



WHEN TRUST MATTERS

Simple monofuel past



Complex multifuel future

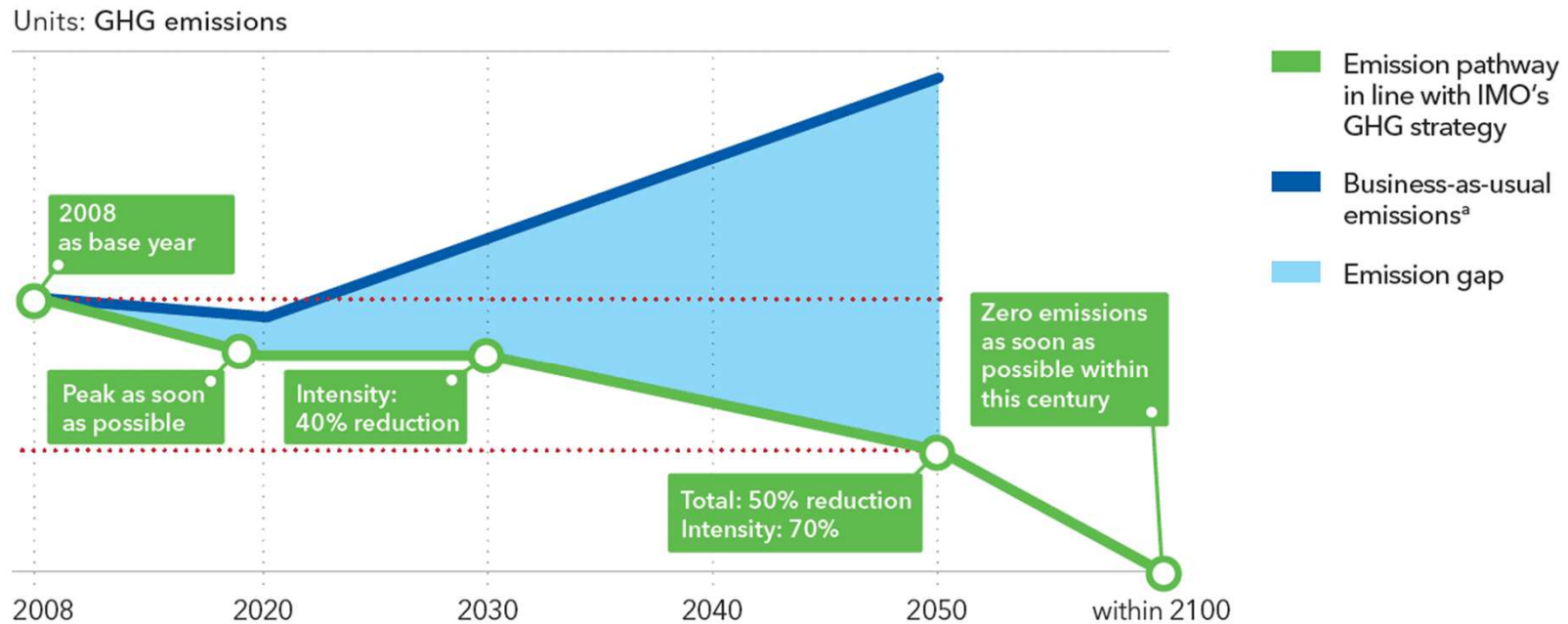
What we know about future maritime fuels –
Discussion Starter

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IMO aims to cut total GHG emissions by half by 2050 – this represents a challenge to shipping

IMO's GHG emission strategy



Total: Refers to the absolute amount of GHG emissions from international shipping.
Intensity: Carbon dioxide (CO₂) emitted per tonne-mile.

Source: DNV "Maritime Forecast to 2050", 2019

The EU, financiers and charterers require shipping to reduce its GHG emissions – on top of IMO

Regulators




Regulation



Financers



Exemplary signatories



Charterers



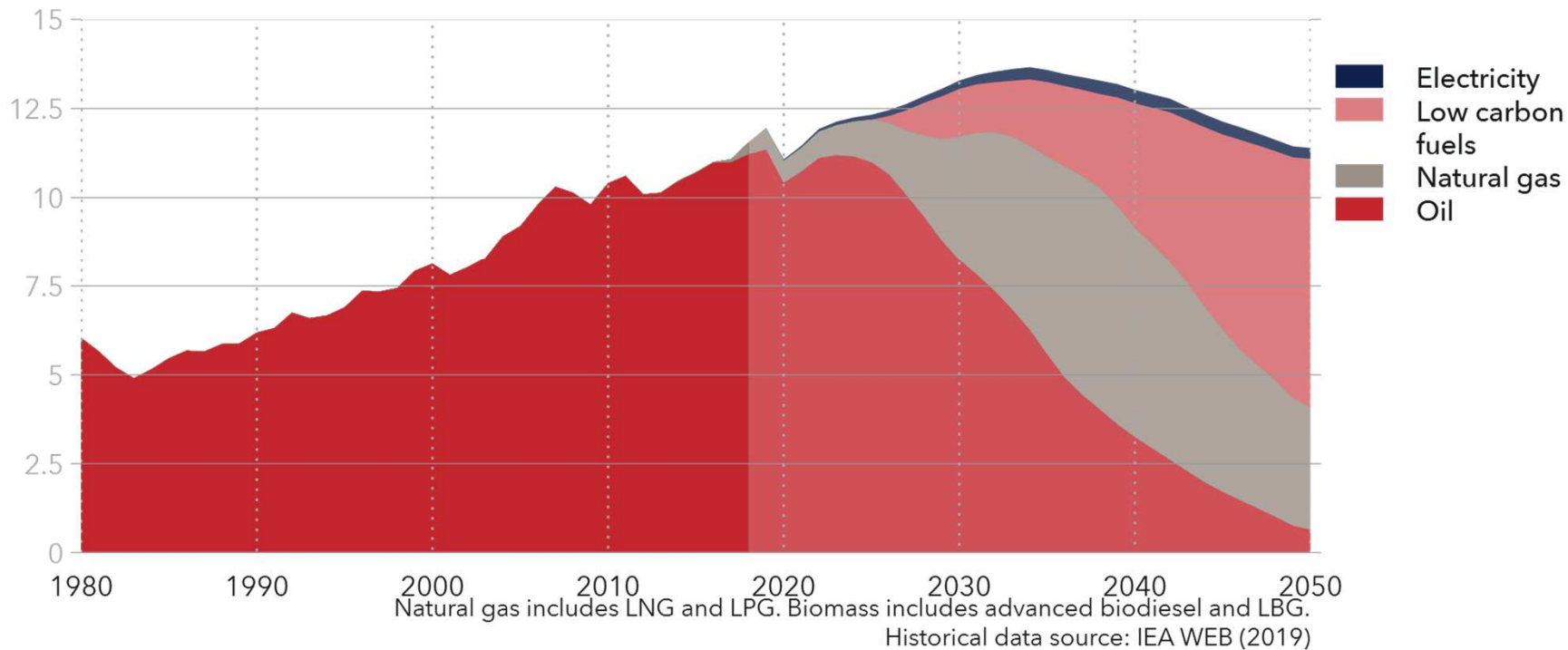
Exemplary signatories



The maritime fuel mix will change dramatically

World maritime subsector energy demand by carrier

Units: EJ/yr



Key assumptions

- Population growth
- Economic growth
- Regulations for decarbonization

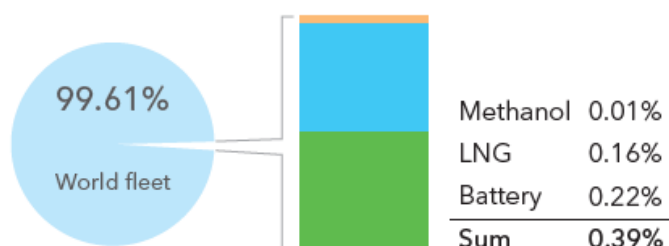
Low Carbon Fuels

- Biofuels
- E-fuels:
 - e-LNG
 - e-methanol
 - ammonia
 - hydrogen

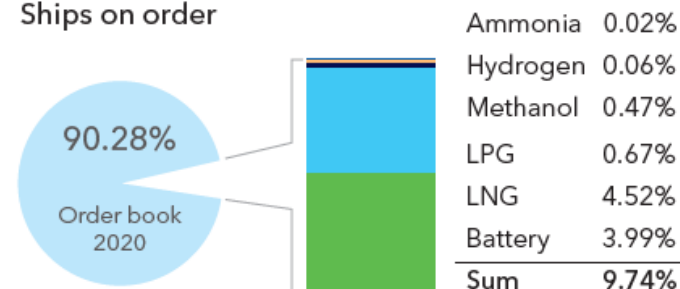
Oil is still by far the predominant ship fuel today, but the uptake of alternative fuels is visible

Alternative fuel uptake (percentage of ships)

Ships in operation



Ships on order



- **Less than 1%** of the existing fleet is running **on alternative fuels today**
- Year-to-date April 2021, **>18% of current newbuilds by # are ordered with LNG**
- Yet, the shipping industry faces **large uncertainty** with respect to selecting the right fuel/technology for assets lasting ~25 years

Source: DNV, Energy Transition Outlook, Maritime Forecast to 2050 (2020)

Alternative fuel options exist – hydrogen is not a credible alternative for deep-sea shipping

Presence

LSFO/MGO,
LNG

Fossil

Future

e-Hydrogen	e-Ammonia	Bio-/e-Methanol	Bio-/e-Methane (LNG)	e-LPG	Bio-/e-Diesel
From renewable electricity	From renewable electricity	From renewable electricity or biomass	From renewable electricity or biomass	From renewable electricity	From renewable electricity or biomass
No carbon H ₂	No carbon NH ₃	CH ₃ OH	CH ₄	E.g. C ₃ H ₆ , C ₃ H ₈ , C ₄ H ₁₀	E.g. C ₁₆ H ₃₄

Increasing carbon ratio, molecule complexity, cost and ease of storage/handling

There's no single best fuel option from today's perspective

	Availability	Infrastructure & Storage	Maturity of Technology	Energy Density	Fuel Price	CAPEX	Green Credentials
VLSFO/MGO	Green	Green	Green	Green	Green	Green	Red
LNG	Green	Yellow	Green	Yellow	Green	Yellow	Yellow
LPG	Green	Yellow	Yellow	Yellow	Green	Green	Yellow
Methanol	Yellow	Yellow	Green	Yellow	Yellow	Green	Yellow
Biofuels	Red	Green	Yellow	Green	Red	Green	Green
Hydrogen	Red	Red	Red	Red	Red	Red	Green
Ammonia	Red	Yellow	Red	Yellow	Yellow	Yellow	Green

What are the implications for ports?

- The past was simple, the future is complex
 - Fuel types: Not all fuels in all ports – but more than one fuel in many ports
 - Evolution trend
 - Smaller ships on short sea trades first, larger vessels on deep sea operations later
 - LNG & biofuels as next step, then Methanol, later hydrogen-based fuels as e.g. Ammonia
- Build up of capabilities and physical infrastructure (invest!) required
 - Local bunkering procedures
 - New bunker infrastructure: ship-to-ship, truck-to-ship, shore-to-ship, shore power

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Thank you

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