



H2 in Shipping— Perspective of a Cruise Operator

Hamburg, September 1, 2023

Who we are?



Carnival Corporation & plc is the **largest global cruise company** with a portfolio of world-class cruise brands. Together these brands comprise a fleet of **90+ ships** visiting over **700 ports worldwide**.

Our talented and diverse workforce of over **160,000 team members** from **150 countries** serve nearly **13 million annual guests** historically – accounting for nearly **half of the overall global cruise market**.

We seek to deliver unforgettable happiness to our guests by providing extraordinary cruise vacations, while **honoring the integrity of every ocean we sail, place we visit and life we touch**.



- Marine Service Unit of AIDA and Costa
- Located in Hamburg
- Operating 26 cruise ships

Portfolio of world-class cruise line:



AIDA Cruises



Carnival Cruise Line



Costa Cruises



Cunard



Holland America Line



Princess Cruises



P&O Cruises (Australia)

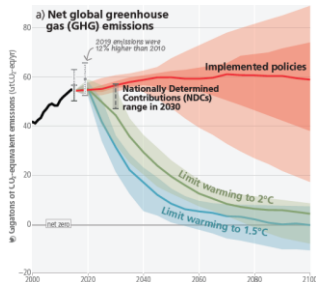


P&O Cruises (UK)

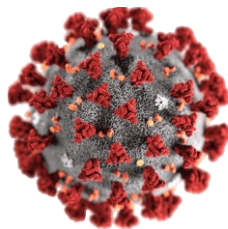


Seabourn

Market environment is transformed by disruptive external factors, maneuvering through the transition rightly is an opportunity



Climate / natural resources



Financial recovery



Energy costs / Inflation

DISRUPTION



Regulations



Invest/Tax/Funding



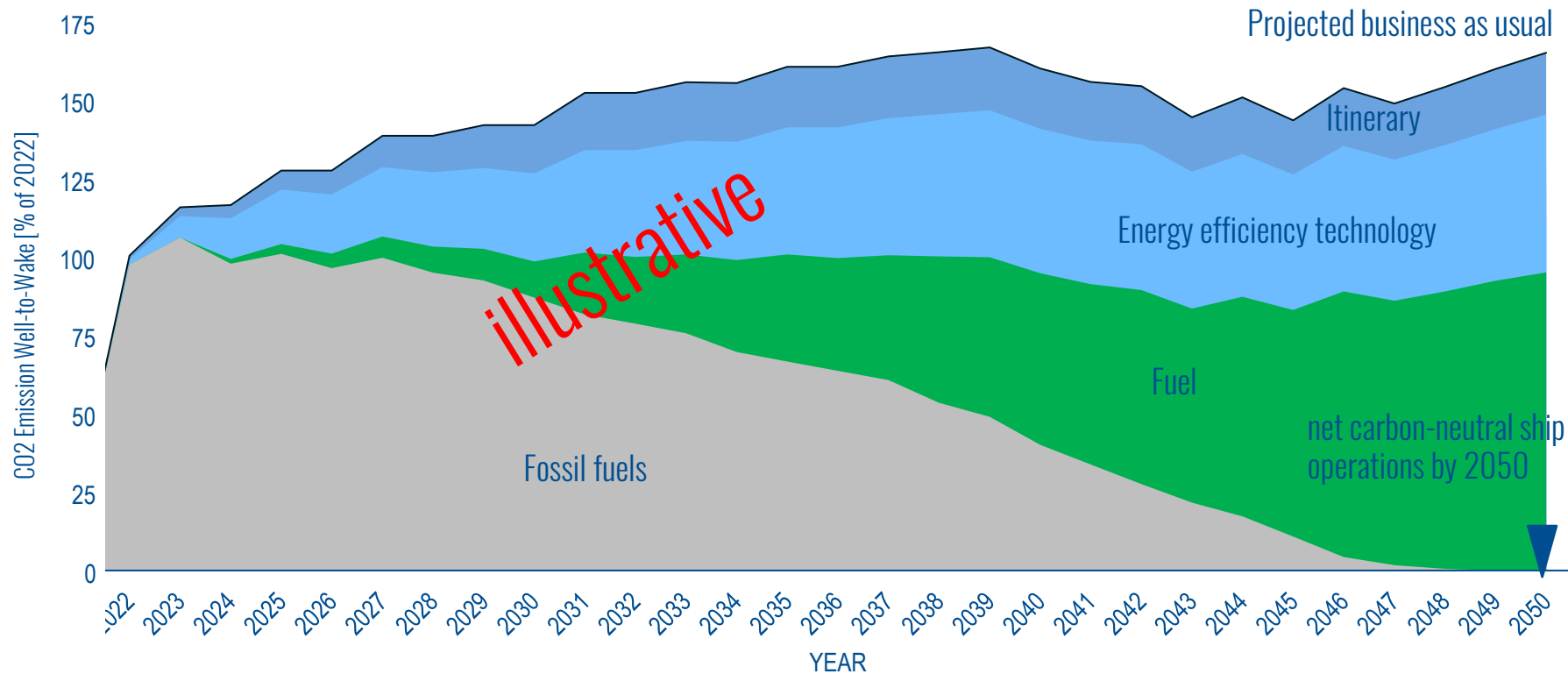
Technologies



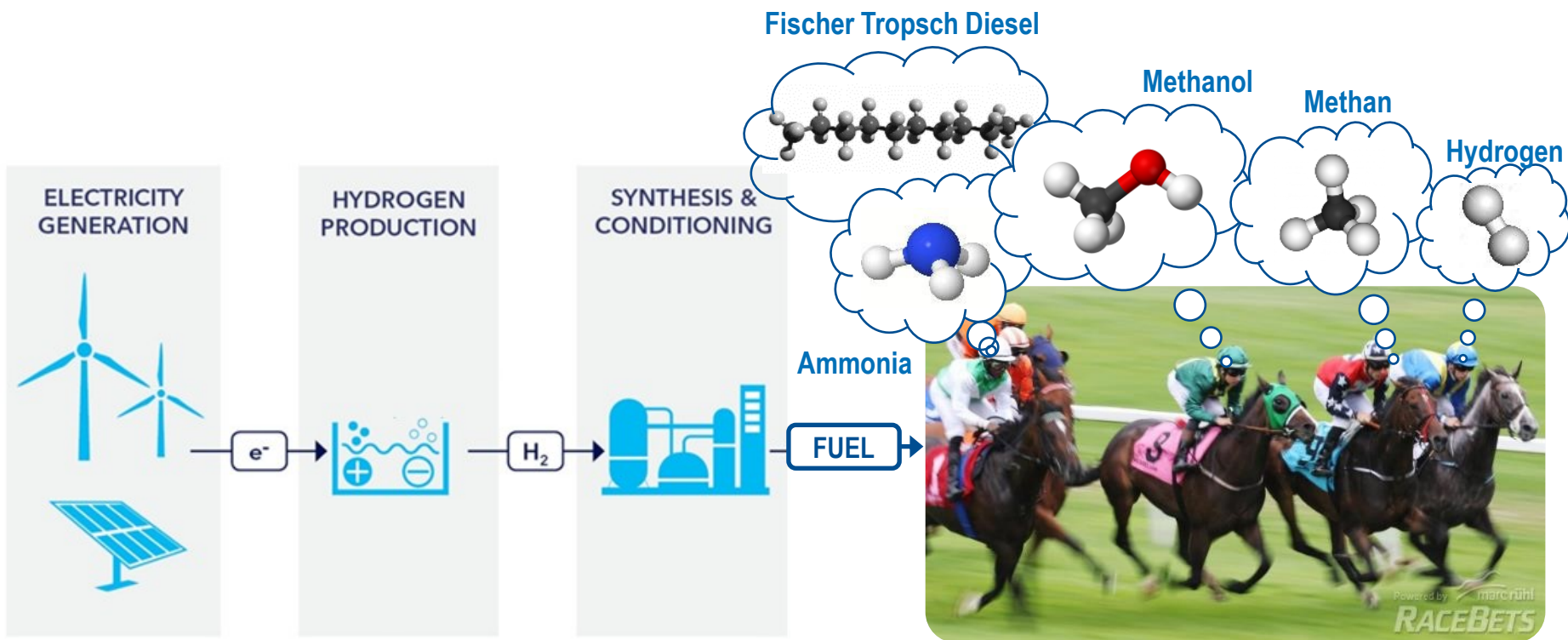
Mindset

(ENERGY) TRANSITION

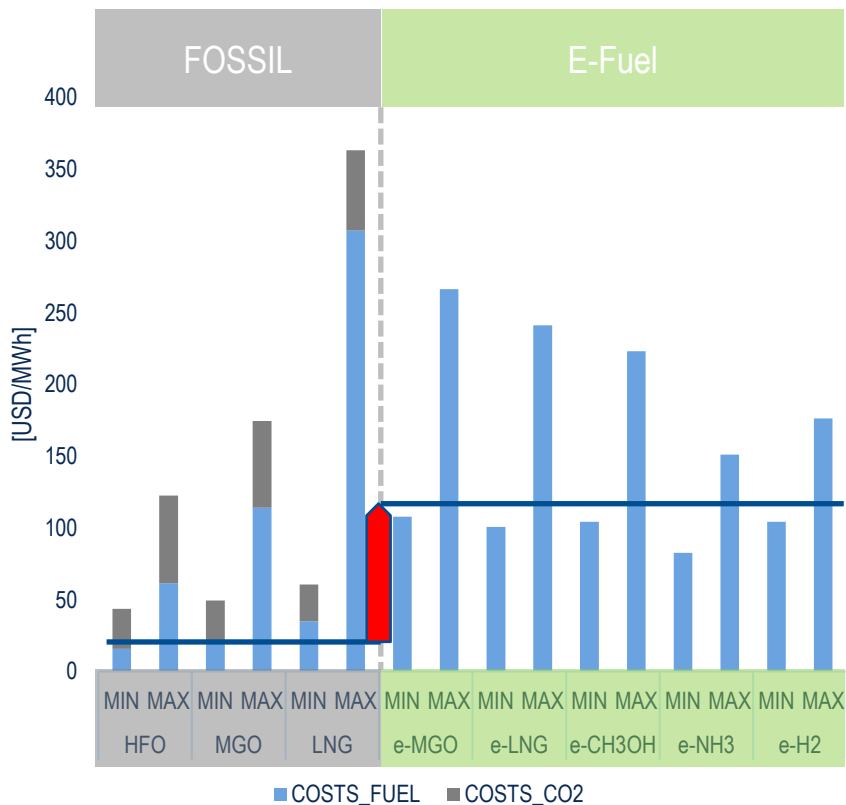
Carnival Corporation has an ambitious decarbonization strategy, most important lever will be GHG neutral energy and zero emission technology



Its hydrogen! - But we need to select the right storage form



Key challenge of cruise ships will be the increasing energy costs, those must be countered by clever design and efficient converters



green fuels

- GHG neutral
- Low pollutants
- Very expensive











converter

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

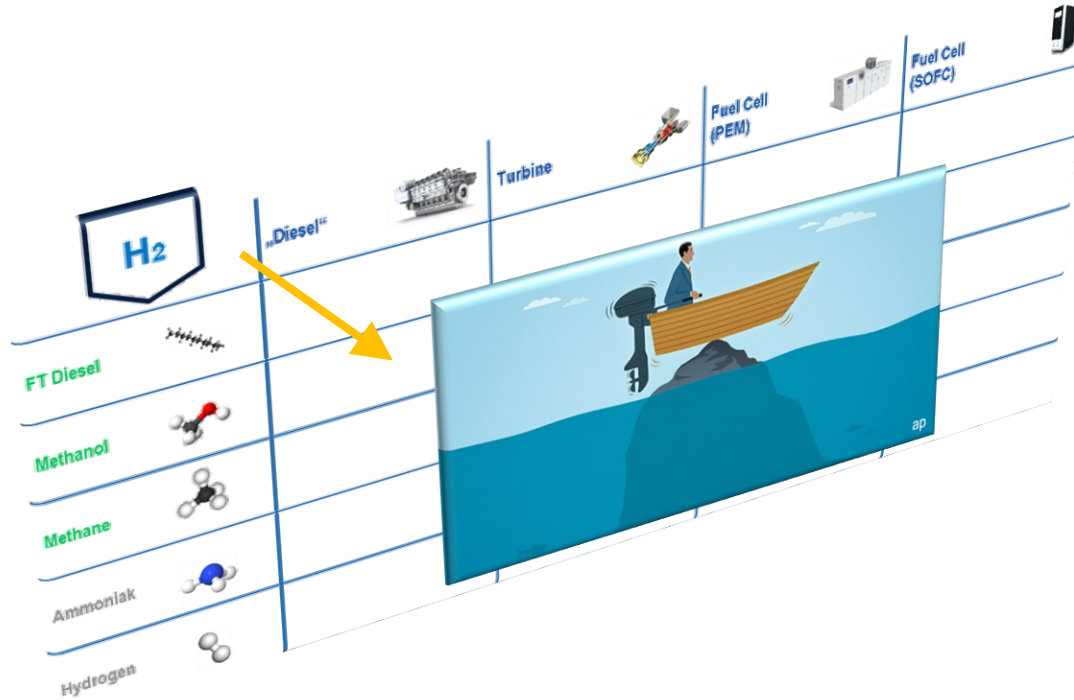
ship design

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

There are various combinations of hydrogen carriers and converters, we need to select the right option to be future proven

	 <p>„Diesel“</p>	 <p>Turbine</p>	 <p>Fuel Cell (PEM)</p>	 <p>Fuel Cell (SOFC)</p>
<p>FT Diesel</p> 				
<p>Methanol</p> 				
<p>Methane</p> 				
<p>Ammoniak</p> 				
<p>Hydrogen</p> 				

Manoeuvring through energy transition has multiple dimensions, flexibility over time is important to avoid stranded assets



A structured technology options matrix reveals that methanol + PEM fuel cell can provide GHG neutral zero emission ship propulsion in short term

