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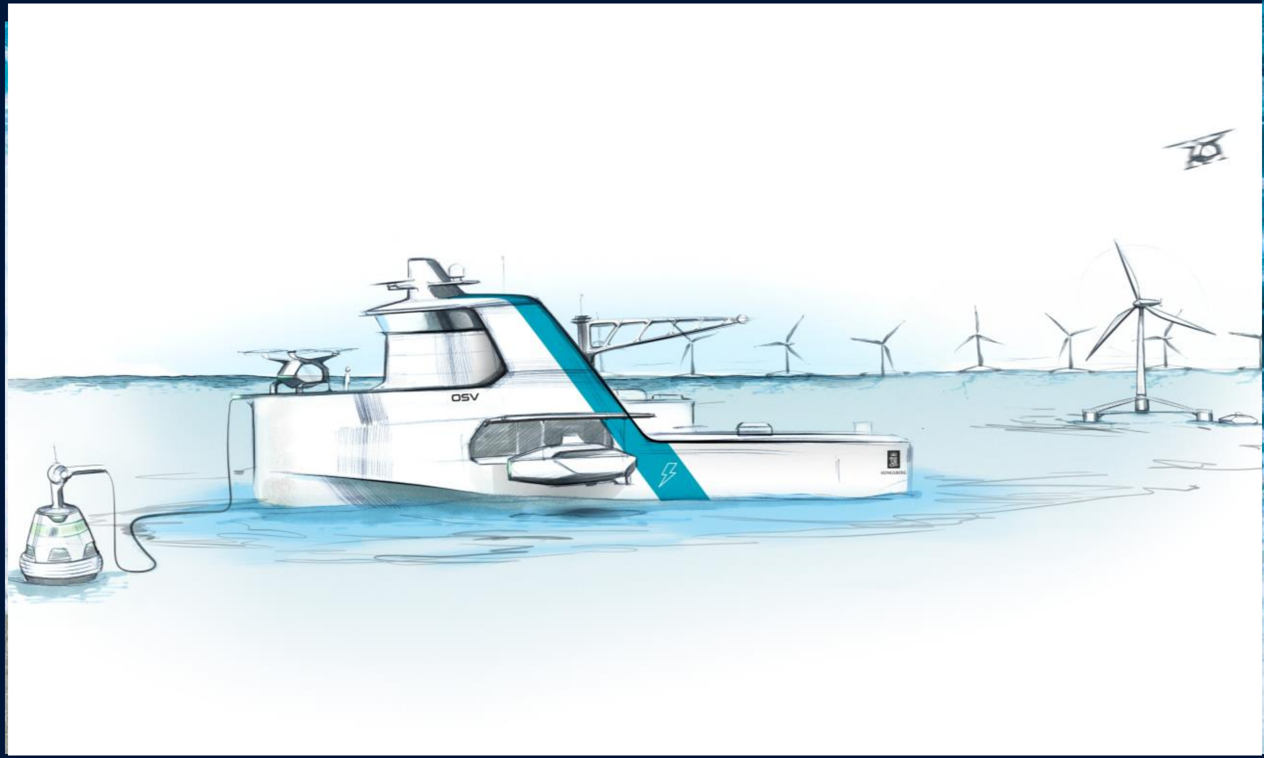
KONGSBERG MARITIME AS

Research Vessel of tomorrow

28/06/2024



Trond Paulsen, VP – Research & Special Purpose Vessels Kongsberg

Vessel Of Tomorrow

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<u>Main Factors for Changes in Maritime</u>

- New Rules & Regulations
- Economic Incentives
- Competitive advantage
- Environmental Impact / Sustainability.
- New Available Technology

<u>Where do we look for change and new technology</u>

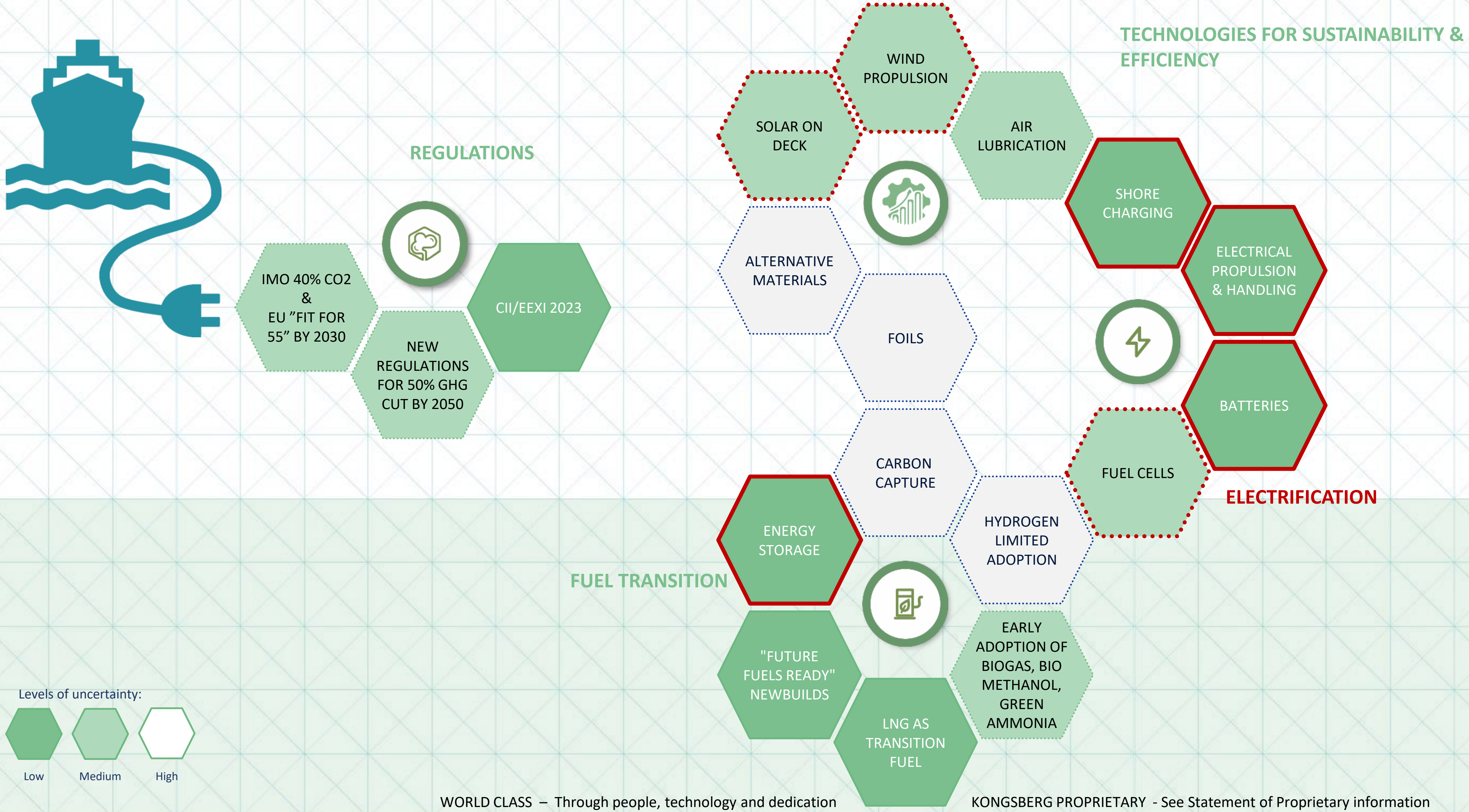
- Military and Naval
- Health sector
- Consumer/Volume Markets
  - Car industry
  - Consumer electronics
- Early Adaptors in various maritime Domains.

Copilot AI generated picture future research vessel

2030 FUTURE LANDSCAPE

Strategic themes

SUSTAINABILITY

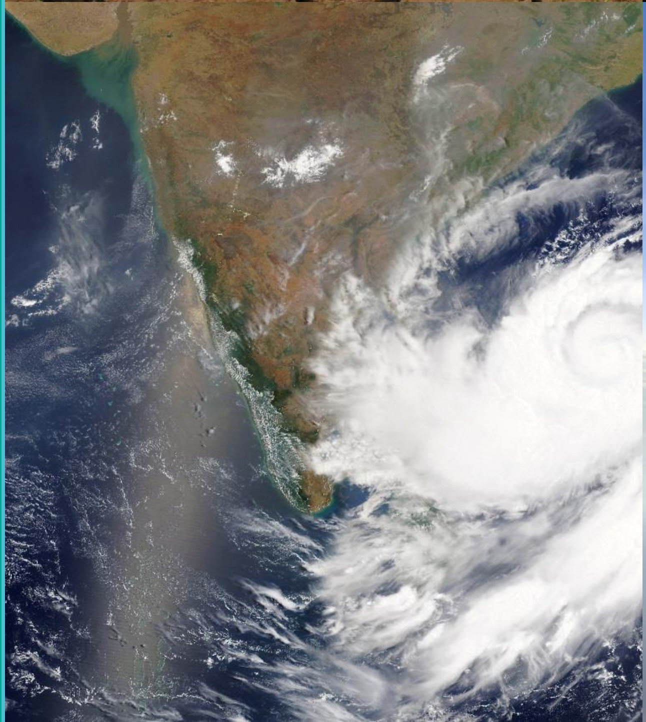


IMO & EU GHG strategy and regulations

EU regulations as Main Driver for change

Addressing the decarbonisation challenge!



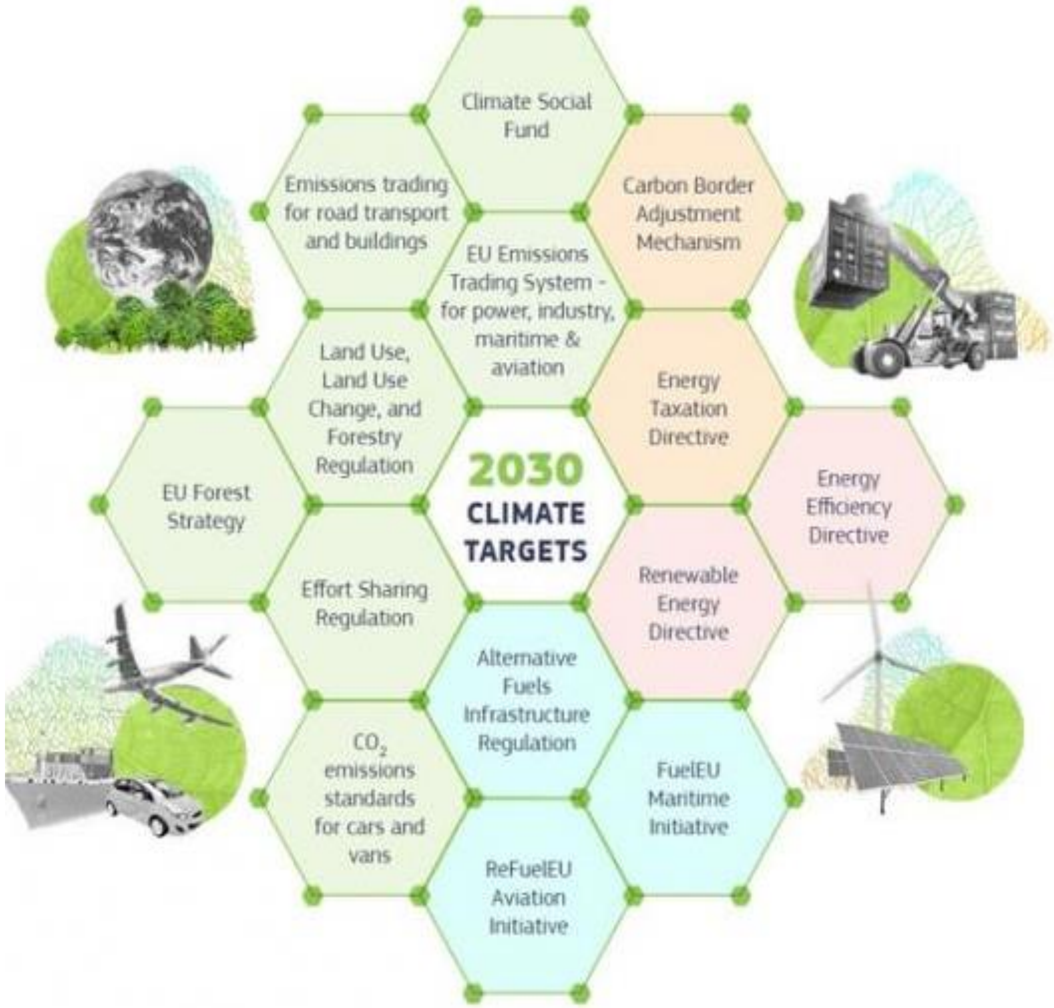



The EU Green Deal

The EU has set an ambition:
Climate-neutral by 2050

Fit for 55 in 2030

EU's plan to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels in line with the European Climate Law.



European Commission

Reduction of Green House Gas (GHG) emissions

Environmental ambitions/strategy for shipping

IMO strategy:
Levels compared to 2008

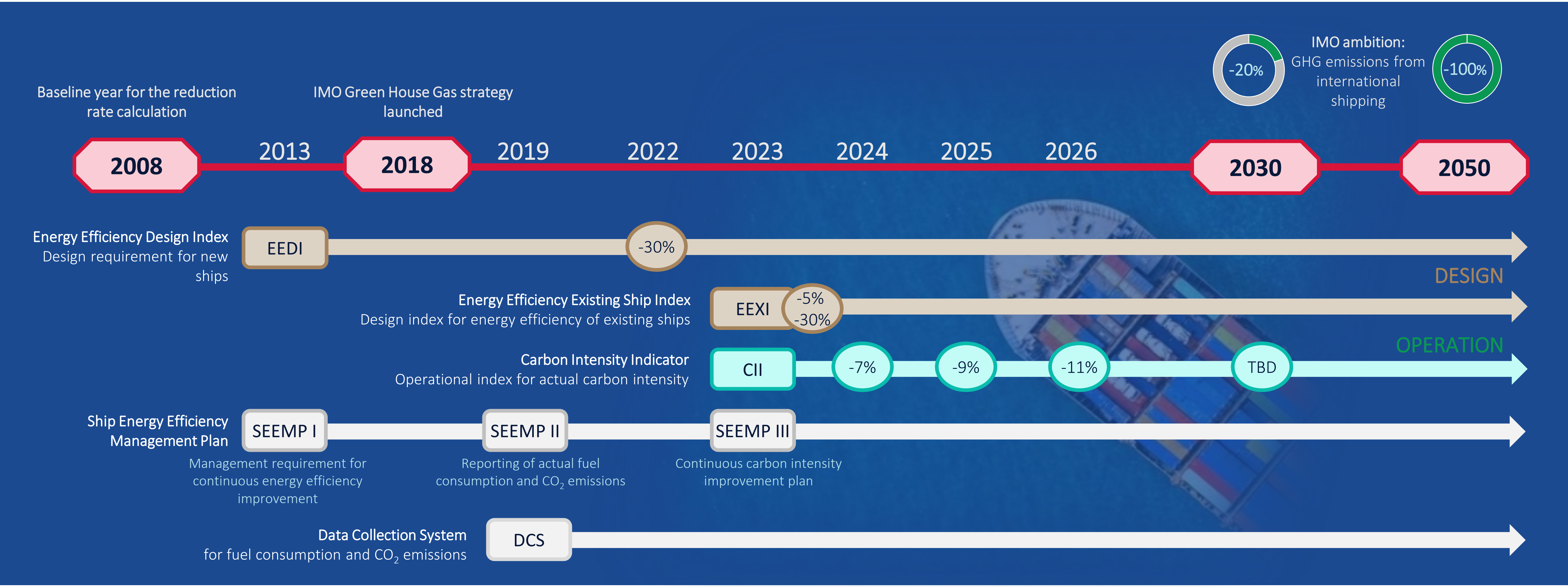
- 2030: -5% — Uptake of zero or near-zero GHG emissions technologies, fuels and/or energy sources
- 2030: -40% — **GHG intensity:** emissions per transport work
- 2030: -20%; 2040: -70%; 2050: NET ZERO — **GHG emissions** (well-to-wake) from international shipping

2030 2040 2050

The European Green Deal
"Fit for 55 package"
Levels compared to 1990 levels

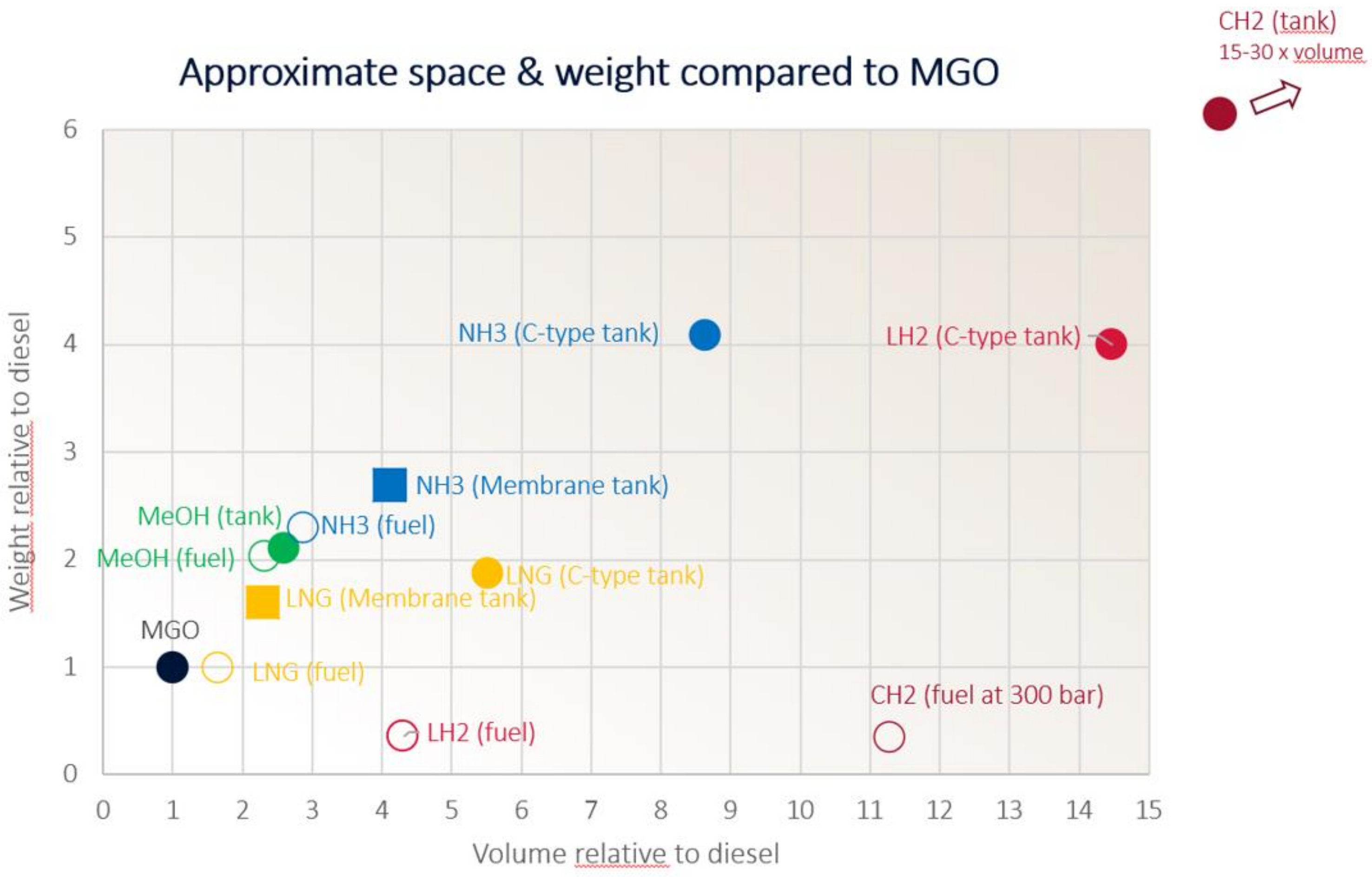
- 2030: -55%; 2050: CLIMATE NEUTRAL — **GHG emissions**

IMO GHG regulations



Alternative Fuel main challenge
Space and weight

- All alternative fuels require more space onboard than MGO
- This is emphasised when the fuel containment systems are included into the calculation
- The alt fuels are also heavier than MGO when the weight of the tanks are included
- This introduces a challenge for the naval architect and might impact endurance, payload capacity or main dimensions of the ship

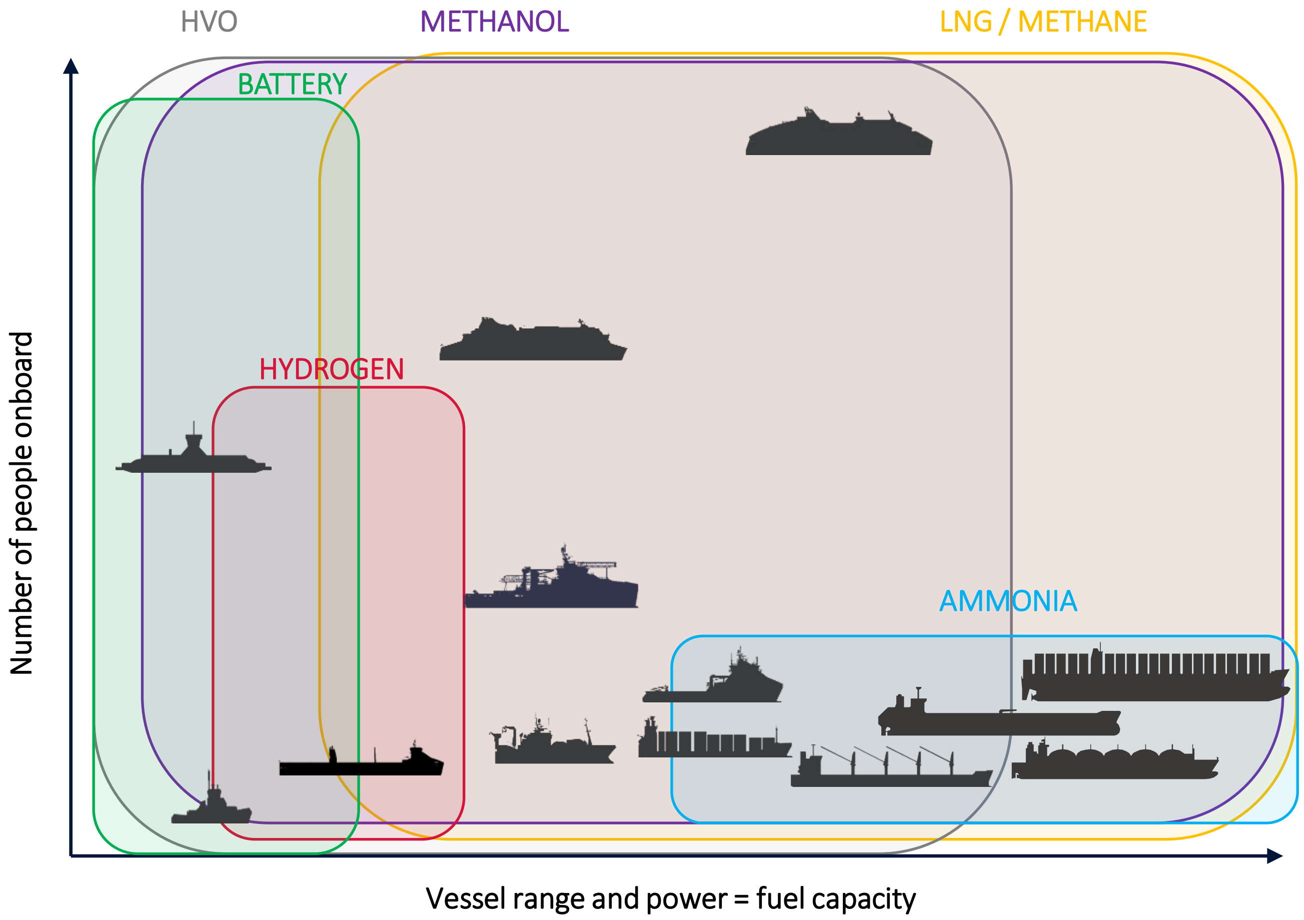


Note: Space for C-type tank is assumed to be the entire tank compartment

Market adoption – no silver bullet

Fuel slection considerations:

- Range/endurance
- Power level (compared to ship size)
- Volume critical or weight critical ship
- Fuel / charging availability
- Fixed routes or world wide tramp trade
- Safety
- Operation area



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Battery Technology Highlights

Today status

- Lithium Nickel Manganese Cobalt Oxide ($LiNiMnCoO_2$) – NMC is dominating the current marine market
- NMC keeps getting more optimised and energy dense, potentially delaying a competitive alternative
- Most future batteries function wonderfully in a theoretical world, but many fail to be commercialized
- Not likely that an alternative technology is able to compete on cost until 2025-2030

- Solid-state battery has the potential to improve most of the concerns with present-day Li-ion batteries, and is presumed to be non-combustible or at least resistant to self-ignition

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Alternative Fuel Transition

LOW CARBON FUELS

To achieve IMO GHG ambitions will require a shift to low carbon fuels

NO SINGLE SILVER BULLET

Still uncertainty around the preferred fuels - there will most likely be a more diverse fuel palette in the future

UNCERTAIN TIMEFRAME

The introduction of low carbon fuels will be driven by new regulations or market instruments

Technology Trends in Maritime

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TECHNOLOGY TRENDS IN MARINE DOMAIN

Help customers improve their operations through market leading technology

SHIP OPERATOR REQUIREMENTS…

OPERATIONAL EFFICIENCY
Reduce Capex or Opex, and increase profitability

SUSTAINABILITY
Greener solutions to meet environmental regulations and stakeholder expectations

SAFETY, SECURITY & RELIABILITY
Improve safety of crew and vessel, reduce risk of accidents at sea, and reduce down time

…DRIVE ADOPTION OF TECHNOLOGY AND BUSINESS MODEL TRENDS

- SMART DATA & ANALYTICS
- CONNECTIVITY & REMOTE SERVICES
- CLEANER FUELS
- ELECTRIFICATION & ENERGY STORAGE
- ADVANCED SENSORS
- REMOTE & AUTONOMY
- ROBOTISATION
- INTEGRATION
- ADVANCED MANUFACTURING & MATERIALS
- HYDRODYNAMICS FOR EFFICIENCY

Wind assisted propulsion

Rotor sails

+ Proven solution
+ Good side wind performance
+ Very high lift coefficient
+ Smaller installation

– Poor headwind performance
– Electric consumption

Suction wing

+ Good upwind performance
+ High lift coefficient
+ Attractive investment cost

– Electric consumption

Wing sail

+ Good upwind performance
+ No motors or el. power consumption

– Modest performance per area
– Large units
– Expensive

Kite

+ High power output at favorable conditions
+ Low footprint

– Poor upwind performance
– Expensive
– Unproven

Driving a change from FPP -> CPP
From Mechnical to Electrical

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Kongsberg Maritime
Pro**tech**ting People and Planet

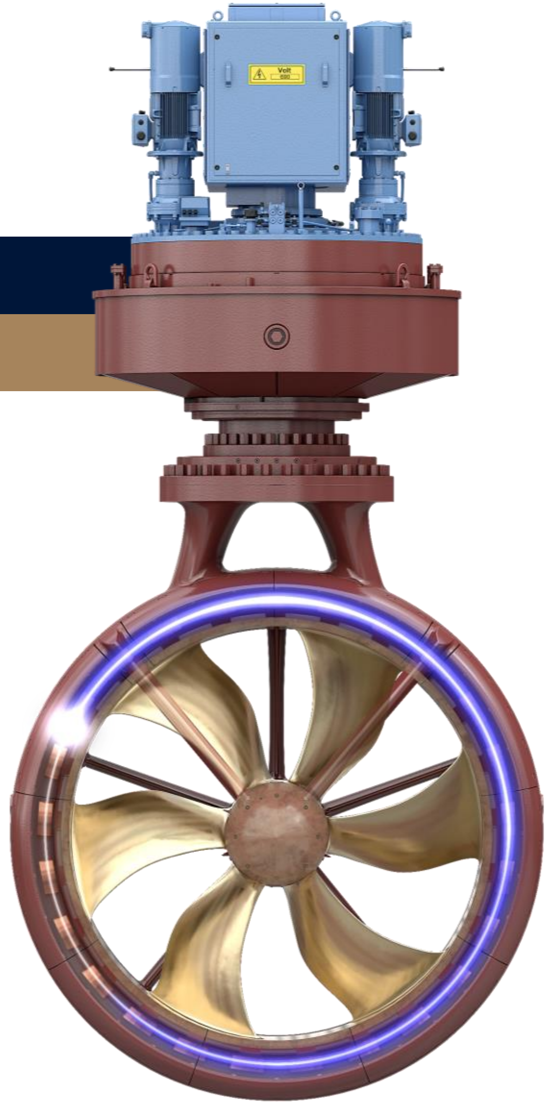
Why permanent magnet technology on Thrusters?

1. EFFICIENCY

- No energy is used for excitation of rotor
- Higher efficiency over entire speed range
- Low heat generation in the machine components
- Best candidate for applications where fuel saving is important
- Best candidate for battery applications
- Rapid response

2. SIMPLICITY

- Permanent magnetic field
- Simple construction
- Robust candidate for high reliability applications
- Integrated product – few rotating parts



COMPANY LIMITED

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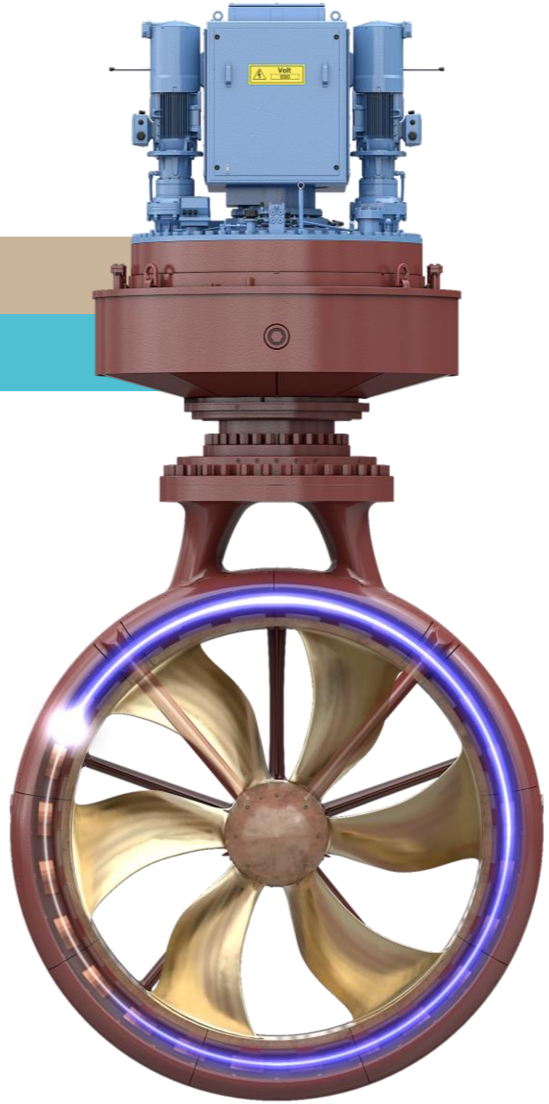
Why permanent magnet technology on Thrusters?

3. COMPACTNESS

- High torque density machine
- 30% more compact than asynchronous machine
- Slim stator and rotor due to high pole number design
- Strong dynamic performance (synchronisation rotor – stator)
- Best candidate where space is valued in the application

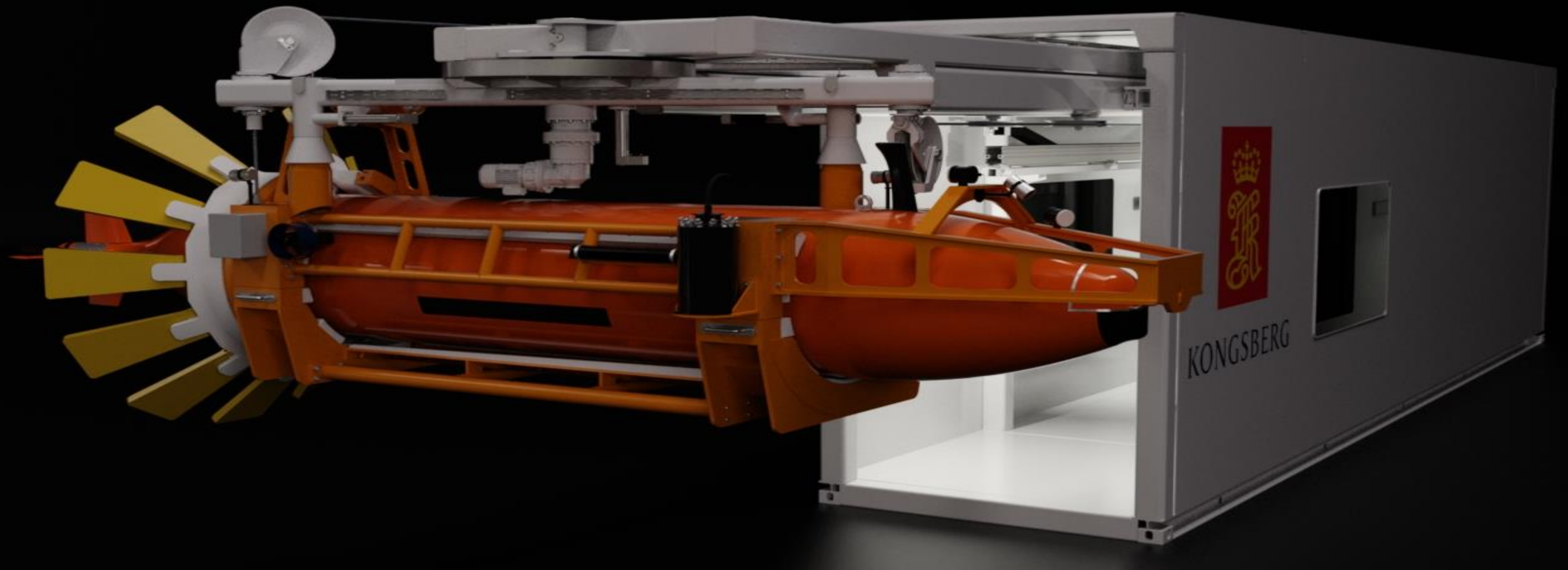
4. ENVIRONMENTALLY FRIENDLY

- Lower noise levels compared to conventional thrusters, Structural & Hydro acoustic noise superior
- Low oil volume
- EAL/VGP approved – biodegradable oil
- Low energy consumption
- Allows full electric ship systems
- Ideal for battery power

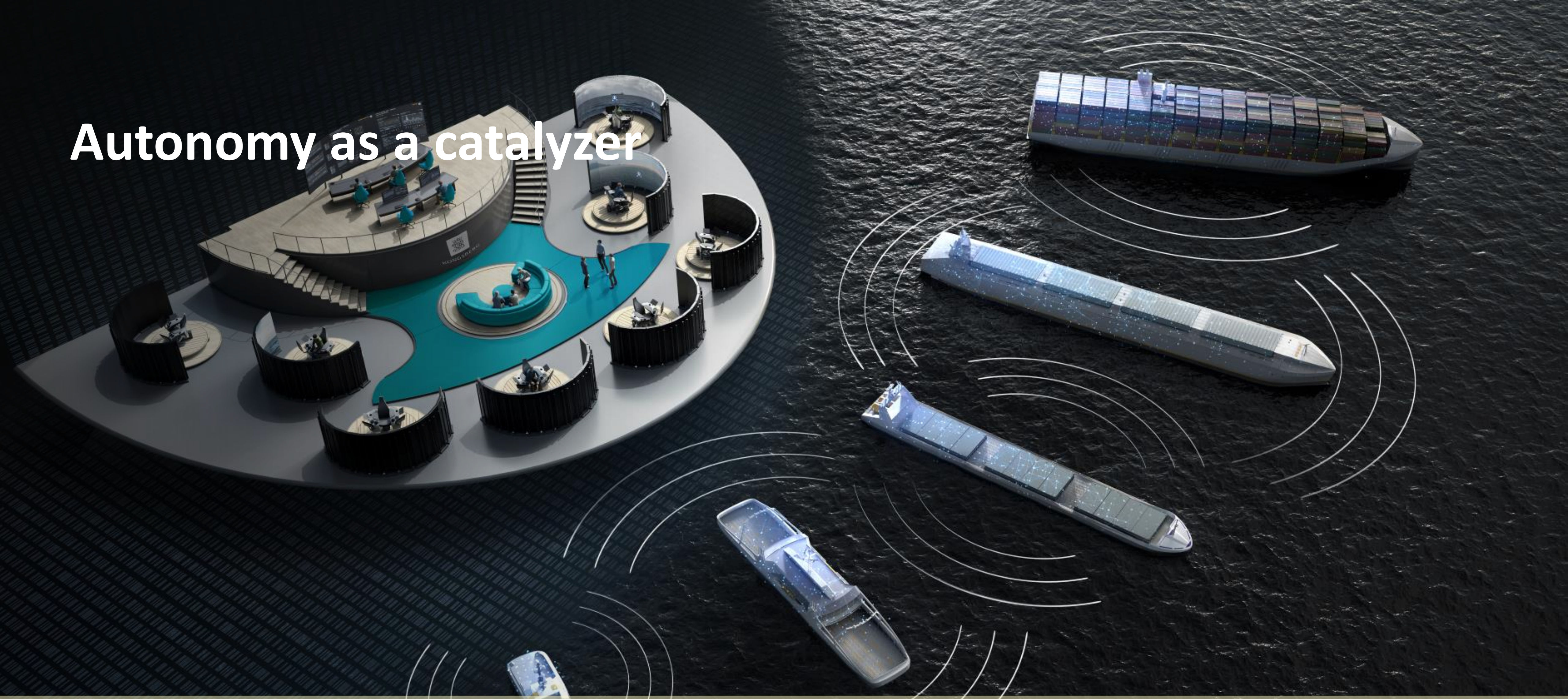


Modularisation and Flexibility in Design

Example LARS for AUV



Autonomy as a catalyzer



The application of new technologies for digitalization and automation may rapidly change the way maritime transport and operations works and operates

Value proposition

Why remote & autonomous

Business

- Increasing revenue
- Increasing attractiveness
- Enabling lean operations
- Talent retention and attractiveness

Safety

- Reducing human errors
- Increasing situational awareness
- Removing humans from hazardous environments

Cost

- Reducing crew costs
- Reducing fleet operation costs
- Reducing newbuild vessel costs
- Reducing fuel costs

Risk

- Reducing overall risk due to transparency and availability of data
- Reducing risk of interruption

Sustainability

- Reducing traveling for onboard crew change
- Optimizing fuel and energy consumption
- Supporting emission regulations

Integrated solutions

Remote & Autonomous

Future proofing sustainable subsea services through **remote and autonomous** operations

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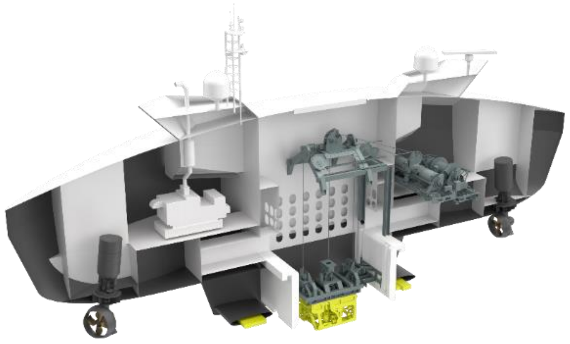
Ongoing project

Reach Subsea



Key facts

- Unmanned surface vessel for ROV operations
- ~24 m length, 110 t lightweight
- Diesel-electric battery hybrid propulsion.
- 1 x WROV, remote operated LARS.
- Stages approach towards remote and autonomous operations
- Remote monitoring and control of the vessel from Massterly ROC

- Video: https://vimeo.com/587866077

Reducing emissions and cost through innovation:

Changing complex ROV operations

- **Vessel size 24.9 m x 8 m**
- **New Design** developed acc to alternative design process
- **Delivery** of first two unmanned surface vessels in **2024**
- **Gamechanger** for the industry
  - Low-emissions - 90% reduction in daily CO_2 emissions
  - Cost-effective
  - Remotely operated
  - Safe work environment
- **KM is the prime contractor:** deliver complete vessels to the customer Reach Remote.
- **Massterly ROC** in Horten to control the vessels
- **ROV** controlled from Haugesund

UT 5208 - Capability

Survey

Reach Remote will be able to perform all kinds of traditional survey tasks like seabed mapping, pipeline inspection, UXO surveys etc. Moreover, Reach Remote will have number of advantages versus traditional vessels and survey spreads.

- Sub bottom profiler – Kongsberg Maritime TOPAS 120
- Multibeam echosounder – Kongsberg Maritime EM2040
- USBL – HIPAP 502
- Navigation – Seapath 380 and iPS4

ROV based survey

Reach Remote will be capable of performing the same way as traditional ROV based survey. In addition, automated functions will increase speed and efficiency of the survey tasks. E-ROV can be equipped with full package of survey sensors.

Our customer commitments

Example projects unmanned

Sjøfartsdirektoratet
Norwegian Maritime Authority

TRANSPORT
STYRELSEN

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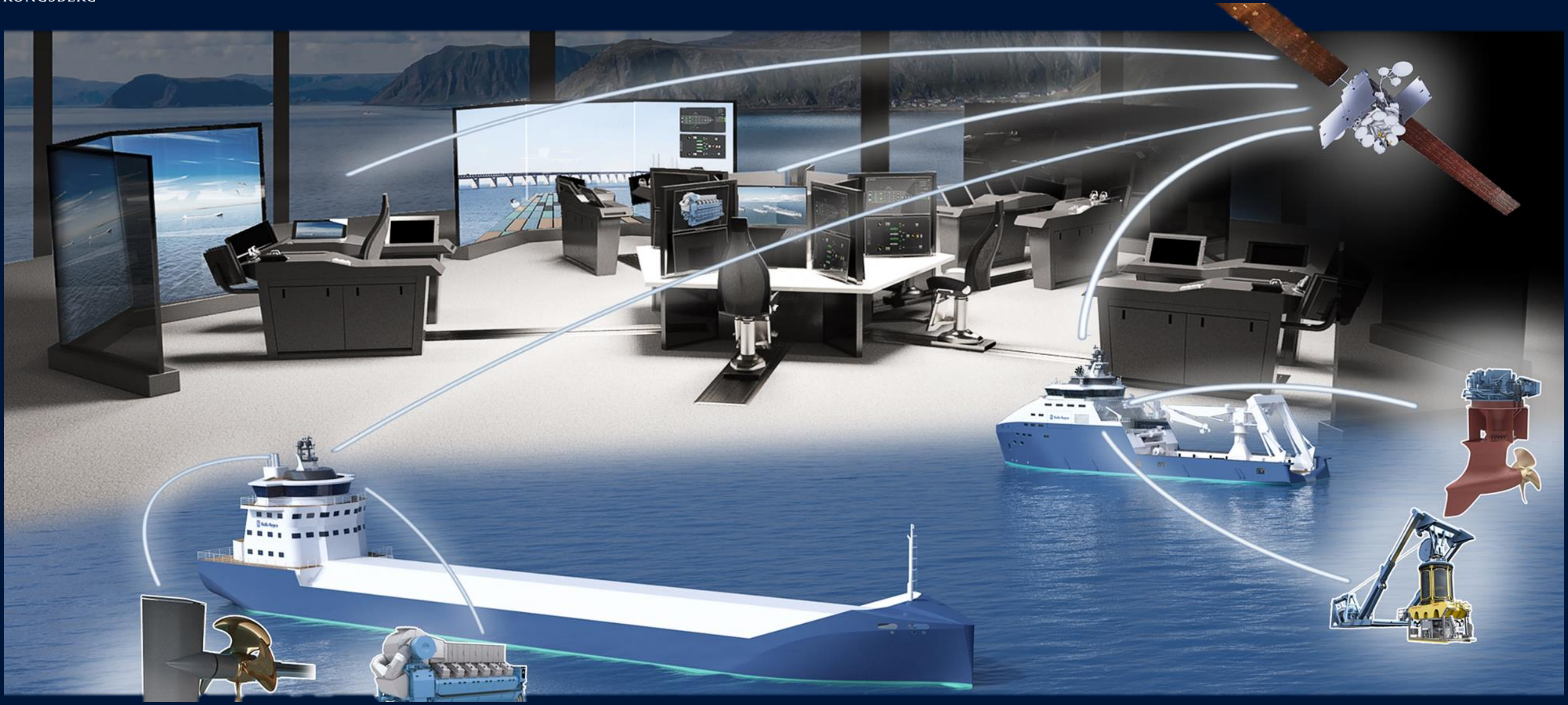
Digitalisation and remote support



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Kongsberg Digital Focus and Offerings

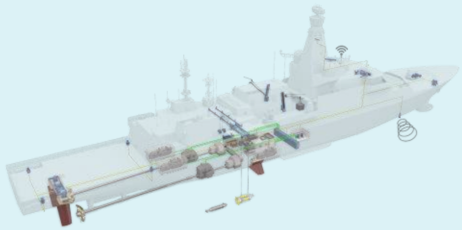
OUR FOCUS

INNOVATION, SUSTAINABILITY, DIGITALISATION

SMART DATA & ANALYTICS

CLEANER FUELS

ELECTRIFICATION & ENERGY STORAGE



CONNECTIVITY & REMOTE SERVICES

REMOTE & AUTONOMY

ADVANCED SENSORS & ROBOTISATION

OUR OFFERINGS

DELIVER CUSTOMER VALUE THROUGH

- **SUSTAINABLE, EFFICIENT PRODUCTS & SYSTEMS**
- **SEAMLESS PLUG & PLAY INTEGRATION**
- **DISRUPTIVE GREEN CONCEPTS**
- **VALUE THROUGH DIGITAL & AUTONOMY**
- **GLOBAL SUPPORT & LIFE CYCLE SOLUTIONS**
- **OPERATIONAL EXCELLENCE**

KM GHG reduction triangle

Reduce resistance // Hull cleaning

Air lubrication // Green DP

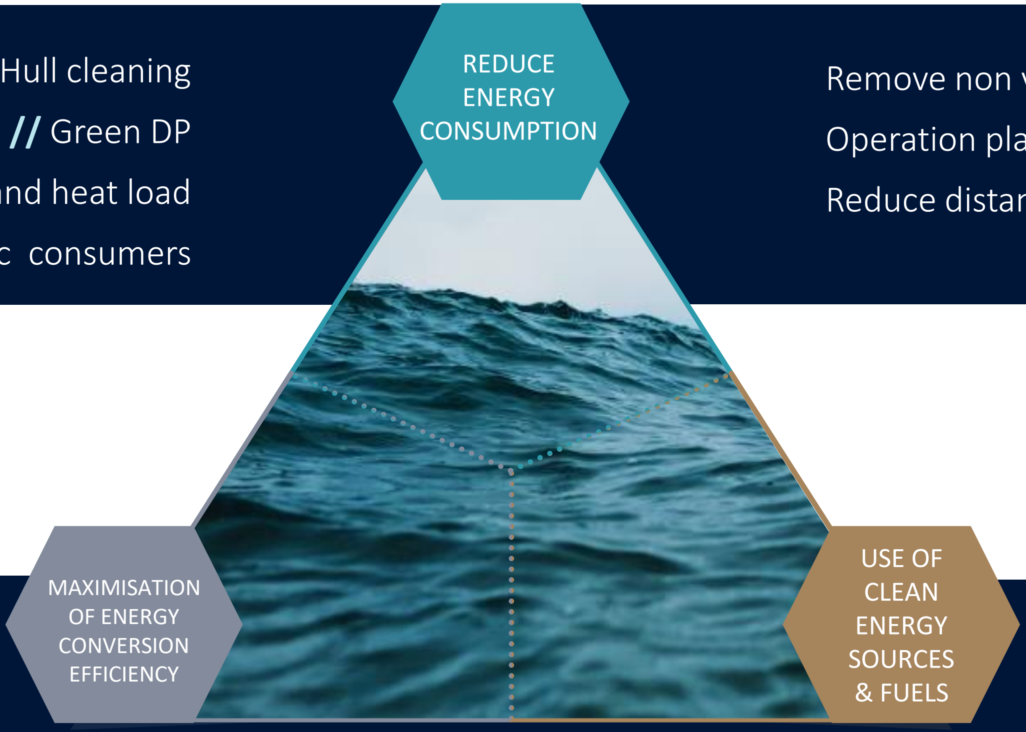
Reduce electric hotel and heat load

Install energy efficient electric consumers

Remove non value adding activities

Operation planning // Operate at lower speed

Reduce distance travelled



Energy optimisation // Energy management

Propulsion, engine and system efficiency

Waste heat recovery

Fuel Cell // Battery

Wind power // Solar power

Shore power // Battery

Bio fuels // LNG/SNG

NH3 // MeOH // H2

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Sooo… Does AI Agree?

From Microsoft Copilot 10.06.2024

Future research vessels are expected to be equipped with a range of advanced technologies designed to enhance oceanographic research and exploration. Here are some of the cutting-edge technologies that we may see:

1. **Modular Research Platforms**:
   - Vessels like the R/V Falkor (too) offer **modular platforms** for conducting diverse research at sea, with extensive laboratory spaces and equipment for high-resolution ocean depth mapping[1].
2. **Advanced Propulsion Systems**:
   - Development of new energy carriers such as **batteries and fuel cells**, and new types of propulsion systems to meet the demands of a carbon-neutral and sustainable society[2].
3. **Remote and Autonomous Vehicles**:
   - Use of **remote underwater vehicles (ROVs)** and **automated underwater vehicles (AUVs)** for deep-sea exploration and data collection[3].
4. **High-Tech Equipment**:
   - Integration of **drones**, both aerial and sail, for data collection and observation.
   - Deployment of **satellite tags** for tracking and studying marine life[3].
5. **Acoustic Technologies**:
   - Advanced **acoustic systems** for mapping, communication, and studying marine organisms[3].
6. **Genetic Analysis Tools**:
   - Onboard facilities for **genetic analysis** to study biodiversity and ecosystem health[3].
7. **Environmental Monitoring Systems**:
   - Systems like a **microplastic water flow-through system** to monitor and study the prevalence of microplastics in the ocean[1].
8. **Innovative Materials and Design**:
   - Research into **new materials**, design approaches, and manufacturing processes, including **nanotechnology** and **biomimicry**, to improve efficiency and sustainability[4].

These technologies will not only expand the capabilities of research vessels but also significantly contribute to our understanding of the oceans and marine life. The future of maritime research looks promising with these technological advancements on the horizon. 🌊 🚢

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NOT USED