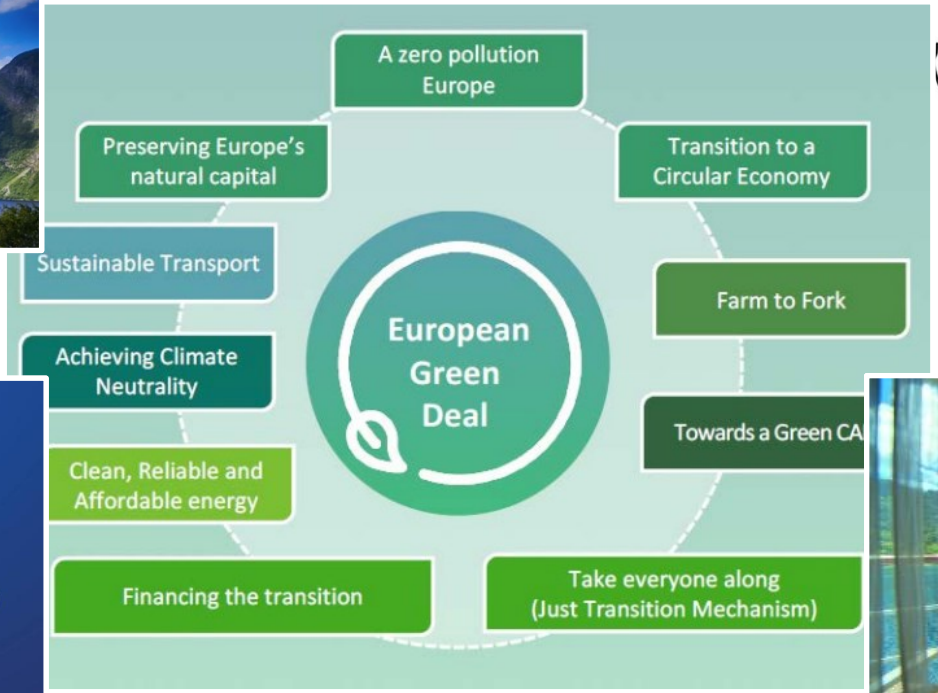
CARNIVAL MARITIME

With fuel cells and e-fuels towards zero emissions in passenger shipping

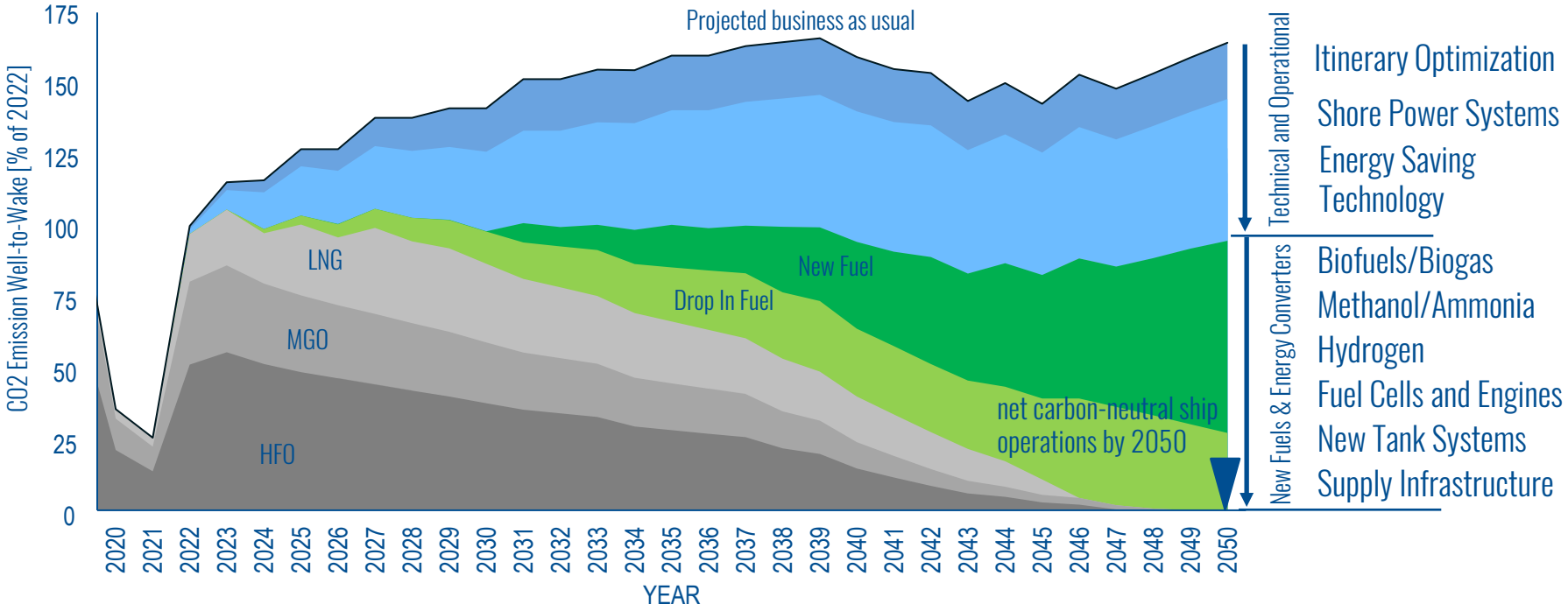
Hamburg, 8th of September 2022

European society and thus market environment of cruising is changing, we aspire to be a frontrunner in sustainable transformation

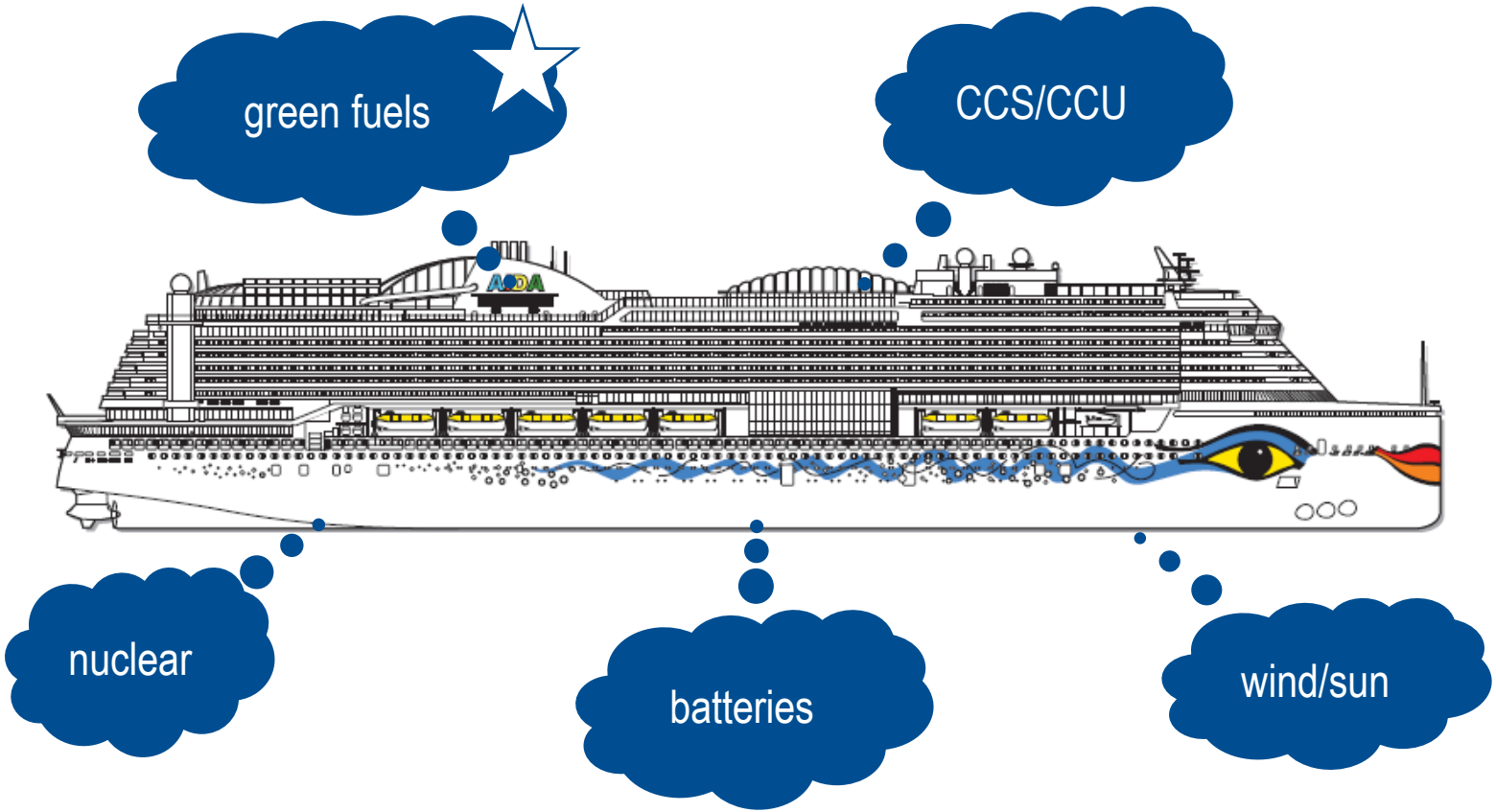


Costa group has an ambitious decarbonization strategy, most important lever will be GHG neutral energy and zero emission technology

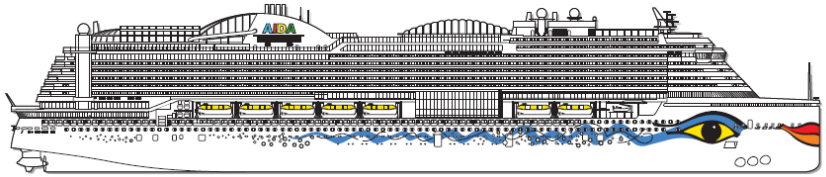
CO2 Emission Projection Costa Group

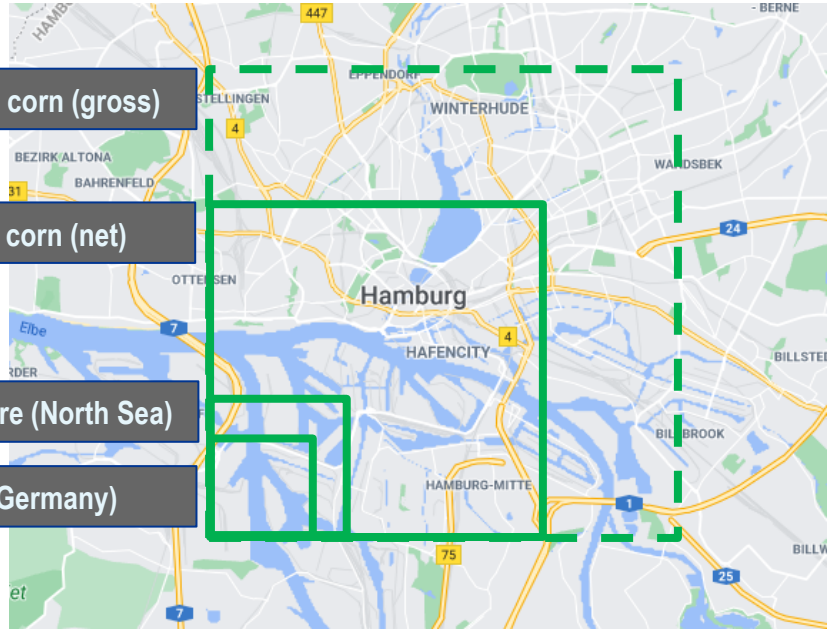


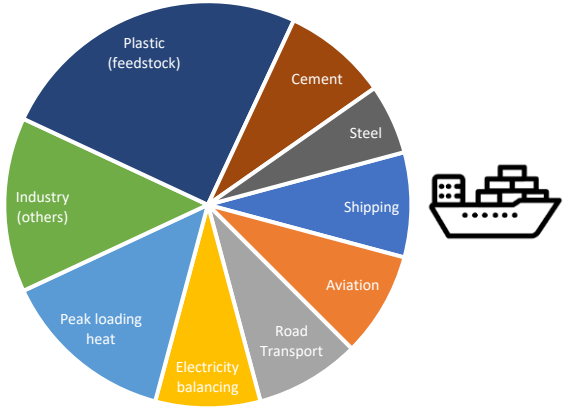
Considering environmental and operational aspects, the main lever for decarbonising cruise ships will be green fuels

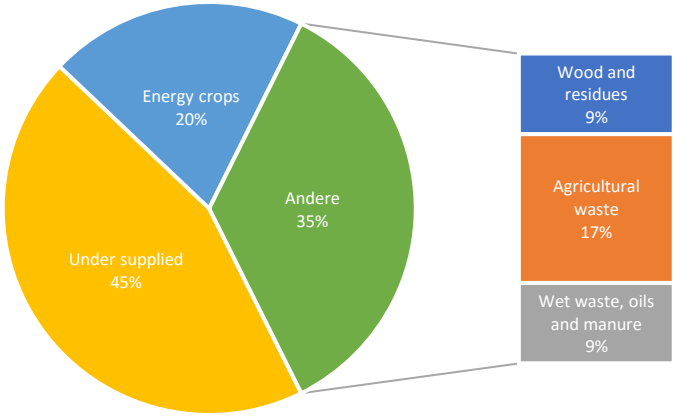


Biofuels are a bridging "technology" for decarbonisation, but will face sustainability and economy limits, therefore Hydrogen fuels are needed

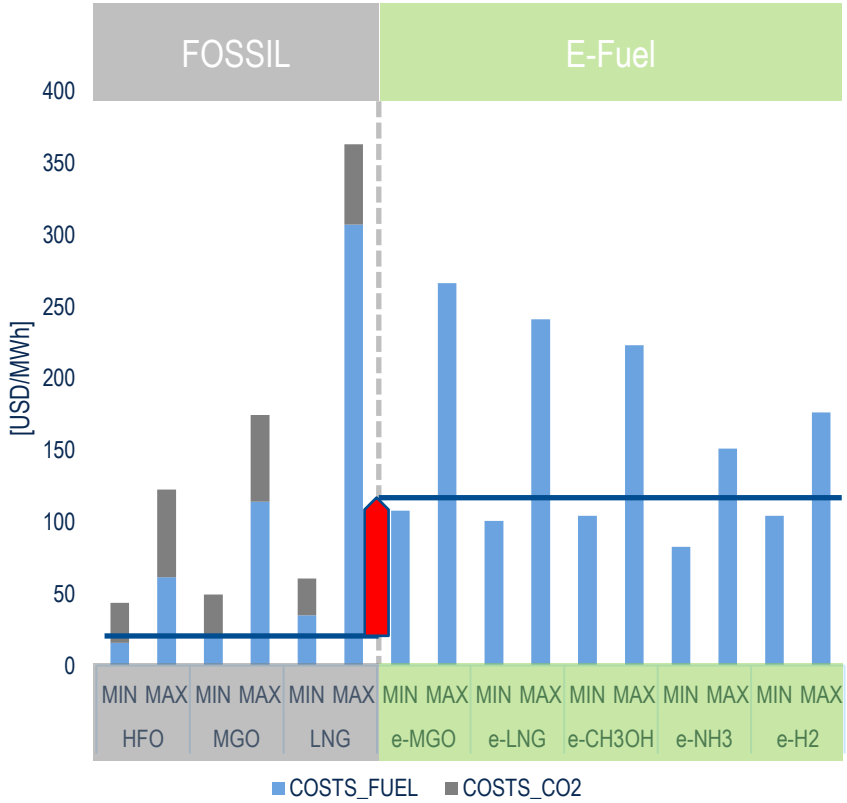








Main challenge of the future for cruise ships will be the increasing energy costs, those must be countered by new converters and clever design



green fuels

- GHG neutral
- Low pollutants
- Very expensive

converter

- very low / zero pollutants
- high efficiency
- high power density
- low capex/opex
- technical maturity

ship design

- Highly energy efficient
- Very compact machinery system
- Modular & (fuel / energy converter) flexible

There are various combinations of hydrogen carriers and converters, methanol + PEM fuel cell create synergies and allow for a fast transition

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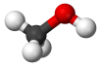
H_2	„Diesel“ 	Turbine 	Fuel Cell (PEM) 	Fuel Cell (SOFC) 
FT Diesel 				
Methanol 				
Methane 				
Ammoniak 				
Hydrogen 				

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H_2	„Diesel“	Turbine	Fuel Cell (PEM)	Fuel Cell (SOFC)
FT Diesel	▪ High efficiency ▪ Low maturity ▪ High CAPEX			
Methanol	▪ Low maturity ▪ Low carbon intensity ▪ High CAPEX			
Methane				
Ammoniak				
Hydrogen				

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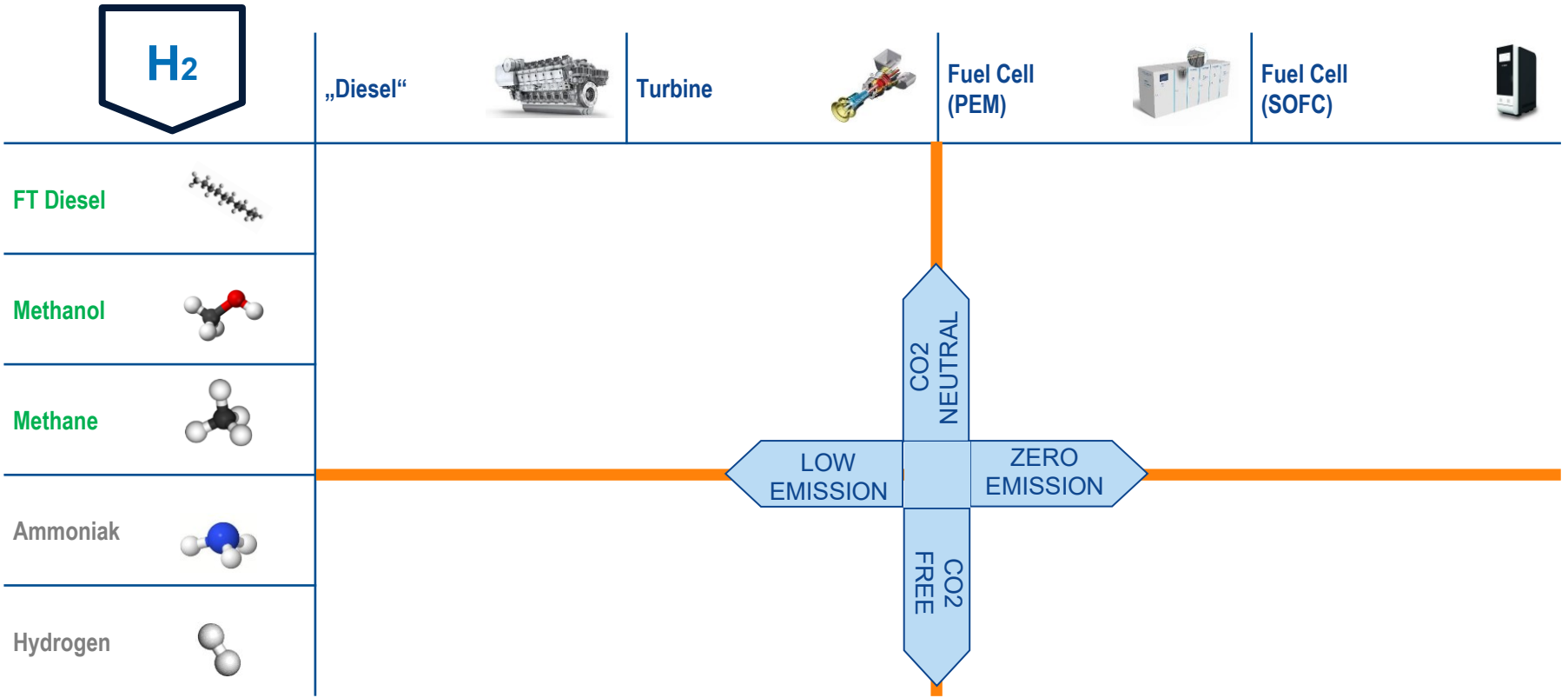

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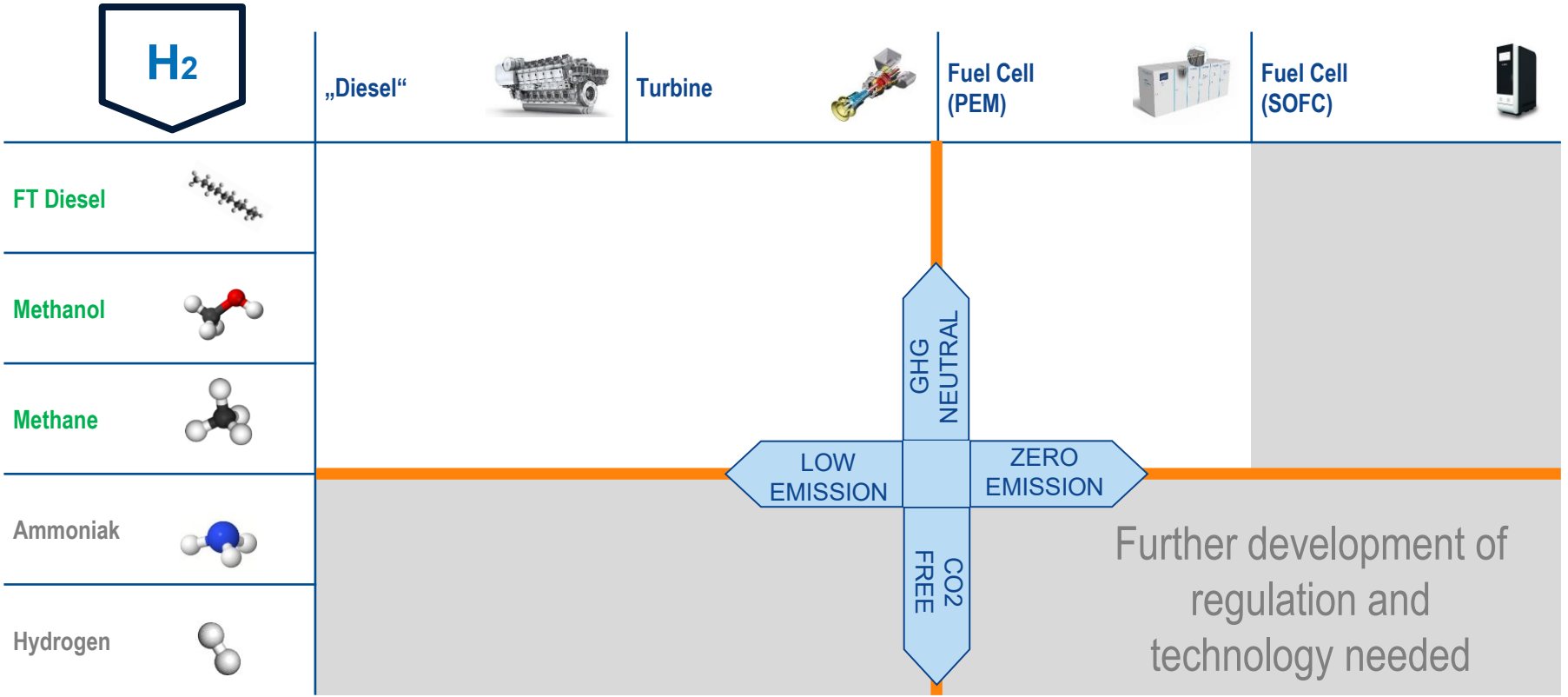

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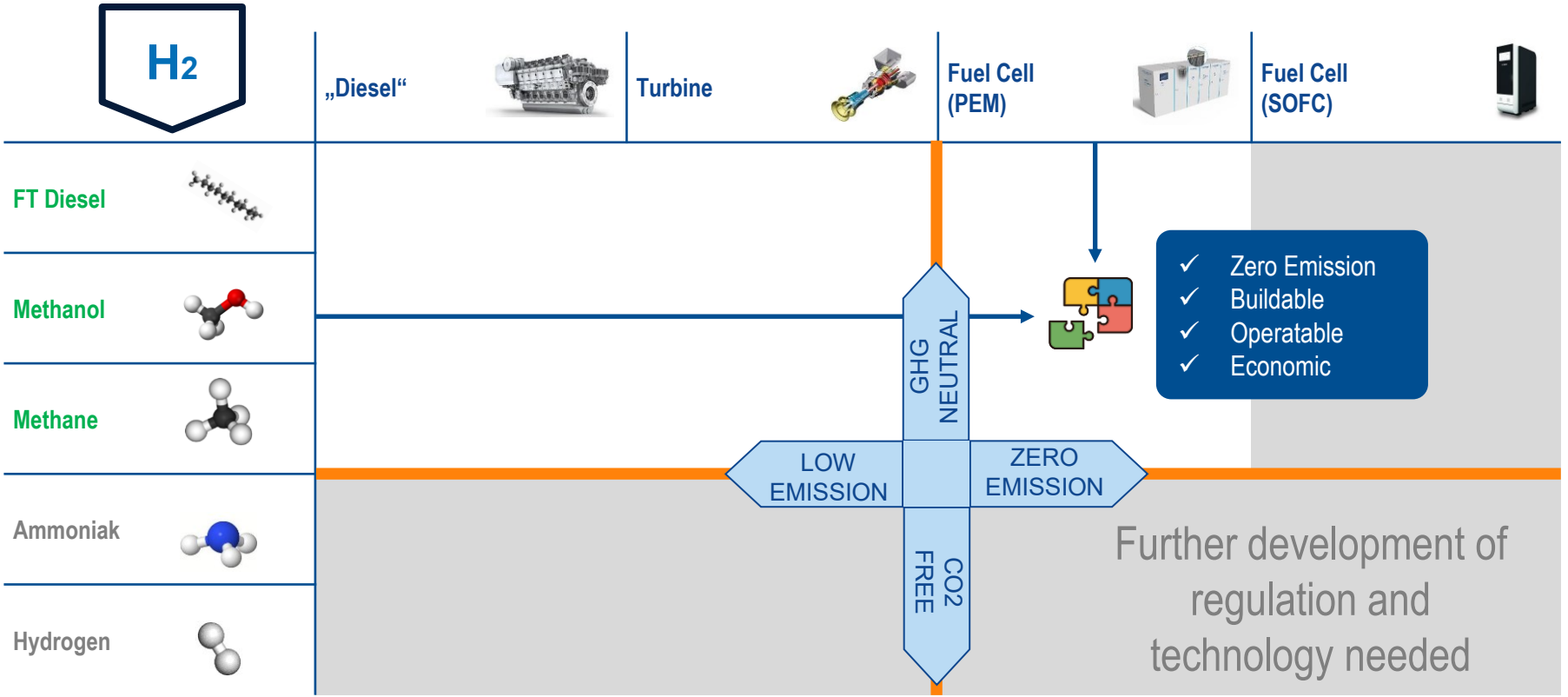

What is needed to get there:
Regulatory certainty / technology openness / funding for lighthouse projects

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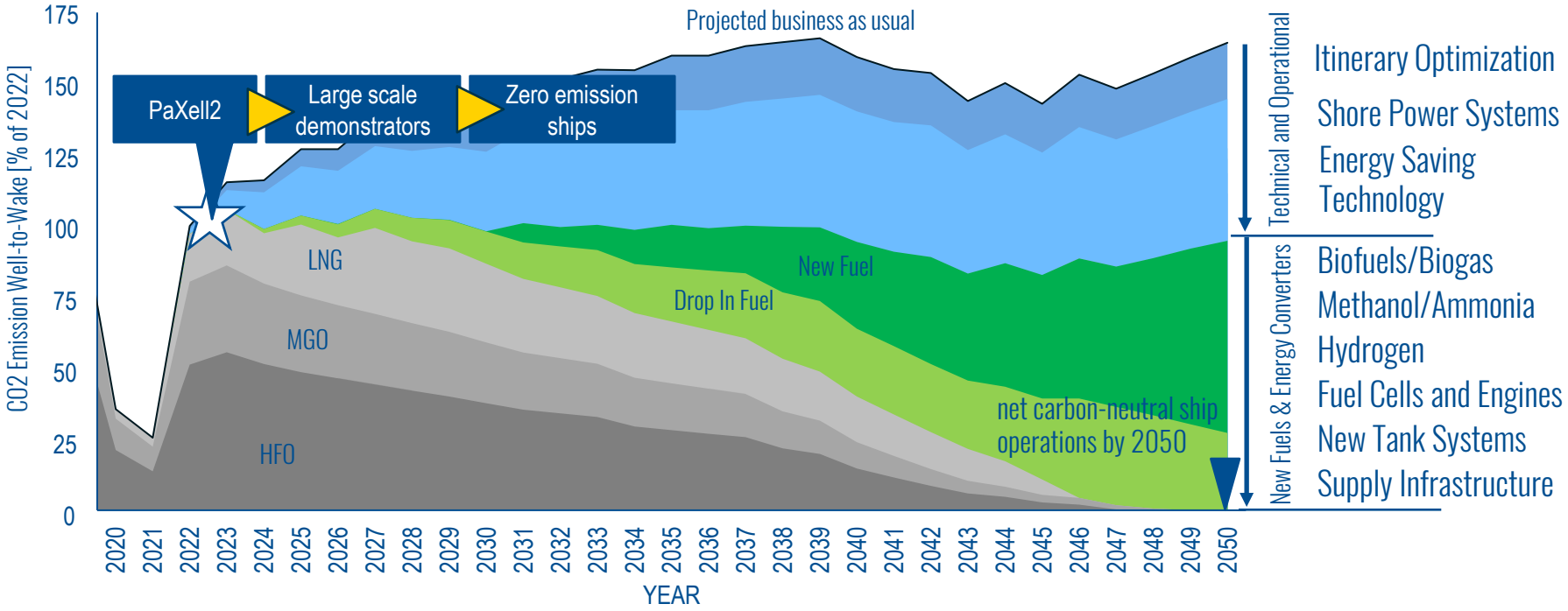
CO2 Emission Projection Costa Group



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Thank you for your attention!