NEW CONSTRUCTION CHALLENGES IN HYBRID AND HYDROGEN PROPELLED VESSELS

Successfull cases in Asturias

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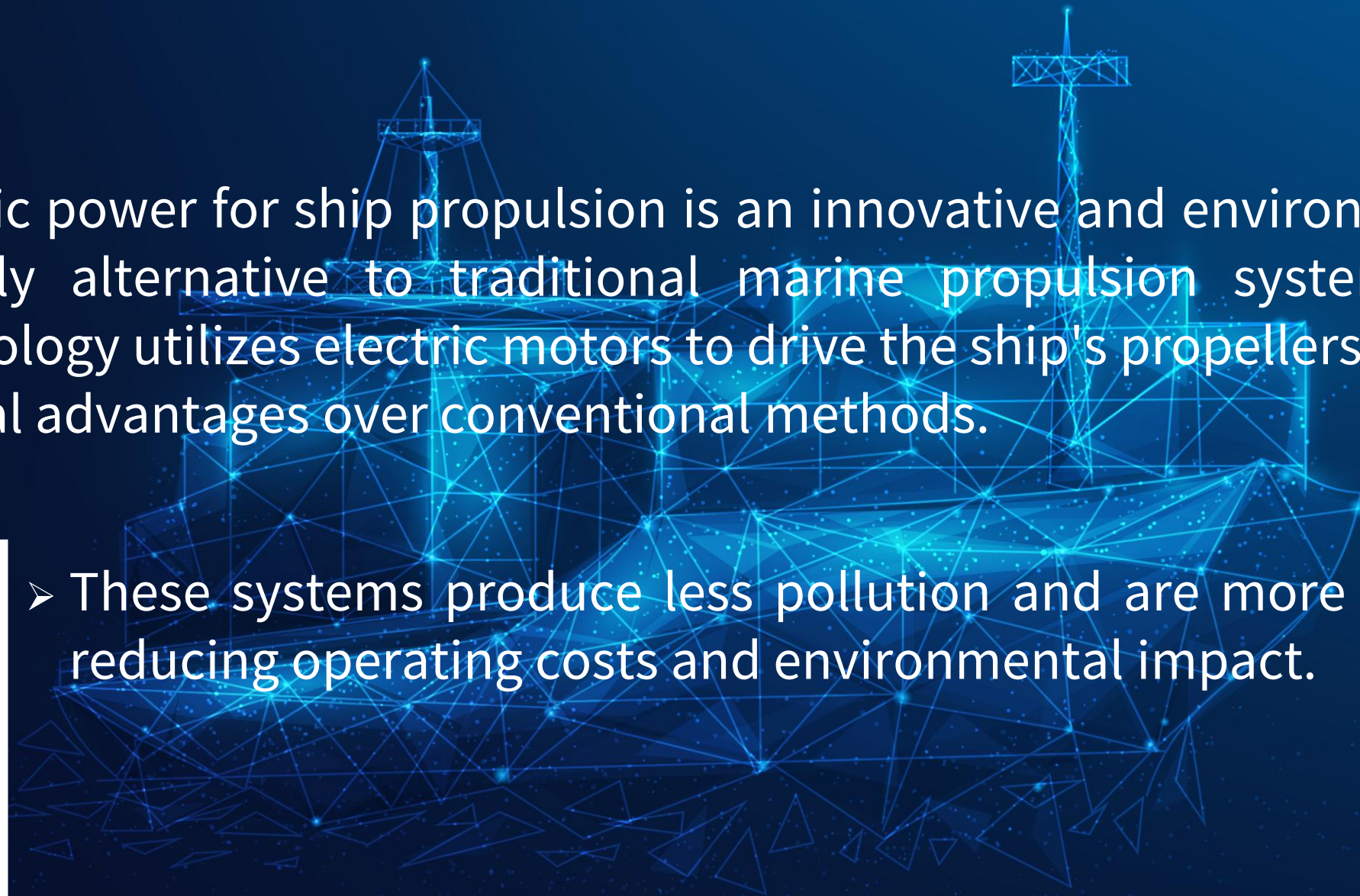
Alternative fuel sources for ships: Trends and developments

- Stringent environmental Regulations due to the challenge of climate change.
- Needs for cleaner and greener shipping, reducing CO_2 emissions.
- Emerging new trends: Ammonia, Biofuel, Electric, Hydrogen, Methanol, Nuclear.

Electric



- Electric power for ship propulsion is an innovative and environmentally friendly alternative to traditional marine propulsion systems. This technology utilizes electric motors to drive the ship's propellers, offering several advantages over conventional methods.

- These systems produce less pollution and are more efficient, reducing operating costs and environmental impact.

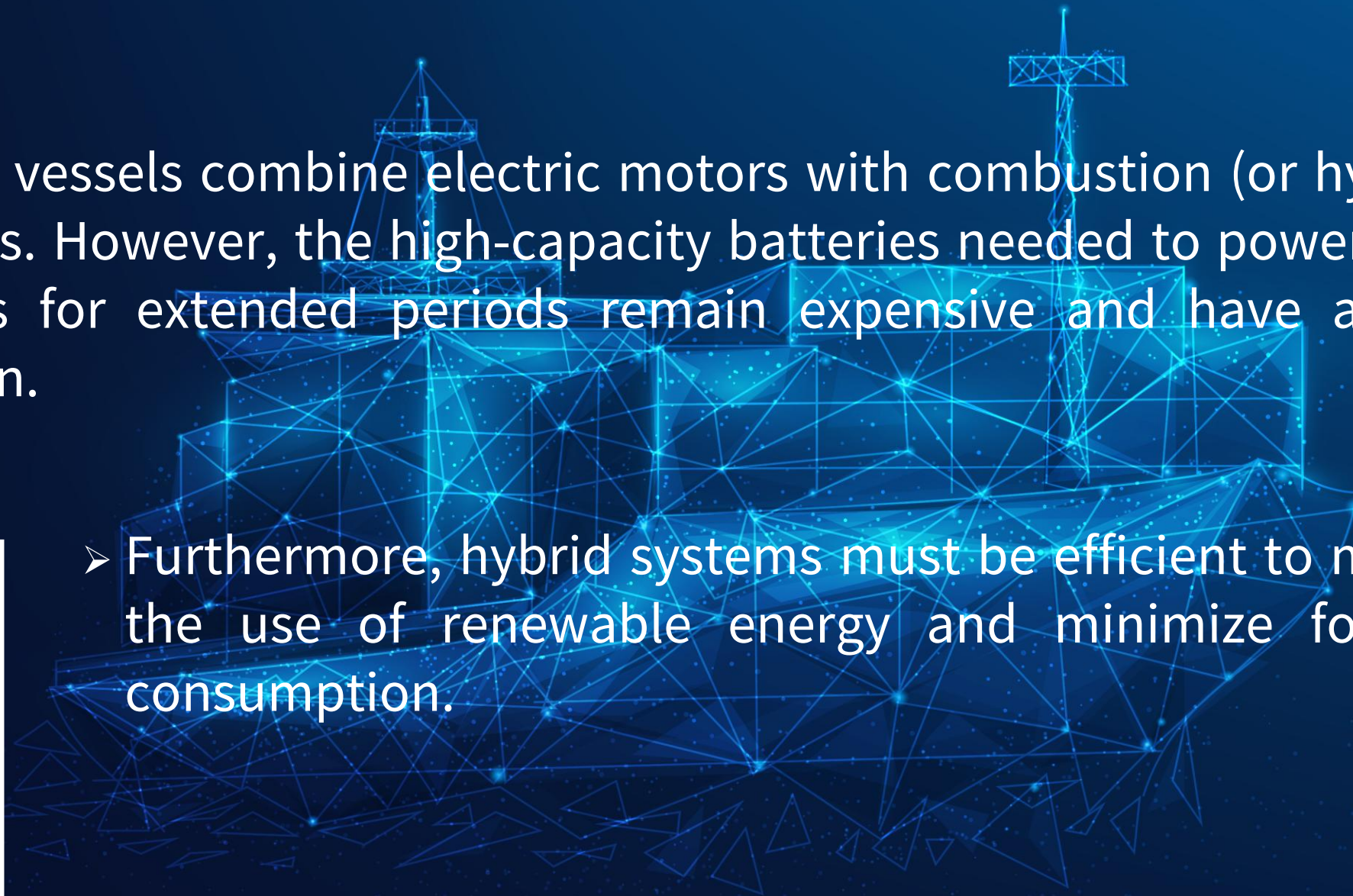
Electric

- One of the key benefits of electric propulsion is its versatility. It is used in various types of vessels, including tugs, trawlers, dredgers, dynamic positioning vessels, cable-laying ships, icebreakers, research ships, and floating cranes. This adaptability makes it a popular choice for both small and large vessels, including cargo ships and cruise liners.
    - Electric propulsion systems also offer improved reliability and reduced maintenance compared to traditional propulsion systems. The simpler design of electric motors, with fewer moving parts, leads to lower maintenance requirements and increased operational uptime.

Electric

- In summary, electric power for ship propulsion is a forward-thinking solution that enhances efficiency, reduces environmental impact, and offers greater flexibility for various maritime applications. As the shipping industry continues to evolve, electric propulsion is set to play a significant role in shaping the future of marine transportation.

Electric



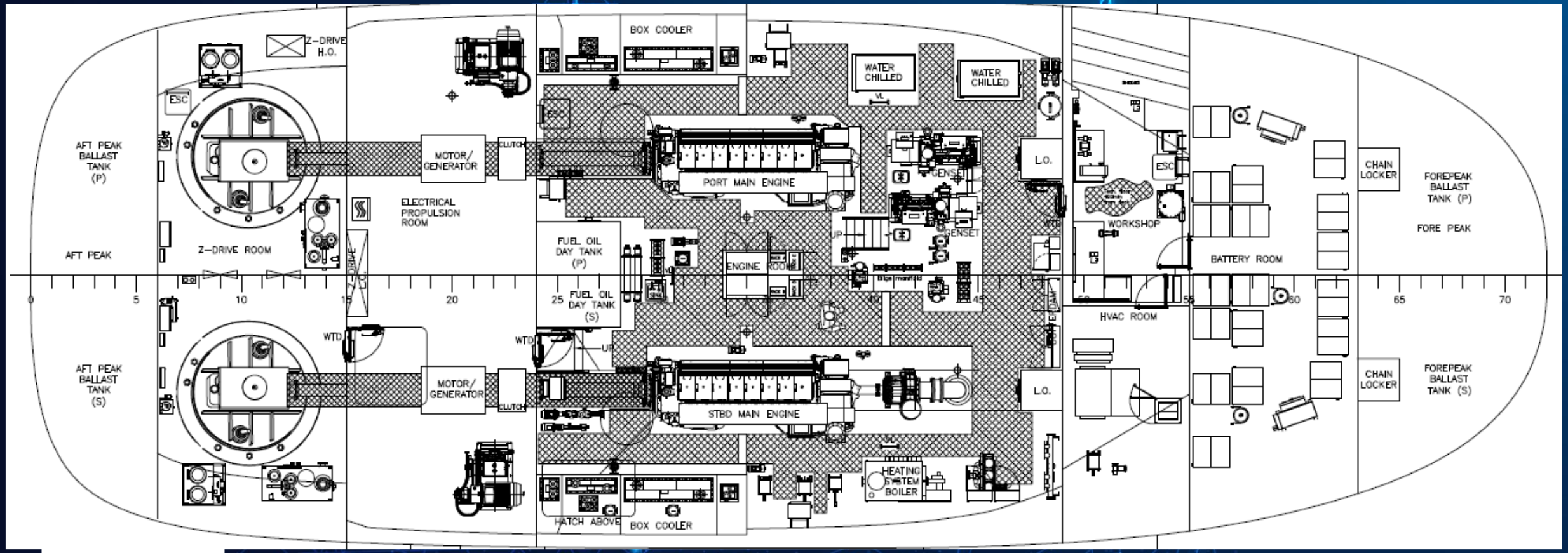
- Hybrid vessels combine electric motors with combustion (or hydrogen) engines. However, the high-capacity batteries needed to power electric motors for extended periods remain expensive and have a limited lifespan.

- Furthermore, hybrid systems must be efficient to maximize the use of renewable energy and minimize fossil fuel consumption.

Electric

- Storing lithium batteries on vessels carries certain risks that must be carefully managed. Some of the main risks associated with storing lithium batteries on vessels include:
  - ✓ Risk of Fire and Explosion: Due to Thermal runaway; caused by malfunction, short circuit, or physical damage.
  - ✓ Release of Toxic Gases: If a lithium battery is affected by overheating or malfunction, it can release flammable gases (such as hydrogen and fluoride) that are hazardous to the crew and onboard systems.

Electric


Z–DRIVE H.O.
ESC
AFT PEAK BALLAST TANK (P)
AFT PEAK
Z–DRIVE ROOM
MOTOR/ GENERATOR
CLUTCH
ELECTRICAL PROPULSION ROOM
BOX COOLER
WATER CHILLED
WATER CHILLED
PORT MAIN ENGINE
GENSET
GENSET
ENGINE ROOM
FUEL OIL DAY TANK (P)
FUEL OIL DAY TANK (S)
WTD
WTD
AFT PEAK BALLAST TANK (S)
MOTOR/ GENERATOR
CLUTCH
STBD MAIN ENGINE
HEATING SYSTEM BOILER
HATCH ABOVE
BOX COOLER
L.O.
L.O.
ESC
WORKSHOP
HVAC ROOM
BATTERY ROOM
CHAIN LOCKER
FOREPEAK BALLAST TANK (P)
FORE PEAK
CHAIN LOCKER
FOREPEAK BALLAST TANK (S)
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Electric

Electric

Electric

Hybrid Challenges

- In Hybrid vessels, special consideration for the safety in regards of the Thermal runaway of the batteries:
  - ✓ How to dealt with an external fire? Fixed Fire Systems to protect the compartment, insulation of boundaries, temperature control, etc.
  - ✓ Thermal Runaway: BMS (Battery Management System) alarm protection system, compartment temperature and moisture control.
  - ✓ Ventilation: Internal from the batteries and from the compartment leading to a safe and non-hazardous area, ATEX equipment.
  - ✓ HAZID & HAZOP recommendations.
  - ✓ Specific training for the crew.

Hybrid Challenges - Risk Assessment

- HAZID & HAZOP Analysis & Identification of Hazards:
  - ✓ Fire in Battery Room due to Thermal Runaway
  - ✓ Fire in Machinery Space.
  - ✓ Battery Pack Short Circuit.
  - ✓ Rupture of battery module
  - ✓ Toxic gas leakage.
  - ✓ Rack falling over.
  - ✓ Damage during routine maintenance

Hydrogen

- As the shipping industry is exploring cleaner alternatives to traditional fuels. Hydrogen emerges as a promising candidate, offering the potential for zero-emission operation. Green hydrogen, produced through electrolysis powered by renewable energy, could hold the key to sustainability. When used in fuel cells, it generates electricity with only water vapor as a byproduct, eliminating harmful pollutants.

- However, its low energy density compared to conventional fuels necessitates larger storage tanks, impacting ship design and cargo capacity.
- Additionally, the technology for production, distribution, and bunkering is still under continue development.

Hydrogen

- Several initiatives are underway with pilot projects of hydrogen-powered vessels potentially demonstrating the feasibility of this technology. Research focuses on improving storage methods and developing efficient engines.

- The road to decarbonising maritime transportation is long, but hydrogen offers a promising path with the potential to significantly reduce the industry's environmental footprint. Continued development and collaboration are crucial to overcome existing challenges and unlock the full potential of hydrogen as a clean fuel for shipping.

Hydrogen

- Hydrogen is an extremely light and volatile gas, making it difficult to store and handle. Vessels require high-pressure or liquid storage systems at very low temperatures, which poses a technical challenge in terms of safety, efficiency, and onboard space.


HYDROTUG1


AIDA

Hydrogen Challenges

- In Hydrogen vessels, many aspects to take into consideration:
  - ✓ Hazardous areas and Hydrogen proof equipment. H_2 detectors in double jacket piping, engine room. Strict safety measures.
  - ✓ Safety System managing the Hydrogen bunkering and supplying Hydrogen to the engines.
  - ✓ Special considerations for dual engines and machinery breakdown.
  - ✓ Hull reinforcement for H_2 bottles protection and safety measures: Fixed water-spray system, temperature detectors, insulation.
  - ✓ HAZID & HAZOP recommendations.
  - ✓ Ports are not yet prepared for Hydrogen propelled vessels.

Hybrid & Hydrogen Challenges

Hybrid & Hydrogen Challenges

- **Initial investment**: Building hybrid or hydrogen-powered vessels is typically significantly more expensive than conventional vessels. Hydrogen storage systems and battery technologies are expensive, which can be a barrier to widespread adoption.
- **Maintenance**: Hybrid systems and hydrogen engines require specialized maintenance. Although hydrogen is cleaner than fossil fuels, storing and converting hydrogen into energy requires high-tech components that may require frequent and specialized maintenance.
- HAZID & HAZOP Recommendations.

Hybrid & Hydrogen Challenges
Risk Assessment

- HAZID & HAZOP Key points analysed:
  - ✓ Human element: Crew competence & training to respond appropriately.
  - ✓ Unauthorized access to hazardous areas.
  - ✓ Fire System Philosophy and Structural Fire protection.
  - ✓ Failure of protective systems.
  - ✓ External events like collisions, contact with quays.
  - ✓ Venting system to safe areas.


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Thank you