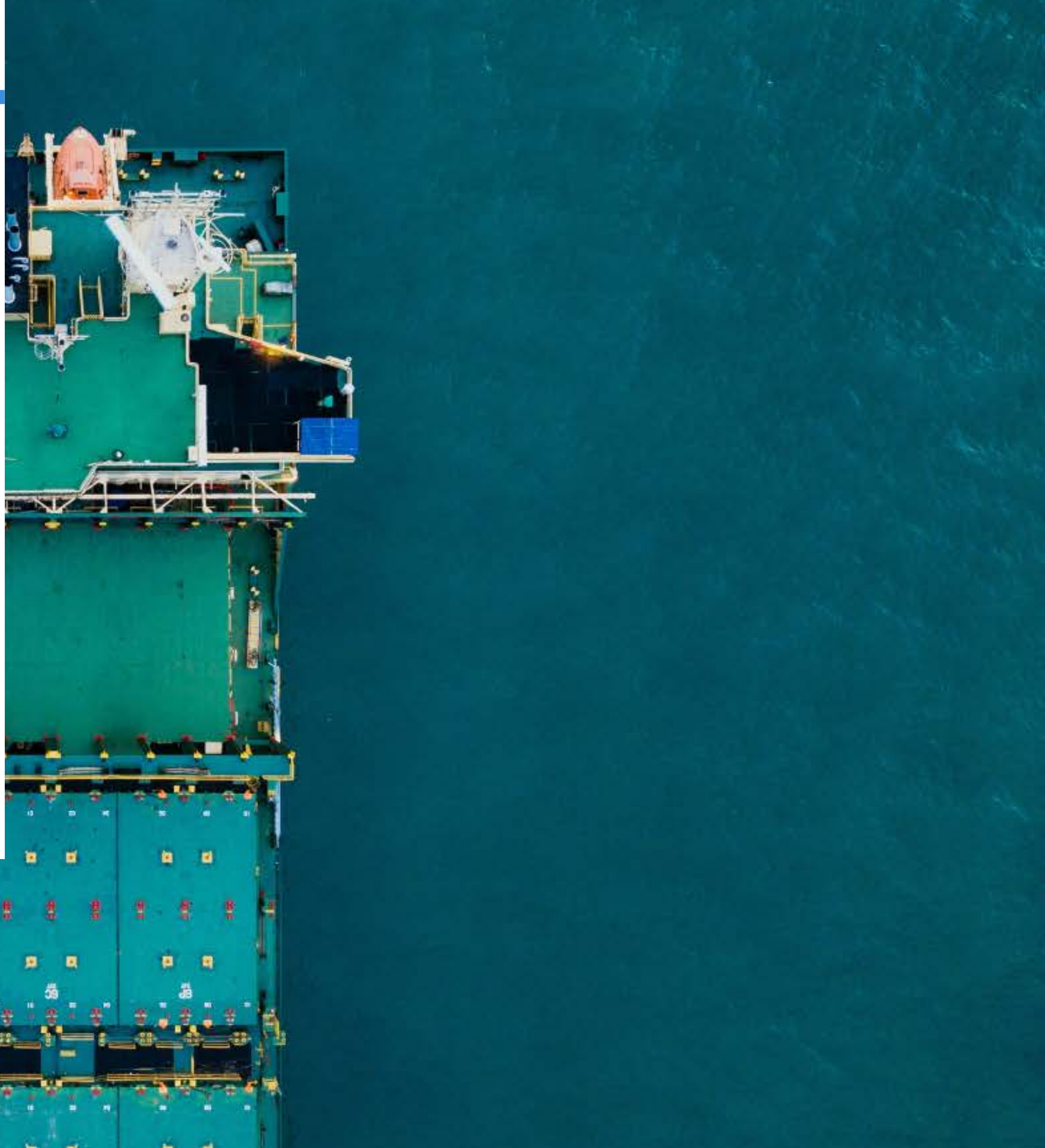
ITF – Decarbonising shipping workshop

26th & 27th November 2018

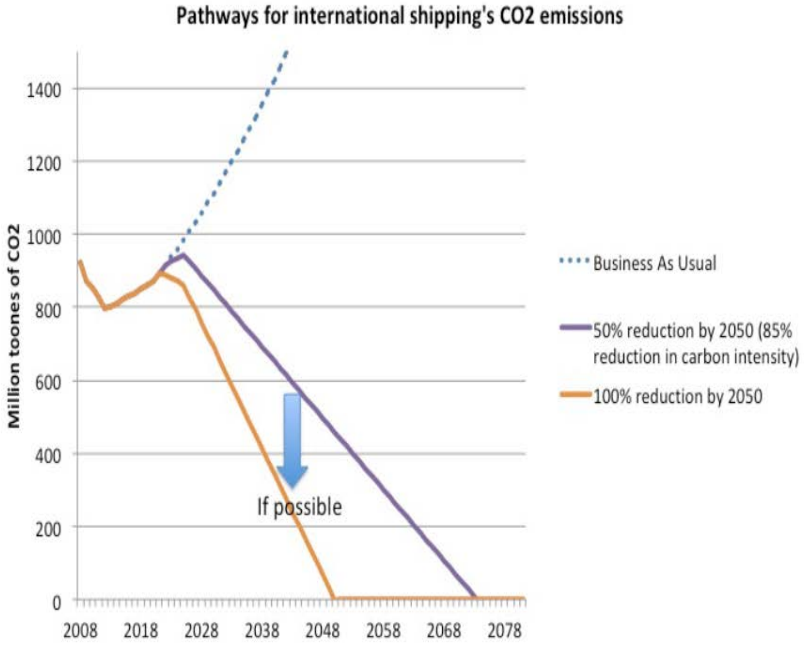
Lloyd's Register



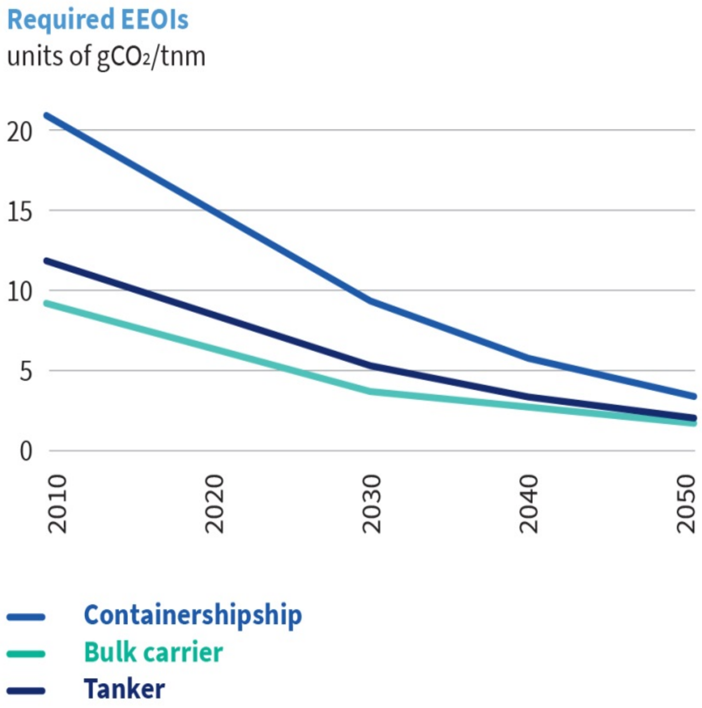
Why are low – zero carbon fuels needed for full decarbonisation?

To achieve an absolute reduction in CO_2 emissions of 50% by 2050

Zero-emission vessels need to be entering service by 2030



At least 50% reduction by 2050 which equates to around 85% reduction in carbon intensity



What do we mean by low – zero carbon fuels?

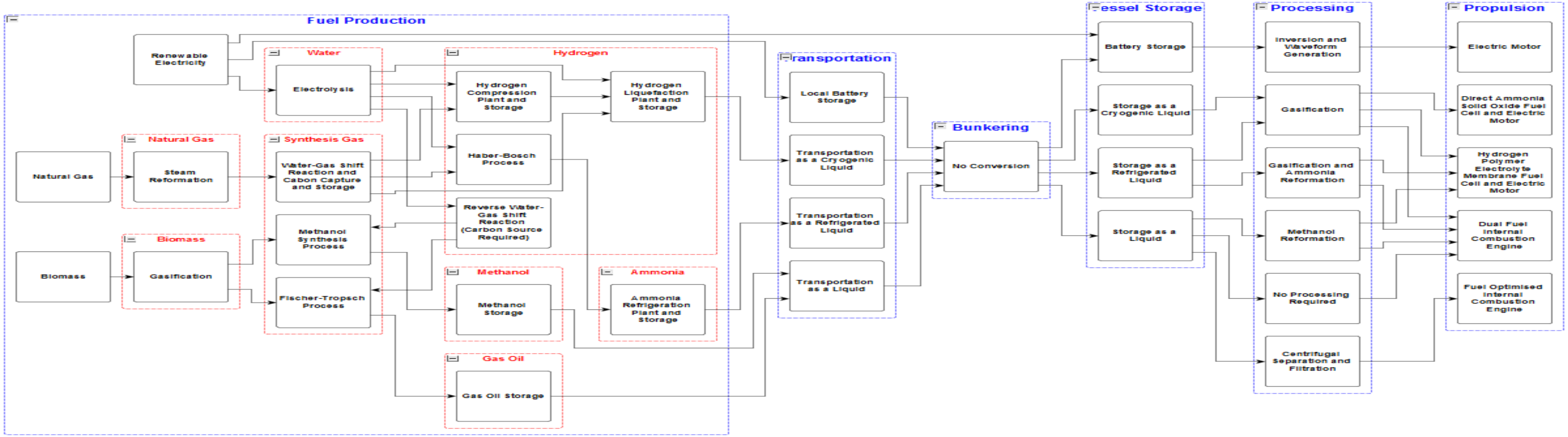
Transition to zero emission vessels means phasing out fossil based fuels

Rapidly changing world of new fuels, energy storage, power conversion and control systems

Energy Source	Low – zero carbon fuels				
	Methanol	Gas Oil	Hydrogen	Ammonia	Electricity
Natural Gas (with or without CCS)			NG – H2	NG – NH3	
Biomass	Bio-methanol	Bio-gas oil			
Renewable Electricity	E-methanol	E-gas oil	E-H2	E-NH3	Batteries

Considerations for switching to low-zero carbon fuels

Not only viable from a commercial perspective but are also technically feasible and can be safely adopted and operated



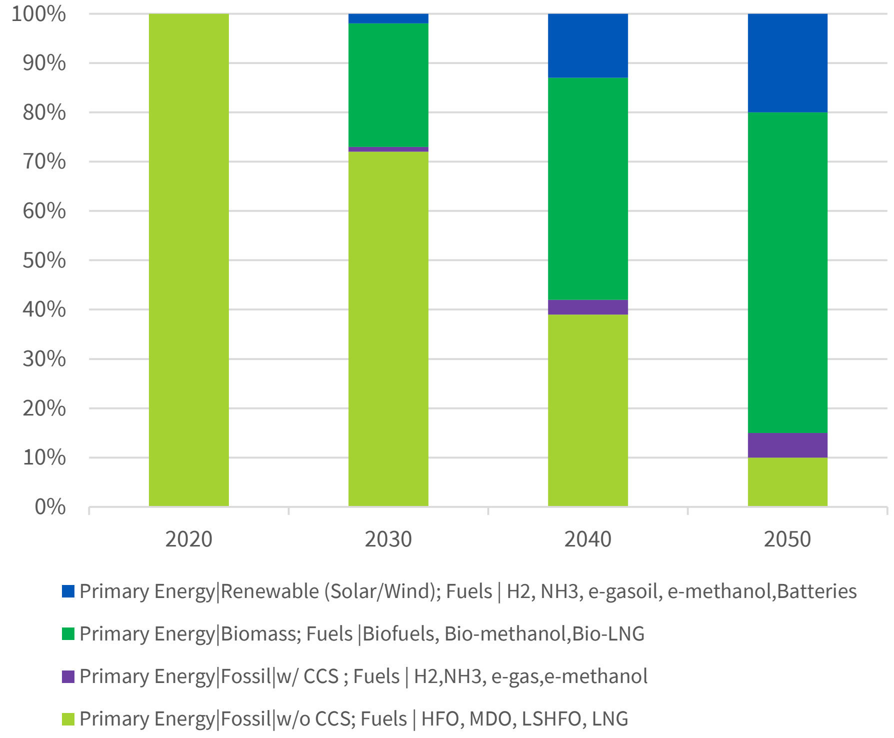
Production & Supply

- A fuel with low-zero upstream emissions
- Sustainability of source
- Production and distribution (costs and prices)
- Technology costs/readiness
- Availability

Marine application

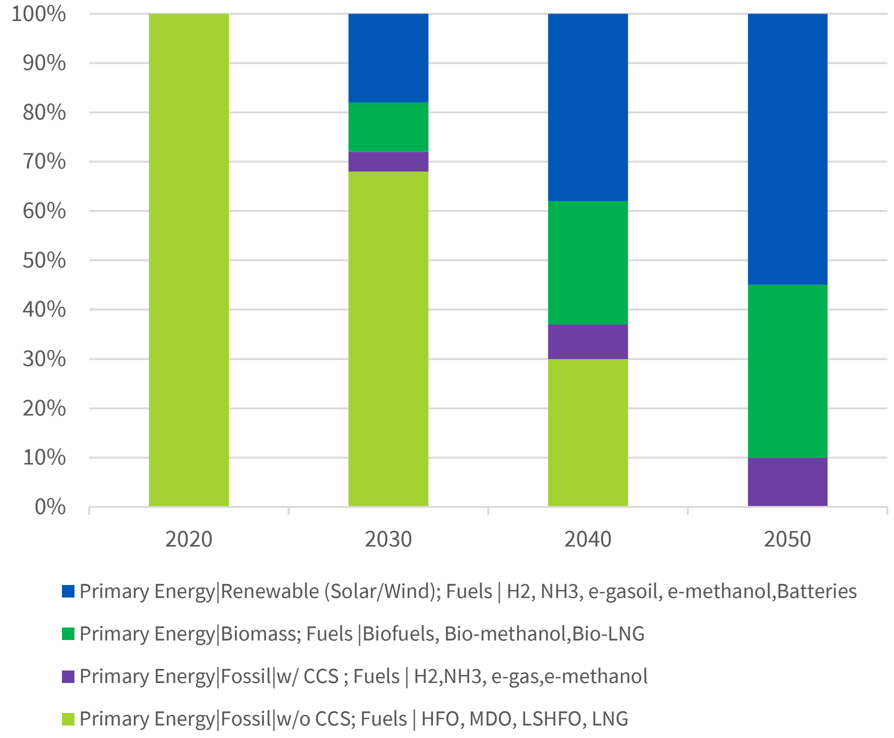
- A fuel with low - zero operational emissions
- Safety
- Storage/Space requirement
- Specific fuel consumption (Energy content of the fuel and efficiency of the main machinery)
- Technology costs/readiness

Bio-energy transition pathway



- Bio-energy capacity will need to grow significantly, be global and shipping will need to have a share,
- Price/energy content of any biofuels will drive the economic advantages,
- The production and distribution needs to be proven to be sustainable,
- Blend standards may be required,
- In 2030 prices at a level of ~60% of HFO prices in terms of $/ton.

Renewable electricity transition pathway



- A complete zero emissions system in 2050,
- At a price of about 19 $/MWh, ZEVs using electro-based fuels are as competitive as bio-based fuels,
- Environmental concerns around bio-based fuels and CCS tech, would favour electro-based fuels,
- E-H2 vs E-NH3 trade-offs is dependent on how hydrogen storage systems develop,
- Safety aspects of fuel handling & storage within acceptable limits.

Preliminary findings

Zero- emission vessel transition pathways

All are likely to achieve the IMOs level of ambition.

- A strong link between the evolution of the fuel supply and the evolution of the fleet,
- All potential pathways have a mix of fuels in 2050 but with different dominant fuels,
- Liquid biofuels and liquid e-fuels maybe more suitable for shipping,
- Batteries play a minor role as suitable only for very small ships and short distances,
- First adopters driven not only by the economic and policy pressure but also by expected environmental consumer pressures,
- Gradually ships would be designed to store less energy onboard and refuel more often.

2020 – 2030 is the most significant decade stressing the urgency for early action

Perspectives on alternatives fuels for full decarbonisation

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