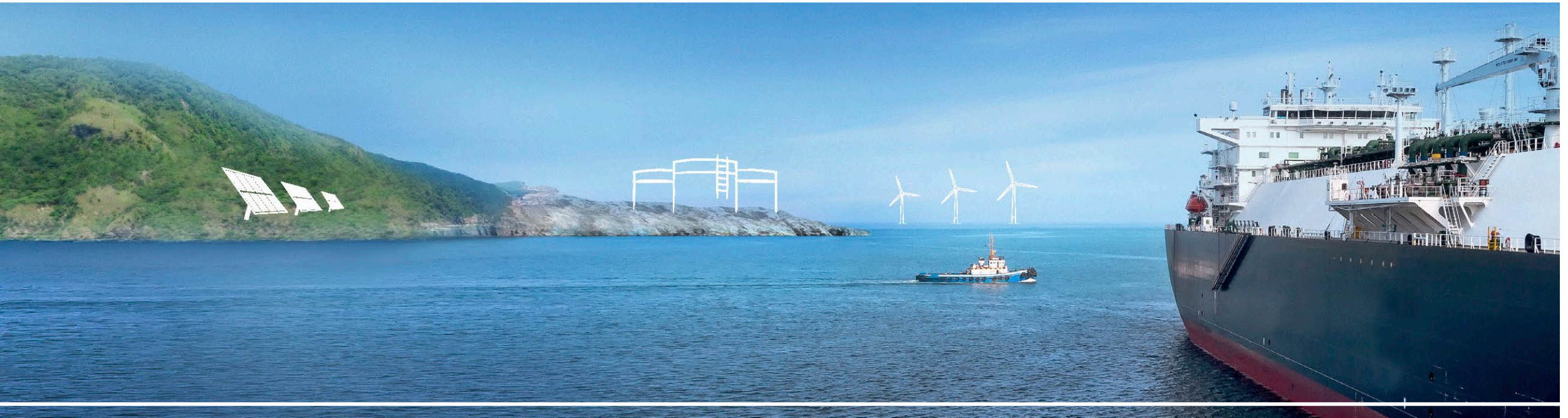




MARITIME FORECAST TO 2050

Energy Transition Outlook 2019

Maritime Forecast 2019

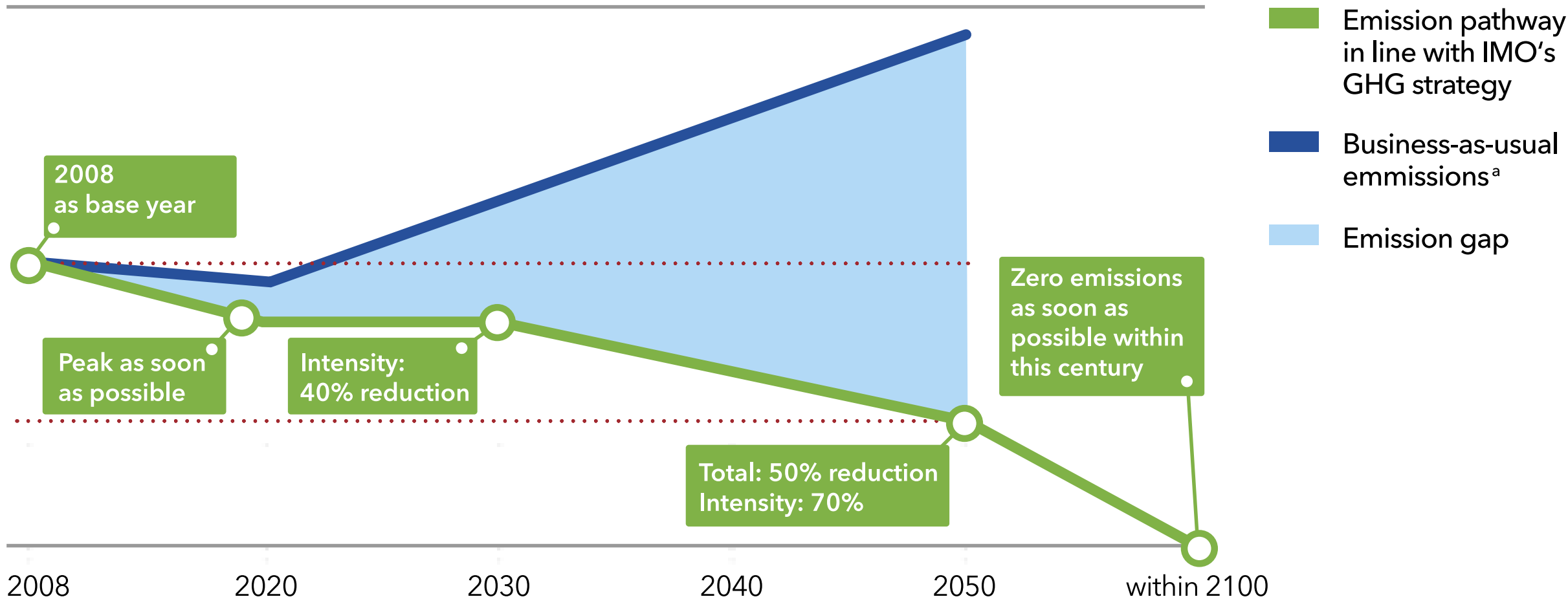
The report looks at how the energy transition will affect shipping leading up to 2050.

Key topics today:

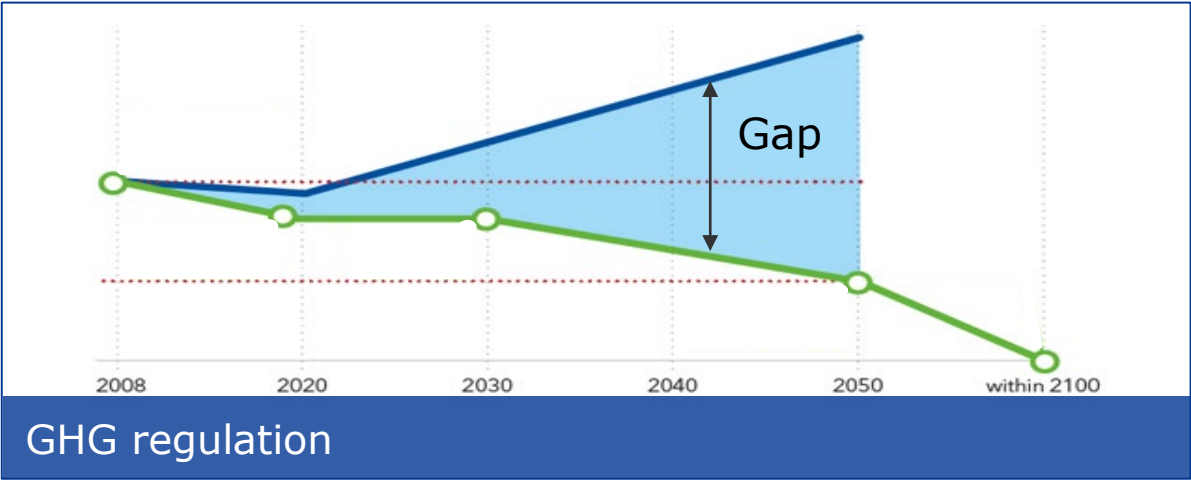
- Pathways to decarbonisation
- Fuel flexibility and bridging philosophies
- Future proofing

The foundation for the outlook is the IMO GHG strategy

Units: GHG emissions

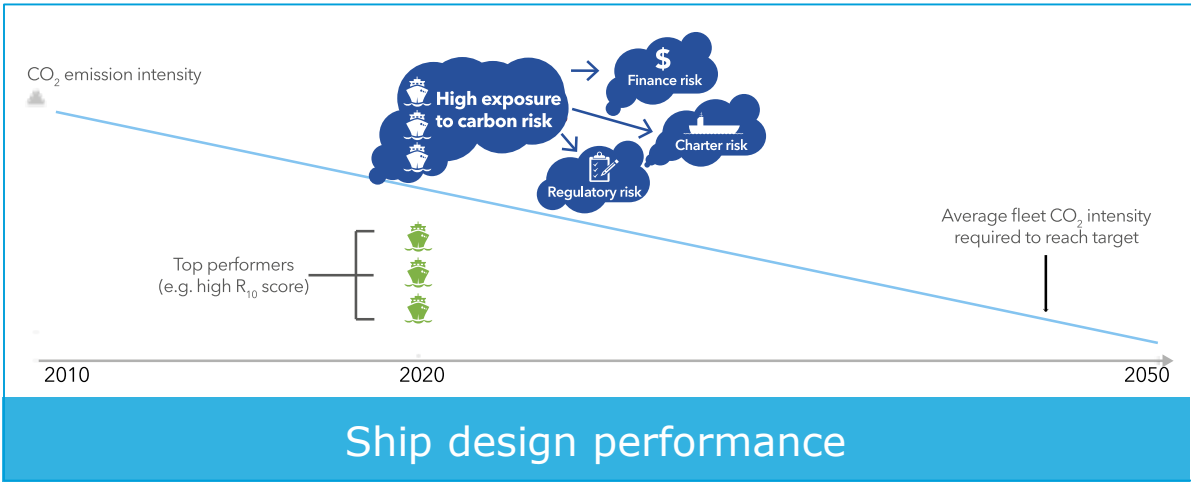
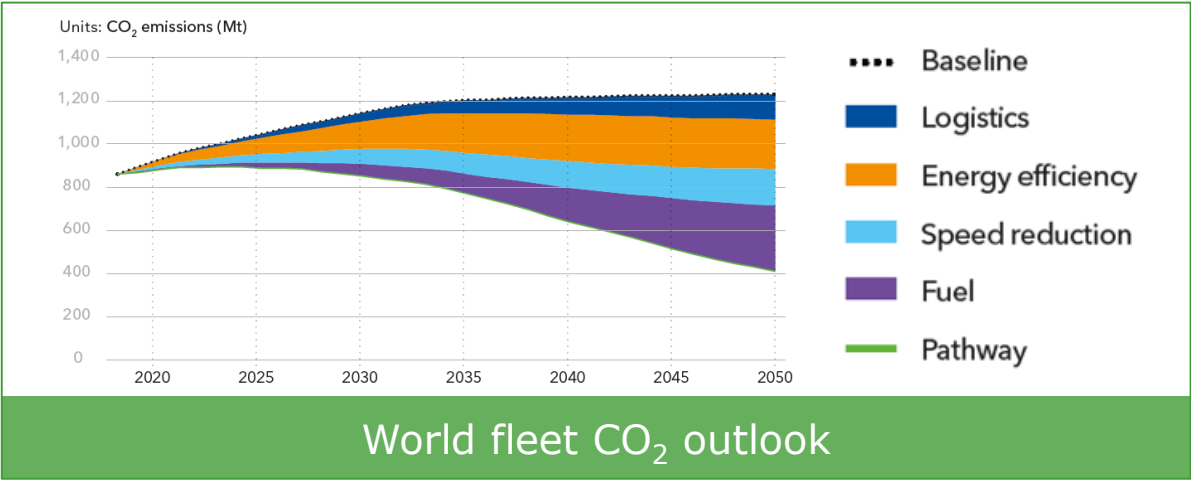


Closing the Decarbonization GAP?



LOGISTICS AND DIGITALIZATION	HYDRODYNAMICS	MACHINERY	FUELS AND ENERGY SOURCES
Speed reduction	Hull coating	Machinery improvements	LNG/LPG
Vessel utilization	Hull-form optimization	Waste heat	Electrification
Vessel size	Air lubrication	Engine de-rating	Biofuel
Alternative routes	Charging	Battery hybridization	Hydrogen

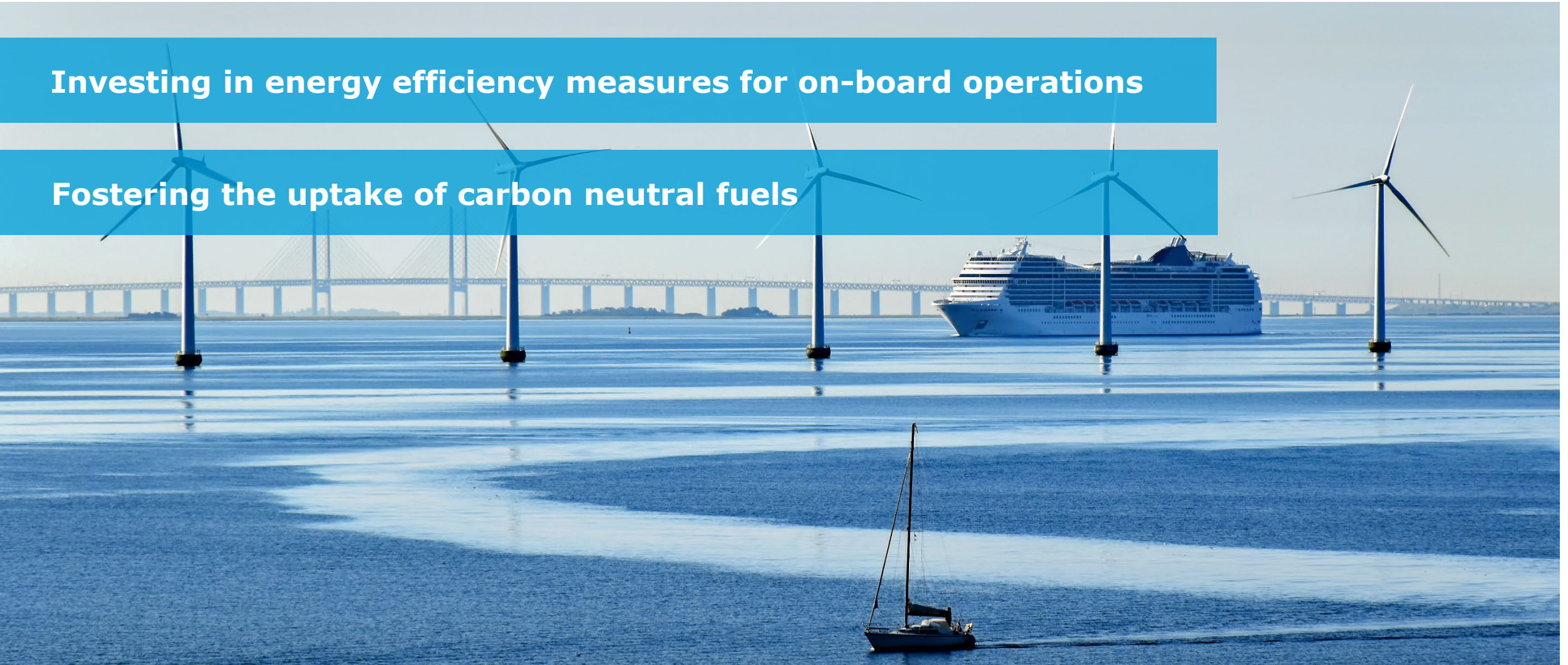
Decarbonization options



Two-fold approach to successfully reducing shipping's carbon footprint

Investing in energy efficiency measures for on-board operations

Fostering the uptake of carbon neutral fuels



Maritime Forecast analyses three pathways to decarbonization

No additional policy measures or regulations

- IMO GHG targets not met
- CO2 reductions around 27% by 2050

Gradually stricter operational requirements

- IMO GHG targets can be met
- Dominant fuels: LNG, Liquid Biogas & Electrofuels (from 2040)

Strictest requirements for newbuilds at later stage

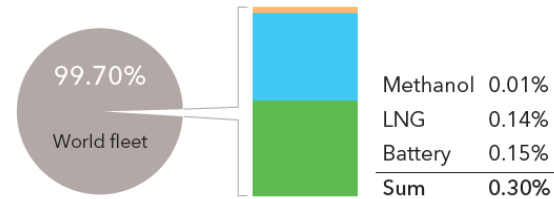
- IMO GHG targets can be met
- Slower energy transition
- Newbuilds could switch to Ammonia

The fuel mix is expected to change – but are we moving in this direction?

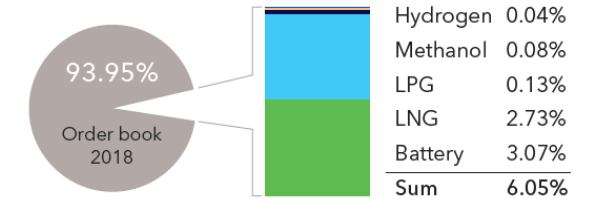
- Are we really moving in this **direction**? And at what **speed**?
 - Less than 1% of existing fleet is using alternative fuels
 - Approximately 6% of current newbuildings are ordered with alternative fuel propulsion
- Major shift expected in fuel mix for shipping
 - Diversification is the main characteristic
 - The Current policy pathway is not fulfilling the IMO ambitions.
 - Alternative policy designs fulfilling the IMO ambitions

Alternative fuel uptake (percentage of ships)

Ships in operation



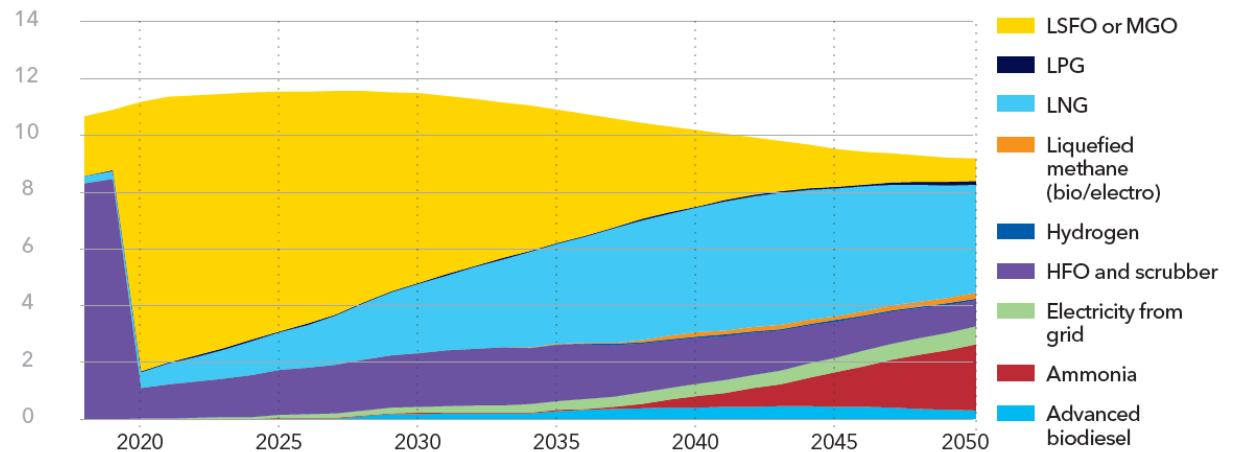
Ships on order



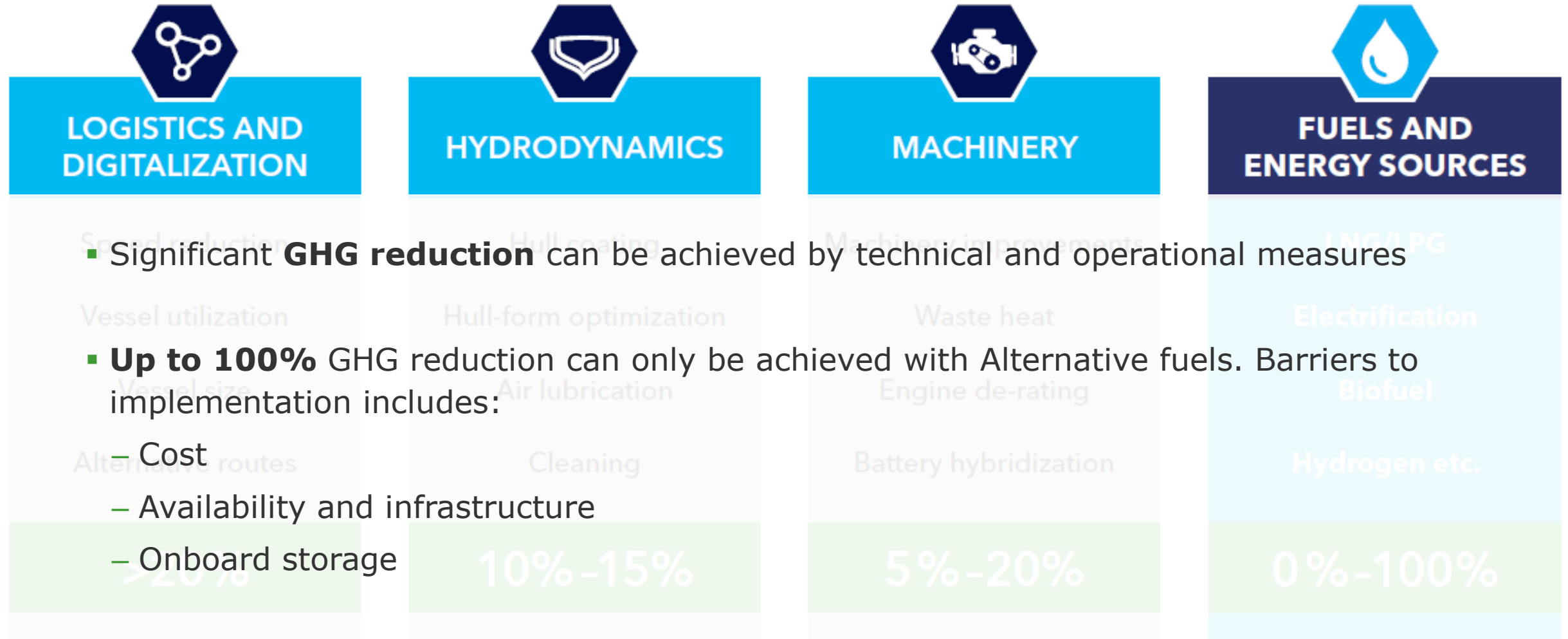
^{a)} DNV GL AFI portal: <https://www.dnvgl.com/services/alternative-fuels-insight-128171>

Energy use and projected fuel mix 2018-2050 for the simulated IMO ambitions pathway with main focus on design requirements

Units: EJ/yr



Decarbonization options for shipping



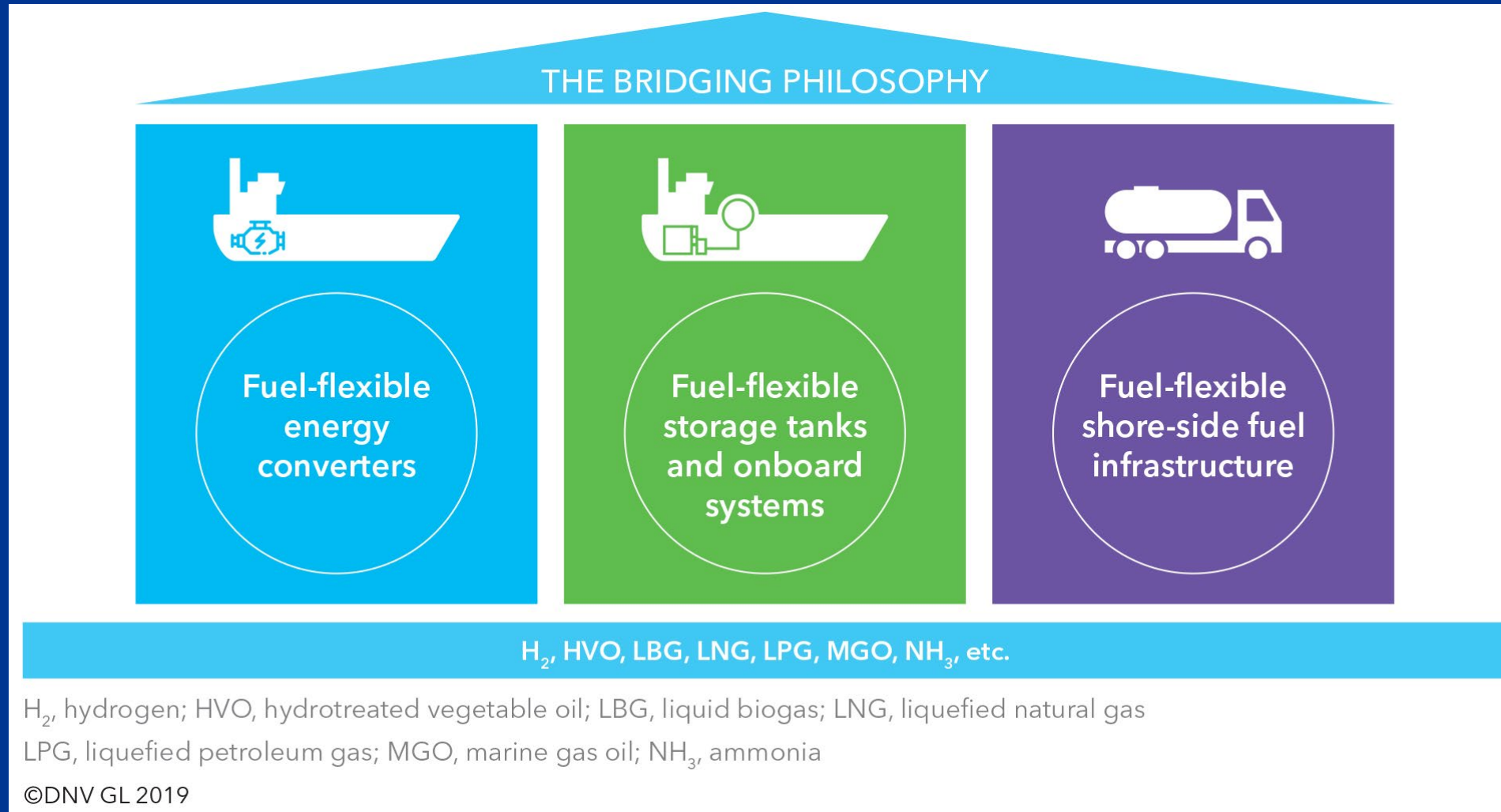
Decarbonization options for shipping - alternative fuels and energy sources

Three main “family types” of fuels, categorized based on energy source.

- Similar fuels can originate from different energy sources, but lifecycle emissions and cost vary greatly
- A given energy converter (e.g. combustion engine) may apply many alternative fuels

Fossil-based	Electricity-based	Bio-based
	Battery	
Methane		
Hydrogen/Ammonia		
Diesel		
Other fuels		

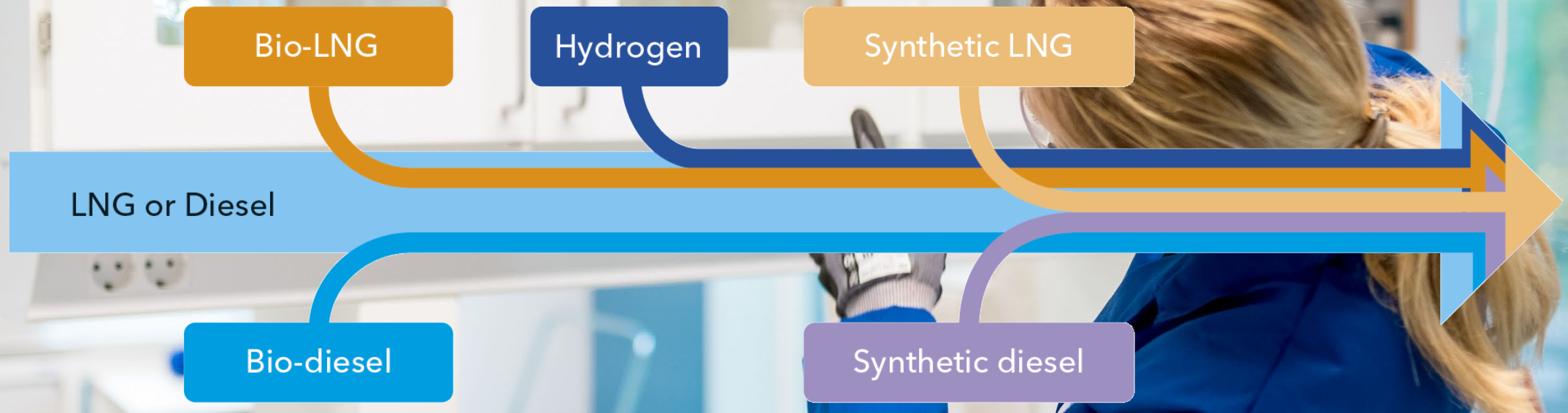
Bridging the gap: Technologies and fuel flexibility



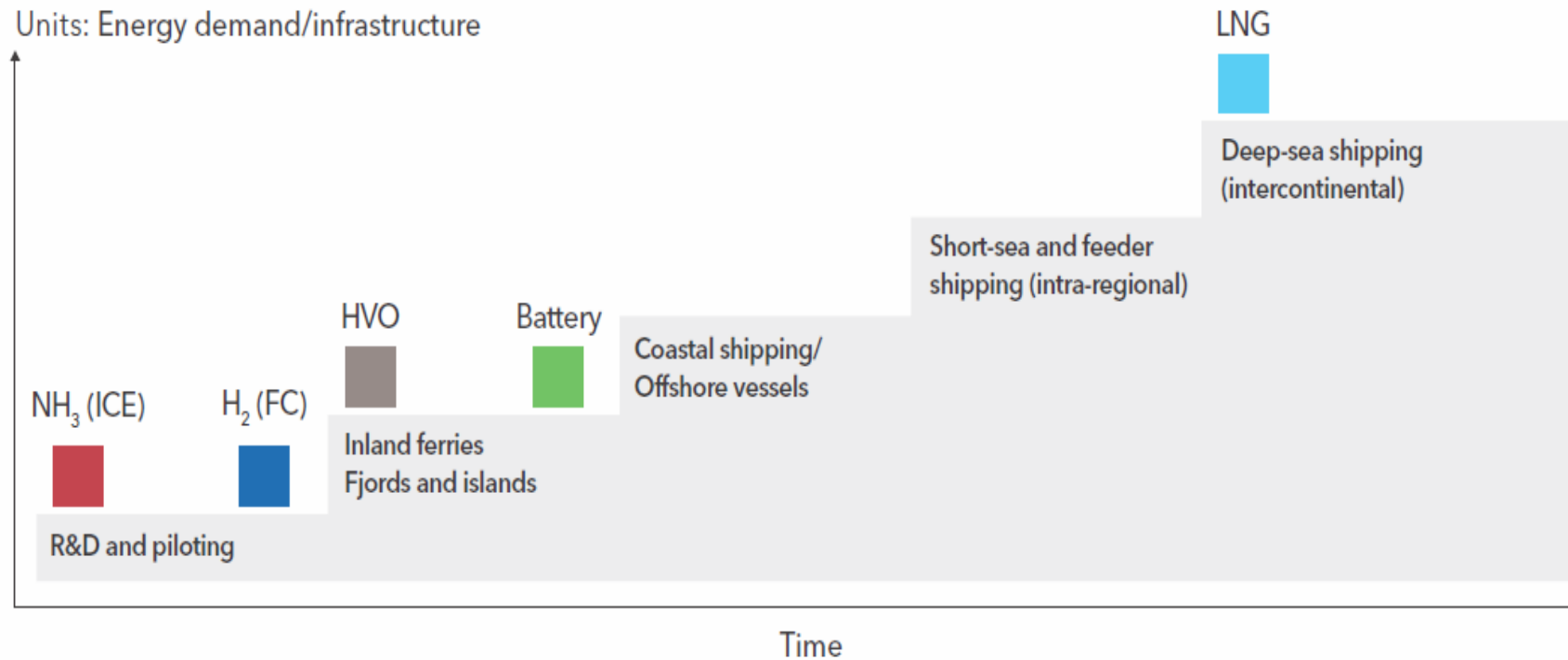
Bridging the gap: Technologies and fuel flexibility



Bridging technologies can facilitate the transition from traditional fuels, via fuels with lower-carbon footprints, to carbon-neutral fuels



Alternative fuels must evolve over time to increase market penetration



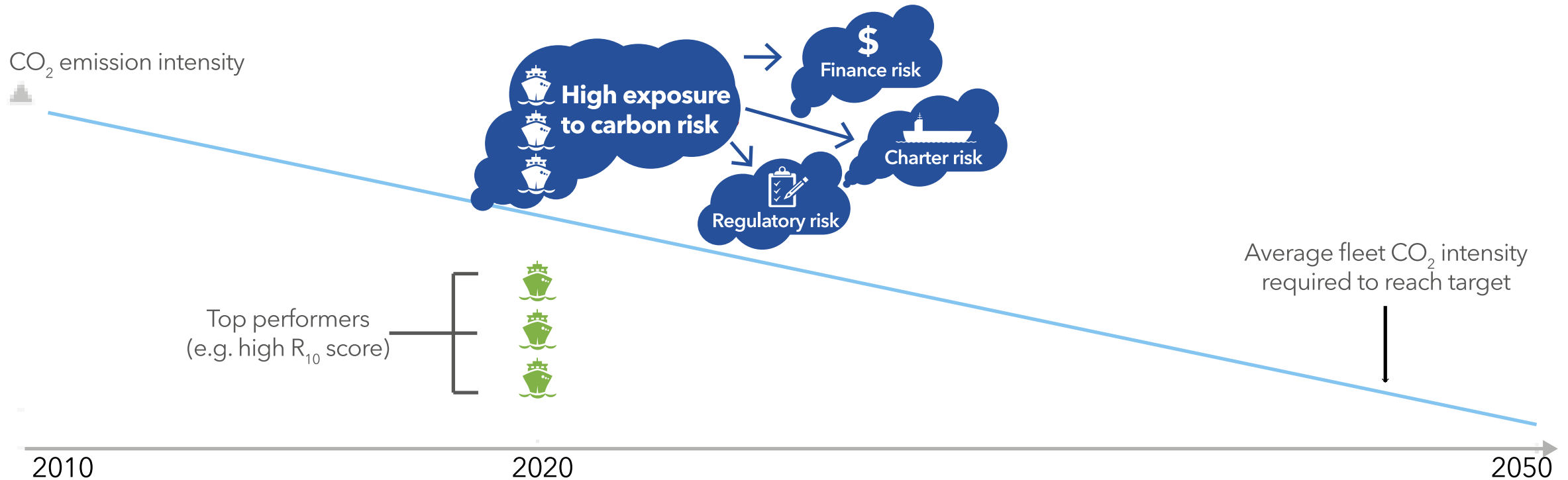
Gradual steps allow for:

- **maturing** of technology
- scaling of supply and **infrastructure**

Not all the options have the potential to reach the deep-sea stage, mainly due to limited energy density

It took LNG around 20 years to climb all steps. To reach the IMO targets, carbon-neutral fuels must mature faster!

Future proof - What is the exposure to carbon risk under different scenarios?



The model evaluates the **CO₂ emissions** of a design to that of the competing fleet.

It is possible to assess the **balance** between short-term cost reduction and long-term carbon-risk exposure.

CO₂ emissions could become an additional **differentiator**.

Key findings

Uptake of alternative fuels is picking up, but needs to breakthrough to the large ocean going ships

In addition to LNG, carbon-neutral fuels will be needed towards 2050
Bridging technologies and fuel flexibility can smooth the transition from traditional fuels

Ships should be future proof in a changing environment, securing competitiveness and mitigating carbon risk

Thank you for your attention.

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